z/OS Communications Server

IP Sockets Application Programming Interface Guide and Reference

Version 1 Release 12

SC31-8788-09

z/OS Communications Server

IP Sockets Application Programming Interface Guide and Reference

Version 1 Release 12

SC31-8788-09

Note:
Before using this information and the product it supports, be sure to read the general information under "Notices" on page 947.

Tenth Edition (September 2010)

This edition applies to Version 1 Release 12 of z/OS (5694-A01) and to all subsequent releases and modifications until otherwise indicated in new editions.

IBM welcomes your comments. You may send your comments to the following address.

International Business Machines Corporation
Attn: z/OS Communications Server Information Development
Department AKCA, Building 501
P.O. Box 12195, 3039 Cornwallis Road
Research Triangle Park, North Carolina 27709-2195

You can send us comments electronically by using one of the following methods:

Fax (USA and Canada):

1+919-254-1258

Send the fax to "Attn: z/OS Communications Server Information Development"

Internet e-mail:

comsvrcf@us.ibm.com

World Wide Web:

http://www.ibm.com/systems/z/os/zos/webqs.html

If you would like a reply, be sure to include your name, address, telephone number, or FAX number. Make sure to include the following in your comment or note:

- Title and order number of this document
- Page number or topic related to your comment

When you send information to IBM, you grant IBM a nonexclusive right to use or distribute the information in any way it believes appropriate without incurring any obligation to you.

© Copyright International Business Machines Corporation 1989, 2010.
US Government Users Restricted Rights – Use, duplication or disclosure restricted by GSA ADP Schedule Contract with IBM Corp.

Contents

Figures . . . . . **xiii**

Tables . . . . . **xvii**

About this document . . . . . **xix**
Who should read this document xix
How this document is organized xix
How to use this document xx
Determining whether a publication is current xx
How to contact IBM service. xxi
Conventions and terminology that are used in this document xxi
How to read a syntax diagram xxii
Prerequisite and related information. xxv
How to send your comments xxix

Summary of changes . . . . . **xxxi**

Part 1. Overview **1**

Chapter 1. Introducing TCP/IP concepts **3**
TCP/IP concepts 3
Understanding sockets concepts 4
Introducing TCP/IP concepts: Programming with sockets 5
Introducing TCP/IP concepts: Selecting sockets. 5
Introducing TCP/IP concepts: Socket libraries 6
Introducing TCP/IP concepts: Address families. 8
Introducing TCP/IP concepts: Addressing sockets in an Internet domain 9

Chapter 2. Organizing a TCP/IP application program **15**
Client and server socket programs. 15
Client/server socket programs: Iterative server socket programs. 16
Client/server socket programs: Concurrent server socket programs. 17
Client/server socket programs: Call sequence in socket programs 17
Call sequence in stream socket sessions 17
Call sequence in datagram socket sessions 18
Client/server socket programs: Blocking, nonblocking, and asynchronous socket calls 19
Client/server socket programs: Testing a program using a miscellaneous server 21
Client/server socket programs: Testing a local machine using a loopback address 22
Client/server socket programs: Accessing required data sets 22

Part 2. Designing programs **25**

Chapter 3. Designing an iterative server program **27**
Allocating sockets in an iterative server program 27
Binding sockets in an iterative server program. 29
Binding with a known port number 29
Binding using socket call gethostbyname 30
Binding a socket to a specific port number 30
Listening for client connection requests in an iterative server program. 32
Accepting client connection requests in an iterative server program 33
Transferring data between sockets in an iterative server program 35
Closing a connection in an iterative server program 35
Active and passive closing in an iterative server program 35

© Copyright IBM Corp. 1989, 2010

Shutdown call in an iterative server program . . . 37
Linger option in an iterative server program . . . 37

Chapter 4. Designing a concurrent server program. . . . 39
Concurrent servers in native MVS environment . . . 39
MVS subtasking considerations in a concurrent server program . . . 40
Access to shared storage areas in a concurrent server program . . . 40
Data set access in MVS . . . 43
Task and workload management in a concurrent server program . . . 43
Security considerations in a concurrent server program . . . 44
Reentrant code in a concurrent server program . . . 44
Understanding the structure of a concurrent server program . . . 44
Selecting requests in a concurrent server program . . . 45
Client connection requests in a concurrent server program. . . . 51
Passing sockets in a concurrent server program . . . 51
Transferring data between sockets in a concurrent server program . . . 55
Closing a concurrent server program . . . 55

Chapter 5. Designing a client program . . . 57
Allocating a socket in a client program . . . 57
Connecting to a server in a client program . . . 57
Transferring data between sockets in a client program . . . 59
Closing a client program . . . 59

Chapter 6. Designing a program to use datagram sockets . . . 61
Datagram socket characteristics . . . 61
Understanding datagram socket program structure . . . 61
Allocating a datagram socket . . . 62
Binding datagram sockets to port numbers . . . 62
Streamline data transfer using connect call . . . 62
Transferring data between datagram sockets . . . 62

Chapter 7. Transferring data between sockets . . . 63
Transferring data between sockets: Streams and messages . . . 63
Transferring data between sockets: Data representation . . . 66
Using send() and recv() calls. . . . 68
The send() and recv() call conversation . . . 68
Using socket calls in a network application . . . 68
Reading and writing data from and to a socket . . . 70
Using sendto() and recvfrom() calls . . . 71

Chapter 8. Designing IPv6 programs . . . 73

Chapter 9. Designing multicast programs . . . 75
Designing multicast programs: Multicast source filters . . . 77
Designing multicast programs: IPv4 multicast options . . . 78
IP_ADD_MEMBERSHIP and IP_DROP_MEMBERSHIP . . . 79
IP_ADD_SOURCE_MEMBERSHIP and IP_DROP_SOURCE_MEMBERSHIP . . . 83
IP_BLOCK_SOURCE and IP_UNBLOCK_SOURCE . . . 84
IP_MULTICAST_IF . . . 86
IP_MULTICAST_LOOP . . . 87
IP_MULTICAST_TTL . . . 88
Designing multicast programs: IPv6 multicast options . . . 89
IPV6_JOIN_GROUP and IPV6_LEAVE_GROUP . . . 89
IPV6_MULTICAST_IF . . . 93
IPV6_MULTICAST_LOOP . . . 94
IPV6_MULTICAST_HOPS . . . 95
Designing multicast programs: Protocol-independent multicast options . . . 95
MCAST_JOIN_GROUP and MCAST_LEAVE_GROUP . . . 95

MCAST_JOIN_SOURCE_GROUP and MCAST_LEAVE_SOURCE_GROUP 98
MCAST_BLOCK_SOURCE and MCAST_UNBLOCK_SOURCE 99
Designing multicast programs: IOCTL multicast commands 100
SIOCGIPMSFILTER 100
SIOCGMSFILTER 101
SIOCSIPMSFILTER 101
SIOCSMSFILTER 101

Part 3. Application program interfaces 103

Chapter 10. C Socket application programming interface 105
Compiler restrictions with C applications 105
Compiling and linking C applications 106
C application compatibility considerations. 106
C socket API: Non-reentrant modules 106
C socket API: Reentrant modules. 109
C program compiler messages. 113
C program abends. 113
C socket implementation 114
C socket header files 114
Manifest.h 115
Prototyping 115
C structures 115
C socket API error messages and return codes 116
C socket calls 116
accept() 117
bind() 119
close() 123
connect() 124
endhostent() 127
endnetent() 128
endprotoent() 129
endservent() 130
fcntl() 131
getclientid() 133
getdtablesize() 134
gethostbyaddr() 135
gethostbyname() 136
gethostent() 137
gethostid() 138
gethostname() 139
getibmopt() 140
getibmsockopt() 142
getnetbyaddr() 143
getnetbyname() 144
getnetent() 145
getpeername() 146
getprotobyname() 147
getprotobynumber() 148
getprotoent() 149
getservbyname() 150
getservbyport() 151
getservent() 152
getsockname() 153
getsockopt() 154
givesocket() 160
htonl() 162
htons() 163
inet_addr() 164
inet_lnaof() 165

inet_makeaddr() . . . 166
inet_netof() . . . 167
inet_network() . . . 168
inet_ntoa() . . . 169
ioctl() . . . 170
listen() . . . 172
maxdesc() . . . 173
ntohl() . . . 175
ntohs() . . . 176
read() . . . 177
readv() . . . 178
recv() . . . 180
recvfrom() . . . 182
recvmsg() . . . 184
select() . . . 186
selectex() . . . 190
send() . . . 192
sendmsg() . . . 194
sendto() . . . 196
sethostent() . . . 198
setibmopt() . . . 199
setibmsockopt() . . . 201
setnetent() . . . 203
setprotoent() . . . 204
setservent() . . . 205
setsockopt() . . . 206
shutdown() . . . 210
sock_debug() . . . 211
sock_do_teststor() . . . 212
socket() . . . 213
takesocket() . . . 216
tcperror() . . . 217
write() . . . 218
writev() . . . 219
Sample C socket programs . . . 221
Executing TCPS and TCPC modules . . . 221
Executing UDPS and UDPC modules . . . 221
C socket TCP client . . . 221
C socket TCP server . . . 224
C socket UDP server . . . 227
C socket UDP client . . . 230

Chapter 11. X/Open Transport Interface . . . 233
XTI software requirements . . . 233
What is provided with XTI . . . 233
How XTI works in the z/OS environment . . . 233
Creating an application using the XTI protocol . . . 234
Coding XTI calls . . . 234
Coding XTI calls: Initializing a transport endpoint . . . 234
Coding XTI calls: Establishing a connection . . . 235
Coding XTI calls: Transferring data . . . 235
Coding XTI calls: Releasing a connection . . . 235
Coding XTI calls: Disabling a connection . . . 235
Coding XTI calls: Managing events . . . 236
Coding XTI calls: Using utility calls . . . 236
Coding XTI calls: Using system calls . . . 236
Compiling and linking XTI applications using cataloged procedures . . . 236
XTICL . . . 237
XTIC . . . 238
XTIS . . . 239
Understanding XTI sample programs . . . 240

XTI socket client sample program . . . 241
XTI socket server sample program . . . 250

Chapter 12. Macro application programming interface . . . 261
Sockets API environmental restrictions and programming requirements . . . 261
Sockets API input register information . . . 262
Sockets API output register information . . . 263
Sockets API compatibility considerations . . . 263
Defining storage for the macro API . . . 263
Understanding common parameter descriptions . . . 264
Sockets API error messages and return codes . . . 265
Characteristics of sockets . . . 265
Task management and asynchronous function processing . . . 267
Macro API asynchronous function processing: How it works . . . 267
Asynchronous exit environmental and programming considerations . . . 269
Using an unsolicited event-exit routine . . . 270
Diagnosing problems in applications using the macro API . . . 271
Macros for assembler programs . . . 271
ACCEPT . . . 271
BIND . . . 274
| BIND2ADDRSEL . . . 278
CANCEL . . . 281
CLOSE . . . 282
CONNECT . . . 284
FCNTL . . . 287
FREEADDRINFO . . . 289
GETADDRINFO . . . 290
GETCLIENTID . . . 298
GETHOSTBYADDR . . . 300
GETHOSTBYNAME . . . 302
GETHOSTID . . . 305
GETHOSTNAME . . . 306
GETIBMOPT . . . 308
GETNAMEINFO . . . 310
GETPEERNAME . . . 314
GETSOCKNAME . . . 317
GETSOCKOPT . . . 320
GIVESOCKET . . . 336
GLOBAL . . . 338
| INET6_IS_SRCADDR . . . 339
INITAPI . . . 342
IOCTL . . . 345
LISTEN . . . 356
NTOP . . . 358
PTON . . . 360
READ . . . 361
READV . . . 363
RECV . . . 365
RECVFROM . . . 368
RECVMSG . . . 372
SELECT . . . 376
SELECTEX . . . 380
SEND . . . 384
SENDMSG . . . 387
SENDTO . . . 390
SETSOCKOPT . . . 394
SHUTDOWN . . . 411
SOCKET . . . 413
TAKESOCKET . . . 416
TASK . . . 418
TERMAPI . . . 419

WRITE 419
WRITEV 421
Macro interface assembler language sample programs 423
EZASOKAS sample server program for IPv4 424
EZASOKAC sample client program for IPv4 434
EZASO6AS sample server program for IPv6 444
EZASO6AC sample client program for IPv6 457

Chapter 13. CALL instruction application programming interface 469
CALL instruction API environmental restrictions and programming requirements 469
CALL instruction API output register information 470
CALL instruction API compatibility considerations 470
CALL instruction application programming interface (API) 470
Understanding COBOL, Assembler, and PL/I call formats 471
COBOL language call format 471
Assembler language call format 471
PL/I language call format 471
Converting parameter descriptions 472
Diagnosing problems in applications using the CALL instruction API 472
CALL instruction API error messages and return codes 473
Code CALL instructions 473
ACCEPT 473
BIND 475
| BIND2ADDRSEL 478
CLOSE 481
CONNECT 482
FCNTL 485
FREEADDRINFO 487
GETADDRINFO 488
GETCLIENTID 498
GETHOSTBYADDR 499
GETHOSTBYNAME 502
GETHOSTID 504
GETHOSTNAME 505
GETIBMOPT 506
GETNAMEINFO 509
GETPEERNAME 513
GETSOCKNAME 515
GETSOCKOPT 517
GIVESOCKET 533
| INET6_IS_SRCADDR 535
INITAPI 538
IOCTL 540
LISTEN 551
NTOP 552
PTON 554
READ 556
READV 558
RECV 559
RECVFROM 561
RECVMSG 565
SELECT 569
SELECTEX 574
SEND 579
SENDMSG 581
SENDTO 585
SETSOCKOPT 589
SHUTDOWN 605
SOCKET 607
TAKESOCKET 608
TERMAPI 610

WRITE . . . 611
WRITEV . . . 612
Using data translation programs for socket call interface . . . 614
Assembler language utility programs call format . . . 614
Data translation . . . 614
Bit-string processing . . . 614
Call interface sample programs . . . 633
Sample code for IPv4 server program . . . 633
Sample program for IPv4 client program . . . 637
Sample code for IPv6 server program . . . 640
Sample program for IPv6 client program . . . 647
Common variables used in PL/I sample programs . . . 651
Common variables used in COBOL sample programs . . . 664
COBOL call interface sample IPv6 server program . . . 672
COBOL call interface sample IPv6 client program . . . 685

Chapter 14. REXX socket application programming interface . . . 695
Overview of the REXX socket API . . . 695
Supported REXX APIs . . . 695
Prerequisites for using REXX sockets . . . 695
Format of the REXX socket function and return values . . . 695
REXX programming hints and tips . . . 696
How structures are represented . . . 698
REXX runtime functions . . . 702
ACCEPT . . . 704
BIND . . . 707
| BIND2ADDRSEL . . . 709
CLOSE . . . 711
CONNECT . . . 712
FCNTL . . . 715
GETADDRINFO . . . 717
GETCLIENTID . . . 727
GETDOMAINNAME . . . 728
GETHOSTBYADDR . . . 729
GETHOSTBYNAME . . . 730
GETHOSTID . . . 732
GETHOSTNAME . . . 733
GETNAMEINFO . . . 734
GETPEERNAME . . . 736
GETPROTOBYNAME . . . 738
GETPROTOBYNUMBER . . . 739
GETSERVBYNAME . . . 740
GETSERVBYPORT . . . 741
GETSOCKNAME . . . 742
GETSOCKOPT . . . 743
GIVESOCKET . . . 753
| INET6ISSRCADDR . . . 755
INITIALIZE . . . 758
IOCTL . . . 759
LISTEN . . . 769
READ . . . 770
RECV . . . 773
RECVFROM . . . 775
RESOLVE . . . 778
SELECT . . . 779
SEND . . . 783
SENDTO . . . 785
SETSOCKOPT . . . 786
SHUTDOWN . . . 800
SOCKET . . . 801
SOCKETSET . . . 803

SOCKETSETLIST . . . 803
SOCKETSETSTATUS . . . 804
TAKESOCKET . . . 806
TERMINATE . . . 808
VERSION . . . 809
WRITE . . . 810
REXX socket sample programs . . . 812
Overview of REXX sample programs . . . 812
The REXX-EXEC RSCLIENT sample program for IPv4 . . . 814
The REXX-EXEC RSSERVER sample program for IPv4 . . . 814
The REXX-EXEC R6CLIENT sample program for IPv6. . . . 815
The REXX-EXEC R6SERVER sample program for IPv6 . . . 815
AT-TLS security definitions for REXX samples . . . 816
Running the REXX sample programs . . . 816
Testing the GIVESOCKET and TAKESOCKET commands . . . 816

Chapter 15. Pascal application programming interface. . . . 817
Steps for Pascal language API procedure calls . . . 817
Pascal language API software requirements . . . 818
Pascal API header files . . . 818
Pascal language API compatibility considerations . . . 818
Pascal language API data structures . . . 819
Connection state . . . 819
Connection information record . . . 820
Notification record . . . 821
File specification record . . . 826
Pascal language API: using procedure calls . . . 827
Notifications. . . . 827
TCP initialization procedures . . . 827
TCP termination procedure. . . . 827
TCP communication procedures . . . 828
PING interface . . . 828
Monitor procedures . . . 828
UDP communication procedures . . . 828
Raw IP interface . . . 828
Timer routines . . . 828
Host lookup routines . . . 828
Assembler calls. . . . 828
Other routines . . . 828
Pascal return codes . . . 829
Pascal language API procedure calls. . . . 830
AddUserNote . . . 831
BeginTcpIp . . . 831
ClearTimer . . . 832
CreateTimer . . . 832
DestroyTimer . . . 832
EndTcpIp. . . . 832
GetHostNumber . . . 833
GetHostResol . . . 833
GetHostString . . . 834
GetIdentity . . . 834
GetNextNote . . . 835
GetSmsg . . . 836
Handle . . . 836
IsLocalAddress . . . 836
IsLocalHost . . . 837
MonQuery . . . 838
PingRequest . . . 839
RawIpClose . . . 839
RawIpOpen . . . 840
RawIpReceive . . . 841

RawIpSend . . . 841
ReadXlateTable . . . 842
SayCalRe . . . 843
SayConSt . . . 843
SayIntAd . . . 844
SayIntNum . . . 844
SayNotEn . . . 844
SayPorTy . . . 845
SayProTy . . . 845
SetTimer . . . 845
TcpAbort . . . 846
TcpClose . . . 847
TcpFReceive, TcpReceive, and TcpWaitReceive . . . 847
TcpFSend, TcpSend, and TcpWaitSend . . . 849
TcpNameChange . . . 851
TcpOpen and TcpWaitOpen . . . 852
TcpOption . . . 854
TcpStatus . . . 855
UdpClose . . . 856
UdpNReceive . . . 856
UdpOpen . . . 857
UdpReceive . . . 858
UdpSend . . . 859
Unhandle . . . 860
Sample Pascal program . . . 860
Building the sample Pascal API module . . . 860
Running the sample module . . . 860
Sample Pascal application program . . . 861

Appendix A. Multitasking C socket sample program . . . 869
Server sample program in C . . . 869
The subtask sample program in C . . . 876
The client sample program in C . . . 879

Appendix B. Socket call error return codes . . . 885
System error codes for socket calls . . . 885
Sockets return codes (ERRNOs) . . . 885
z/OS UNIX return codes . . . 904
Additional return codes . . . 904
Sockets extended ERRNOs . . . 905
User abend U4093 . . . 909

Appendix C. Address family cross reference . . . 911

Appendix D. GETSOCKOPT/SETSOCKOPT command values . . . 917

Appendix E. Abbreviations and acronyms . . . 921

Appendix F. Related protocol specifications . . . 927
Internet drafts . . . 943

Appendix G. Accessibility . . . 945

Notices . . . 947
Programming interface information . . . 955
Policy for unsupported hardware . . . 955
Trademarks . . . 955

Bibliography . . . 957

Index **961**

Communicating your comments to IBM **977**

Figures

1. The TCP/IP protocol stack . . . 3
2. Socket concept . . . 4
3. TCP/IP networking API relationship on z/OS . . . 7
4. The port concept . . . 10
5. Port number assignments . . . 10
6. Iterative server main logic . . . 16
7. A typical stream socket session . . . 18
8. A typical datagram socket session . . . 19
9. Socket call variables . . . 28
10. MVS TCP/IP socket descriptor table . . . 29
11. An application using the bind() call . . . 30
12. A bind() call using gethostbyname() . . . 30
13. Variables used for the BIND call . . . 31
14. Variables used by the listen call . . . 32
15. Variables used by the ACCEPT call . . . 34
16. Socket states . . . 35
17. Closing sockets . . . 36
18. Serialized access to a shared storage area . . . 41
19. Synchronized use of a common service task . . . 42
20. Concurrent server in an MVS address space . . . 45
21. To set/test bits for SELECT calls . . . 48
22. An application using the select() call . . . 50
23. Accepting a client connection . . . 51
24. Giving a socket to a subtask . . . 54
25. Taking sockets from the main process . . . 55
26. Finding the IP address of a server host using gethostbyname() . . . 58
27. Layout of a message between a TPI client and a TPI server . . . 64
28. Transaction request message segment . . . 64
29. The TCP buffer flush technique . . . 65
30. Big or little endian byte order for a 2-byte integer . . . 67
31. An application using the send() and recv() calls . . . 69
32. An application using the sendto() and recvfrom() Calls . . . 72
33. IP_ADD_MEMBERSHIP and IP_DROP_MEMBERSHIP . . . 80
34. IP_ADD_SOURCE_MEMBERSHIP and IP_DROP_SOURCE_MEMBERSHIP . . . 83
35. IP_BLOCK_SOURCE and IP_UNBLOCK_SOURCE . . . 84
36. IP_MULTICAST_IF . . . 86
37. IP_MULTICAST_LOOP . . . 87
38. IP_MULTICAST_TTL . . . 88
39. IPV6_JOIN_GROUP and IPV6_LEAVE_GROUP . . . 90
40. IPV6_MULTICAST_IF . . . 93
41. IPV6_MULTICAST_LOOP . . . 94
42. IPV6_MULTICAST_HOPS . . . 95
43. MCAST_JOIN_GROUP and MCAST_LEAVE_GROUP . . . 97
44. MCAST_JOIN_SOURCE_GROUP and MCAST_LEAVE_SOURCE_GROUP . . . 99
45. MCAST_BLOCK_SOURCE and MCAST_UNBLOCK_SOURCE . . . 100
46. Sample JCL for compiling non-reentrant modules . . . 108
47. Sample JCL for linking non-reentrant modules . . . 109
48. Sample JCL for running non-reentrant modules . . . 109
49. Sample JCL for compiling reentrant modules . . . 111
50. Sample JCL for prelinking and linking reentrant modules . . . 112
51. Sample JCL for running the reentrant program . . . 113
52. C socket TCP client sample . . . 222
53. C socket TCP server sample . . . 225
54. C socket UDP server sample . . . 228
55. C socket UDP client sample . . . 231

© Copyright IBM Corp. 1989, 2010

56. Using XTI with TCP/IP . . . 234
57. Sample compile and link-edit job control procedure . . . 237
58. Sample client execution job control procedure . . . 239
59. Sample server execution job control procedure . . . 240
60. Sample client code for XTI . . . 242
61. Sample server code for XTI . . . 251
62. ECB input parameter . . . 268
63. User token setting . . . 268
64. HOSTENT structure returned by the GETHOSTBYADDR macro . . . 302
65. HOSTENT structure returned by the GETHOSTBYNAME macro . . . 304
66. NUM_IMAGES field settings . . . 309
67. EZASOKAS sample server program for IPv4 . . . 425
68. EZASOKAC sample client program for IPv4 . . . 435
69. EZASO6AS sample server program for IPv6 . . . 445
70. EZASO6AC sample client program for IPv6 . . . 458
71. Storage definition statement examples . . . 472
72. ACCEPT call instructions example . . . 474
73. BIND call instruction example . . . 477
74. BIND2ADDRSEL call instruction example . . . 480
75. CLOSE call instruction example . . . 482
76. CONNECT call instruction example . . . 484
77. FCNTL call instruction example . . . 486
78. FREEADDRINFO call instruction example . . . 488
79. GETADDRINFO call instruction example . . . 490
80. GETCLIENTID call instruction example . . . 499
81. GETHOSTBYADDR call instruction example . . . 500
82. HOSTENT structure that is returned by the GETHOSTBYADDR call . . . 501
83. GETHOSTBYNAME call instruction example . . . 502
84. HOSTENT structure returned by the GETHOSTYBYNAME call . . . 503
85. GETHOSTID call instruction example . . . 505
86. GETHOSTNAME call instruction example . . . 506
87. GETIBMOPT call instruction example . . . 507
88. Example of name field . . . 509
89. GETNAMEINFO call instruction example . . . 510
90. GETPEERNAME call instruction example . . . 514
91. GETSOCKNAME call instruction example . . . 516
92. GETSOCKOPT call instruction example . . . 518
93. GIVESOCKET call instruction example . . . 534
94. INET6_IS_SRCADDR call instruction example . . . 536
95. INITAPI call instruction example . . . 539
96. IOCTL call instruction example . . . 541
97. COBOL language example for SIOCGHOMEIF6 . . . 543
98. COBOL language example for SIOCGIFNAMEINDEX . . . 545
99. COBOL II example for SIOCGIFCONF . . . 551
100. LISTEN call instruction example . . . 552
101. NTOP call instruction example . . . 553
102. PTON call instruction example . . . 555
103. READ call instruction example . . . 557
104. READV call instruction example . . . 558
105. RECV call instruction example . . . 560
106. RECVFROM call instruction example . . . 563
107. RECVMSG call instruction example . . . 566
108. SELECT call instruction example . . . 572
109. SELECTEX call instruction example . . . 577
110. SEND call instruction example . . . 580
111. SENDMSG call instruction example . . . 582
112. SENDTO call instruction example . . . 587
113. SETSOCKOPT call instruction example . . . 589
114. SHUTDOWN call instruction example . . . 606
115. SOCKET call instruction example . . . 607
116. TAKESOCKET call instruction example . . . 609

117. TERMAPI call instruction example . . . 611
118. WRITE call instruction example . . . 612
119. WRITEV call instruction example . . . 613
120. EZACIC04 EBCDIC-to-ASCII table . . . 615
121. EZACIC04 call instruction example . . . 615
122. EZACIC05 ASCII-to-EBCDIC table . . . 617
123. EZACIC05 call instruction example . . . 617
124. EZACIC06 call instruction example . . . 619
125. EZAZIC08 call instruction example . . . 622
126. EZACIC09 call instruction example . . . 625
127. EZACIC14 EBCDIC-to-ASCII table . . . 629
128. EZACIC14 call instruction example . . . 629
129. EZACIC15 ASCII-to-EBCDIC table . . . 631
130. EZACIC15 call instruction example . . . 631
131. EZASOKPS PL/1 sample server program for IPv4 . . . 634
132. EZASOKPC PL/1 sample client program for IPv4 . . . 638
133. EZASO6PS PL/1 sample server program for IPv6 . . . 642
134. EZASO6PC PL/1 sample client program for IPv6 . . . 648
135. CBLOCK PL/1 common variables . . . 652
136. EZACOBOL COBOL common variables . . . 665
137. EZASO6CS COBOL call interface sample IPv6 server program . . . 673
138. EZASO6CC COBOL call interface sample IPv6 client program . . . 686
139. ACCEPT command example . . . 707
140. CLOSE command example . . . 712
141. CONNECT command example . . . 715
142. FCNTL command example . . . 717
143. GETCLIENTID command example . . . 728
144. GETDOMAINNAME command example . . . 729
145. GETHOSTBYADDR command example . . . 730
146. GETHOSTBYNAME command example . . . 732
147. GETHOSTID command example . . . 733
148. GETHOSTNAME command example . . . 734
149. GETNAMEINFO command example . . . 736
150. GETPEERNAME command example . . . 738
151. GETPROTOBYNAME command example . . . 739
152. GETPROTOBYNUMBER command example . . . 740
153. GETSERVBYNAME command example . . . 741
154. GETSERVBYPORT command example . . . 742
155. GETSOCKNAME command example . . . 743
156. ASCII to EBCDIC . . . 747
157. EBCDIC to ASCII . . . 748
158. GETSOCKOPT command example . . . 753
159. READ command example . . . 773
160. READ command example . . . 778
161. RESOLVE command example . . . 779
162. SELECT command example . . . 782
163. ASCII to EBCDIC . . . 794
164. EBCDIC to ASCII . . . 795
165. SOCKET command example . . . 802
166. SOCKETSET command example . . . 803
167. SOCKETSETLIST command example . . . 804
168. SOCKETSETSTATUS command example . . . 806
169. TERMINATE command example . . . 809
170. VERSION command example . . . 810
171. Pascal declaration of connection state type . . . 819
172. Pascal declaration of connection information record . . . 820
173. Pascal declaration of socket type . . . 821
174. Notification record . . . 822
175. Pascal declaration of file specification record . . . 827
176. Sample calling sequence . . . 831
177. BeginTcpIp example . . . 831

178. ClearTimer example 832
179. Create timer example 832
180. Destroy timer example 832
181. EndTcpIp example 833
182. GetHostNumber example 833
183. GetHostResol example 834
184. GetHostString example 834
185. GetIdentity example 835
186. GetNextNote example 835
187. GetSmsg example 836
188. Handle example 836
189. IsLocalAddress example 837
190. IsLocalHost example 837
191. MonQuery example 838
192. Monitor query record 838
193. PingRequest example 839
194. RawIpClose example 840
195. RawIpOpen example 840
196. RawIpReceive example 841
197. RawIpSend example 842
198. ReadXlateTable example 843
199. SayCalRe example 843
200. SayConSt example 844
201. SayIntAd example 844
202. SayIntNum example 844
203. SayNotEn example. 845
204. SayPorTy example 845
205. SayProTy example 845
206. SetTimer example 846
207. TcpAbort example 846
208. TcpClose example 847
209. TcpFReceive example 848
210. TcpReceive example 848
211. TcpWaitReceive example 848
212. TcpFSend example 850
213. TcpSend example 850
214. TcpWaitSend example. 850
215. TcpNameChange example 852
216. TcpOpen example 852
217. TcpWaitOpen example 852
218. TcpOption example 854
219. TcpStatus example 855
220. UdpClose example. 856
221. UdpNReceive example 857
222. UdpOpen example. 858
223. UdpReceive example 858
224. UdpSend example 859
225. Unhandle example. 860
226. Sample Pascal API with receive option 861
227. Sample Pascal API with send option 861
228. Sample Pascal application program 862
229. MTCSRVR C socket server program sample 870
230. MTCCSUB C socket server program sample 877
231. MTCCLNT C socket server program sample 880
232. Example of abend U4093. 909

Tables

1. Socket programming interface actions . . . 20
2. TCP/IP data sets and applications . . . 22
3. Effect of shutdown socket call . . . 37
4. First fullword passed in a bit string select() . . . 46
5. Second fullword passed in a bit string using select() . . . 47
6. C structures in assembler language format . . . 115
7. Initializing a call . . . 235
8. Establishing a connection . . . 235
9. Transferring data . . . 235
10. Releasing a connection . . . 235
11. Disabling a connection . . . 235
12. Managing events . . . 236
13. Using utilities . . . 236
14. System function calls . . . 236
15. OPTNAME options for GETSOCKOPT and SETSOCKOPT . . . 322
16. IOCTL macro arguments . . . 355
17. OPTNAME options for GETSOCKOPT and SETSOCKOPT . . . 397
18. OPTNAME options for GETSOCKOPT and SETSOCKOPT . . . 519
19. IOCTL call arguments. . . . 549
20. OPTNAME options for GETSOCKOPT and SETSOCKOPT . . . 590
21. REXX socket sample programs . . . 812
22. TCP connection states . . . 820
23. Pascal language return codes . . . 829
24. Sockets ERRNOs . . . 886
25. Sockets extended ERRNOs . . . 905
26. C socket address families cross reference . . . 911
27. MACRO, CALL, REXX, socket address families cross reference . . . 913
28. MACRO, CALL, REXX, exceptions . . . 916
29. GETSOCKOPT/SETSOCKOPT command values for Macro, Assembler, COBOL and PL/I . . . 917
30. GETSOCKOPT/SETSOCKOPT optname value for C programs . . . 918

© Copyright IBM Corp. 1989, 2010

About this document

This document describes the syntax of the TCP/IP application programming interface (API). The APIs described in this document can be used to create TCP/IP client and server applications or modify existing applications to communicate using TCP/IP. The information in this document supports both IPv6 and IPv4. Unless explicitly noted, information describes IPv4 networking protocol. IPv6 support is qualified within the text.

This document refers to Communications Server data sets by their default SMP/E distribution library name. Your installation might, however, have different names for these data sets where allowed by SMP/E, your installation personnel, or administration staff. For instance, this document refers to samples in SEZAINST library as simply in SEZAINST. Your installation might choose a data set name of SYS1.SEZAINST, CS390.SEZAINST or other high-level qualifiers for the data set name.

To provide flexibility in writing new applications and adapting existing applications, the following programming languages and interfaces are described:
- C sockets
- X/Open Transport Interface (XTI)
- Assembler, PL/I, and COBOL sockets
- REXX sockets
- Pascal language

Who should read this document

This document is intended for experienced programmers familiar with MVS™, the IBM® multiple virtual storage operating system, TCP/IP protocols, UNIX® sockets, and data networks.

To use this document, you should be familiar with MVS and the IBM timesharing option (TSO).

You should also be familiar with z/OS® Communications Server and installing and customizing any required programming products for your network.

Depending on the design and function of your application, you should be familiar with one or more of the following programming languages:
- Assembler
- C
- COBOL
- Pascal
- PL/I
- REXX

How this document is organized

This document is organized into the following parts:

© Copyright IBM Corp. 1989, 2010

Part 1, “Overview,” on page 1 presents an overview of TCP/IP concepts and organizing a TCP/IP application program.

Part 2, “Designing programs,” on page 25 describes ways to design various types of programs.

Part 3, “Application program interfaces,” on page 103 describes the following socket application program interfaces (APIs):

- C Socket application programming interface (API)
- X/Open Transport Interface (XTI)
- Macro application programming interface (API)
- CALL instruction application programming interface (API)
- REXX socket application programming interface (API)
- Pascal application programming interface (API)

″Part 4. ’Appendices’ ″ provides additional information for this document.

″Notices″ contains notices and trademarks used in this document.

″Bibliography″ contains descriptions of the documents in the z/OS Communications Server library.

How to use this document

To use this document, you should be familiar with z/OS TCP/IP Services and the TCP/IP suite of protocols.

Determining whether a publication is current

As needed, IBM updates its publications with new and changed information. For a given publication, updates to the hardcopy and associated BookManager® softcopy are usually available at the same time. Sometimes, however, the updates to hardcopy and softcopy are available at different times. The following information describes how to determine if you are looking at the most current copy of a publication:

- At the end of a publication’s order number there is a dash followed by two digits, often referred to as the dash level. A publication with a higher dash level is more current than one with a lower dash level. For example, in the publication order number GC28-1747-07, the dash level 07 means that the publication is more current than previous levels, such as 05 or 04.
- If a hardcopy publication and a softcopy publication have the same dash level, it is possible that the softcopy publication is more current than the hardcopy publication. Check the dates shown in the Summary of Changes. The softcopy publication might have a more recently dated Summary of Changes than the hardcopy publication.
- To compare softcopy publications, you can check the last two characters of the publication’s file name (also called the book name). The higher the number, the more recent the publication. Also, next to the publication titles in the CD-ROM booklet and the readme files, there is an asterisk (*) that indicates whether a publication is new or changed.

How to contact IBM service

For immediate assistance, visit this Web site: http://www.software.ibm.com/network/commserver/support/

Most problems can be resolved at this Web site, where you can submit questions and problem reports electronically, as well as access a variety of diagnosis information.

For telephone assistance in problem diagnosis and resolution (in the United States or Puerto Rico), call the IBM Software Support Center anytime (1-800-IBM-SERV). You will receive a return call within 8 business hours (Monday – Friday, 8:00 a.m. – 5:00 p.m., local customer time).

Outside the United States or Puerto Rico, contact your local IBM representative or your authorized IBM supplier.

If you would like to provide feedback on this publication, see "Communicating your comments to IBM" on page 977.

Conventions and terminology that are used in this document

Commands in this book that can be used in both TSO and z/OS UNIX environments use the following conventions:

- When describing how to use the command in a TSO environment, the command is presented in uppercase (for example, NETSTAT).
- When describing how to use the command in a z/OS UNIX environment, the command is presented in bold lowercase (for example, **netstat**).
- When referring to the command in a general way in text, the command is presented with an initial capital letter (for example, Netstat).

All the exit routines described in this document are *installation-wide exit routines*. The installation-wide exit routines also called installation-wide exits, exit routines, and exits throughout this document.

The TPF logon manager, although included with VTAM®, is an application program; therefore, the logon manager is documented separately from VTAM.

Samples used in this book might not be updated for each release. Evaluate a sample carefully before applying it to your system.

For definitions of the terms and abbreviations that are used in this document, you can view the latest IBM terminology at the IBM Terminology Web site.

Clarification of notes

Information traditionally qualified as **Notes** is further qualified as follows:

Note Supplemental detail

Tip Offers shortcuts or alternative ways of performing an action; a hint

Guideline
Customary way to perform a procedure

Rule Something you must do; limitations on your actions

Restriction
Indicates certain conditions are not supported; limitations on a product or facility

Requirement
Dependencies, prerequisites

Result Indicates the outcome

How to read a syntax diagram

This syntax information applies to all commands and statements that do not have their own syntax described elsewhere.

The syntax diagram shows you how to specify a command so that the operating system can correctly interpret what you type. Read the syntax diagram from left to right and from top to bottom, following the horizontal line (the main path).

Symbols and punctuation

The following symbols are used in syntax diagrams:

Symbol	Description
►►	Marks the beginning of the command syntax.
►	Indicates that the command syntax is continued.
|	Marks the beginning and end of a fragment or part of the command syntax.
►◄	Marks the end of the command syntax.

You must include all punctuation such as colons, semicolons, commas, quotation marks, and minus signs that are shown in the syntax diagram.

Commands

Commands that can be used in both TSO and z/OS UNIX environments use the following conventions in syntax diagrams:

- When describing how to use the command in a TSO environment, the command is presented in uppercase (for example, NETSTAT).
- When describing how to use the command in a z/OS UNIX environment, the command is presented in bold lowercase (for example, **netstat**).

Parameters

The following types of parameters are used in syntax diagrams.

Required
Required parameters are displayed on the main path.

Optional
Optional parameters are displayed below the main path.

Default
Default parameters are displayed above the main path.

Parameters are classified as keywords or variables. For the TSO and MVS console commands, the keywords are not case sensitive. You can code them in uppercase or lowercase. If the keyword appears in the syntax diagram in both uppercase and lowercase, the uppercase portion is the abbreviation for the keyword (for example, OPERand).

For the z/OS UNIX commands, the keywords must be entered in the case indicated in the syntax diagram.

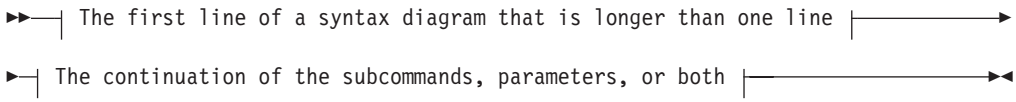
Variables are italicized, appear in lowercase letters, and represent names or values you supply. For example, a data set is a variable.

Syntax examples

In the following example, the USER command is a keyword. The required variable parameter is *user_id*, and the optional variable parameter is *password*. Replace the variable parameters with your own values.

Longer than one line

If a diagram is longer than one line, the first line ends with a single arrowhead and the second line begins with a single arrowhead.



Required operands

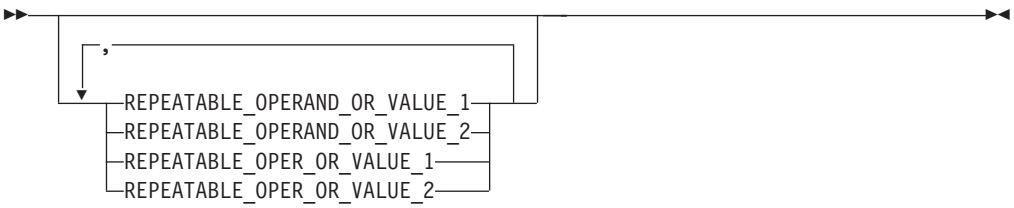
Required operands and values appear on the main path line. You must code required operands and values.

Optional values

Optional operands and values appear below the main path line. You do not have to code optional operands and values.

Selecting more than one operand

An arrow returning to the left above a group of operands or values means more than one can be selected, or a single one can be repeated.



Nonalphanumeric characters

If a diagram shows a character that is not alphanumeric (such as parentheses, periods, commas, and equal signs), you must code the character as part of the syntax. In this example, you must code OPERAND=(001,0.001).

Blank spaces in syntax diagrams

If a diagram shows a blank space, you must code the blank space as part of the syntax. In this example, you must code OPERAND=(001 FIXED).

Default operands

Default operands and values appear above the main path line. TCP/IP uses the default if you omit the operand entirely.

Variables

A word in all lowercase italics is a *variable*. Where you see a variable in the syntax, you must replace it with one of its allowable names or values, as defined in the text.

Syntax fragments

Some diagrams contain syntax fragments, which serve to break up diagrams that are too long, too complex, or too repetitious. Syntax fragment names are in mixed case and are shown in the diagram and in the heading of the fragment. The fragment is placed below the main diagram.

Syntax fragment:

```
├──1ST_OPERAND──,──2ND_OPERAND──,──3RD_OPERAND──────────────────────────────┤
```

Prerequisite and related information

z/OS Communications Server function is described in the z/OS Communications Server library. Descriptions of those documents are listed in "Bibliography" on page 957, in the back of this document.

Required information

Before using this product, you should be familiar with TCP/IP, VTAM, MVS, and UNIX System Services.

Softcopy information

Softcopy publications are available in the following collections.

Titles	Order Number	Description
z/OS V1R12 Collection	SK3T-4269	This CD collection is shipped with the z/OS product. It includes the libraries for z/OS V1R12, in both BookManager and PDF formats.
z/OS Software Products Collection	SK3T-4270	This CD includes, in both BookManager and PDF formats, the libraries of z/OS software products that run on z/OS but are not elements and features, as well as the *Getting Started with Parallel Sysplex®* bookshelf.
z/OS V1R12 and Software Products DVD Collection	SK3T-4271	This collection includes the libraries of z/OS (the element and feature libraries) and the libraries for z/OS software products in both BookManager and PDF format. This collection combines SK3T-4269 and SK3T-4270.
z/OS Licensed Product Library	SK3T-4307	This CD includes the licensed documents in both BookManager and PDF format.
IBM System z® Redbooks Collection	SK3T-7876	The Redbooks® selected for this CD series are taken from the IBM Redbooks inventory of over 800 books. All the Redbooks that are of interest to the zSeries® platform professional are identified by their authors and are included in this collection. The zSeries subject areas range from e-business application development and enablement to hardware, networking, Linux®, solutions, security, parallel sysplex, and many others.

Other documents

For information about z/OS products, refer to *z/OS Information Roadmap* (SA22-7500). The Roadmap describes what level of documents are supplied with each release of z/OS Communications Server, as well as describing each z/OS publication.

Relevant RFCs are listed in an appendix of the IP documents. Architectural specifications for the SNA protocol are listed in an appendix of the SNA documents.

The following table lists documents that might be helpful to readers.

Title	Number
DNS and BIND, Fifth Edition, O'Reilly Media, 2006	ISBN 13: 978-0596100575
Routing in the Internet , Second Edition, Christian Huitema (Prentice Hall 1999)	ISBN 13: 978-0130226471
sendmail, Fourth Edition, Bryan Costales, Claus Assmann, George Jansen, and Gregory Shapiro, O'Reilly Media, 2007	ISBN 13: 978-0596510299
SNA Formats	GA27-3136
TCP/IP Illustrated, Volume 1: The Protocols, W. Richard Stevens, Addison-Wesley Professional, 1994	ISBN 13: 978-0201633467
TCP/IP Illustrated, Volume 2: The Implementation, Gary R. Wright and W. Richard Stevens, Addison-Wesley Professional, 1995	ISBN 13: 978-0201633542
TCP/IP Illustrated, Volume 3: TCP for Transactions, HTTP, NNTP, and the UNIX Domain Protocols, W. Richard Stevens, Addison-Wesley Professional, 1996	ISBN 13: 978-0201634952
TCP/IP Tutorial and Technical Overview	GG24-3376
Understanding LDAP	SG24-4986
z/OS Cryptographic Services System SSL Programming	*SC24-5901*
z/OS Integrated Security Services LDAP Server Administration and Use	*SC24-5923*
z/OS JES2 Initialization and Tuning Guide	*SA22-7532*
z/OS Problem Management	*G325-2564*
z/OS MVS Diagnosis: Reference	*GA22-7588*
z/OS MVS Diagnosis: Tools and Service Aids	*GA22-7589*
z/OS MVS Using the Subsystem Interface	*SA22-7642*
z/OS Program Directory	*GI10-0670*
z/OS UNIX System Services Command Reference	*SA22-7802*
z/OS UNIX System Services Planning	*GA22-7800*
z/OS UNIX System Services Programming: Assembler Callable Services Reference	*SA22-7803*
z/OS UNIX System Services User's Guide	*SA22-7801*
z/OS XL C/C++ Run-Time Library Reference	*SA22-7821*
System z10, System z9 and zSeries OSA-Express Customer's Guide and Reference	*SA22-7935*

Redbooks

The following Redbooks might help you as you implement z/OS Communications Server.

Title	Number
IBM z/OS V1R11 Communications Server TCP/IP Implementation, Volume 1: Base Functions, Connectivity, and Routing	SG24-7798
IBM z/OS V1R11 Communications Server TCP/IP Implementation, Volume 2: Standard Applications	SG24-7799
IBM z/OS V1R11 Communications Server TCP/IP Implementation, Volume 3: High Availability, Scalability, and Performance	SG24-7800
IBM z/OS V1R11 Communications Server TCP/IP Implementation, Volume 4: Security and Policy-Based Networking	SG24-7801
IBM Communication Controller Migration Guide	SG24-6298
IP Network Design Guide	SG24-2580

Title	Number
Managing OS/390® TCP/IP with SNMP	SG24-5866
Migrating Subarea Networks to an IP Infrastructure Using Enterprise Extender	SG24-5957
SecureWay™ Communications Server for OS/390 V2R8 TCP/IP: Guide to Enhancements	SG24–5631
SNA and TCP/IP Integration	SG24-5291
TCP/IP in a Sysplex	SG24-5235
TCP/IP Tutorial and Technical Overview	GG24-3376
Threadsafe Considerations for CICS	SG24-6351

Where to find related information on the Internet

z/OS

This site provides information about z/OS Communications Server release availability, migration information, downloads, and links to information about z/OS technology

http://www.ibm.com/systems/z/os/zos/

z/OS Internet Library

Use this site to view and download z/OS Communications Server documentation

www.ibm.com/systems/z/os/zos/bkserv/

IBM Communications Server product

The primary home page for information about z/OS Communications Server

http://www.software.ibm.com/network/commserver/

IBM Communications Server product support

Use this site to submit and track problems and search the z/OS Communications Server knowledge base for Technotes, FAQs, white papers, and other z/OS Communications Server information

http://www.software.ibm.com/network/commserver/support/

IBM Communications Server performance information

This site contains links to the most recent Communications Server performance reports.

http://www.ibm.com/support/docview.wss?uid=swg27005524

IBM Systems Center publications

Use this site to view and order Redbooks, Redpapers, and Technotes

http://www.redbooks.ibm.com/

IBM Systems Center flashes

Search the Technical Sales Library for Techdocs (including Flashes, presentations, Technotes, FAQs, white papers, Customer Support Plans, and Skills Transfer information)

http://www.ibm.com/support/techdocs/atsmastr.nsf

RFCs

Search for and view Request for Comments documents in this section of the Internet Engineering Task Force Web site, with links to the RFC repository and the IETF Working Groups Web page

http://www.ietf.org/rfc.html

Internet drafts

View Internet-Drafts, which are working documents of the Internet Engineering Task Force (IETF) and other groups, in this section of the Internet Engineering Task Force Web site

http://www.ietf.org/ID.html

Information about Web addresses can also be found in information APAR II11334.

Note: Any pointers in this publication to Web sites are provided for convenience only and do not in any manner serve as an endorsement of these Web sites.

DNS Web sites

For more information about DNS, see the following USENET news groups and mailing addresses:

USENET news groups
comp.protocols.dns.bind

BIND mailing lists
https://lists.isc.org/mailman/listinfo

BIND Users

- Subscribe by sending mail to bind-users-request@isc.org.
- Submit questions or answers to this forum by sending mail to bind-users@isc.org.

BIND 9 Users (This list might not be maintained indefinitely.)

- Subscribe by sending mail to bind9-users-request@isc.org.
- Submit questions or answers to this forum by sending mail to bind9-users@isc.org.

The z/OS Basic Skills Information Center

The z/OS Basic Skills Information Center is a Web-based information resource intended to help users learn the basic concepts of z/OS, the operating system that runs most of the IBM mainframe computers in use today. The Information Center is designed to introduce a new generation of Information Technology professionals to basic concepts and help them prepare for a career as a z/OS professional, such as a z/OS system programmer.

Specifically, the z/OS Basic Skills Information Center is intended to achieve the following objectives:

- Provide basic education and information about z/OS without charge
- Shorten the time it takes for people to become productive on the mainframe
- Make it easier for new people to learn z/OS

To access the z/OS Basic Skills Information Center, open your Web browser to the following Web site, which is available to all users (no login required):
http://publib.boulder.ibm.com/infocenter/zoslnctr/v1r7/index.jsp

How to send your comments

Your feedback is important in helping to provide the most accurate and high-quality information. If you have any comments about this document or any other z/OS Communications Server documentation, do one of the following:

- Go to the z/OS contact page at http://www.ibm.com/systems/z/os/zos/webqs.html. You can enter and submit your comments in the form provided at this Web site.
- Send your comments by e-mail to comsvrcf@us.ibm.com. Be sure to include the name of the document, the part number of the document, the version of z/OS Communications Server, and, if applicable, the specific location of the text that you are commenting on (for example, a section number, a page number or a table number).

Summary of changes

Summary of changes
for SC31-8788-09
z/OS Version 1 Release 12

This document contains information previously presented in SC31-8788-08, which supports z/OS Version 1 Release 11.

New information

- Configurable default address selection policy table, see the following topics:
  - BIND2ADDRSEL and INET6_IS_SRCADDR macros, see “Macros for assembler programs” on page 271.
  - BIND2ADDRSEL and INET6_IS_SRCADDR calls, see “Code CALL instructions” on page 473.
  - BIND2ADDRSEL and INET6ISSRCADDR commands, see Chapter 14. ″REXX socket application programming interface″.

Changed information

- Support for z/OS Communications Server for intraensemble networks, see getsockopt() call information in “C socket calls” on page 116.
- Configurable default address selection policy table, see the following topics:
  - GETADDRINFO, GETSOCKOPT, and SETSOCKOPT macros, see “Macros for assembler programs” on page 271.
  - GETADDRINFO, GETSOCKOPT, and SETSOCKOPT calls, see “Code CALL instructions” on page 473.
  - GETADDRINFO, GETSOCKOPT, and SETSOCKOPT commands, see Chapter 14. ″REXX socket application programming interface″.
  - “Sockets return codes (ERRNOs)” on page 885
  - Table 27 on page 913
  - Table 29 on page 917
- IPv6 resolver API enhancements, see the following topics:
  - GETADDRINFO macro, see “Macros for assembler programs” on page 271.
  - GETADDRINFO call, see “Code CALL instructions” on page 473.
- Trusted TCP connections, see the following topics:
  - IOCTL macro, see “Macros for assembler programs” on page 271.
  - IOCTL call, see “Code CALL instructions” on page 473.
  - IOCTL command, see Chapter 14. ″REXX socket application programming interface″.
  - “Sockets return codes (ERRNOs)” on page 885

This document contains terminology, maintenance, and editorial changes. Technical changes or additions to the text and illustrations are indicated by a vertical line to the left of the change.

You might notice changes in the style and structure of some content in this document--for example, headings that use uppercase for the first letter of initial

© Copyright IBM Corp. 1989, 2010

words only, and procedures that have a different look and format. The changes are ongoing improvements to the consistency and retrievability of information in our documents.

Summary of changes
for SC31-8788-08
z/OS Version 1 Release 11

This document contains information previously presented in SC31-8788-07, which supports z/OS Version 1 Release 10.

New information

- AT-TLS enhancements, see IOCTL command information in Chapter 14. ″REXX socket application programming interface″.
- New API to obtain IPv4 network interface MTU, see the following:
  - SIOCGIFMTU macro information in Chapter 12, “Macro application programming interface,” on page 261.
  - SIOCGIFMTU call information in Chapter 13, “CALL instruction application programming interface,” on page 469.
  - SIOCGIFMTU API information in Chapter 14. ″REXX socket application programming interface″.

This document contains terminology, maintenance, and editorial changes.

Summary of changes
for SC31-8788-07
z/OS Version 1 Release 10

This document contains information previously presented in SC31-8788-06, which supports z/OS Version 1 Release 9.

New information

Socket API timeout support

- See the following macro APIs:
  - “GETSOCKOPT” on page 320
  - “RECV” on page 365
  - “RECVFROM” on page 368
  - “RECVMSG” on page 372
  - “SETSOCKOPT” on page 394
- See the following call instruction APIs:
  - “GETSOCKOPT” on page 517
  - “RECV” on page 559
  - “RECVFROM” on page 561
  - “RECVMSG” on page 565
  - “SETSOCKOPT” on page 589
- See the following REXX socket APIs:
  - GETSOCKOPT
  - RECV
  - RECVFROM

– SETSOCKOPT

This document contains terminology, maintenance, and editorial changes.

Part 1. Overview

For native IPv4 addresses, the application must create an AF_INET address family socket. For native IPv6 addresses and IPv4-mapped IPv6 addresses, the application must create an AF_INET6 address family socket. See *z/OS Communications Server: IPv6 Network and Application Design Guide* and the **SOCKET** command under the APIs that support IPv6 for details.

For details on which TCP/IP APIs and commands support the AF_INET6 (IPv6) address family, see Appendix C, "Address family cross reference," on page 911.

© Copyright IBM Corp. 1989, 2010

Chapter 1. Introducing TCP/IP concepts

This information explains basic TCP/IP concepts and sockets programming.

TCP/IP concepts

Conceptually, the TCP/IP protocol stack consists of four layers, each layer consisting of one or more protocols. A protocol is a set of rules or standards that two entities must follow so as to allow each other to receive and interpret messages sent to them. The entities could, for example, be two application programs in an application protocol, or the entities might be two TCP protocol layers in two different IP hosts (the TCP protocol).

Figure 1 illustrates the TCP/IP protocol stack.

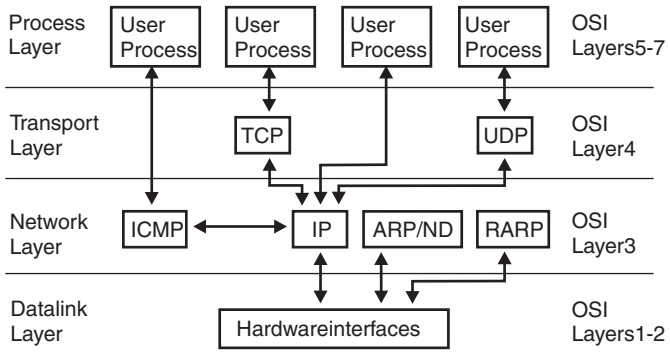


Figure 1. The TCP/IP protocol stack

Programs are located at the process layer; here they can interface with the two transport layer protocols (TCP and UDP), or directly with the network layer protocols (ICMP and IP).

TCP Transmission Control Protocol is a transport protocol providing a reliable, full-duplex byte stream. Most TCP/IP applications use the TCP transport protocol.

UDP User Datagram Protocol is a connectionless protocol providing datagram services. UDP is less reliable because there is no guarantee that a UDP datagram ever reaches its intended destination, or that it reaches its destination only once and in the same condition as it was passed to the sending UDP layer by a UDP application.

ICMP Internet Control Message Protocol is used to handle error and control information at the IP layer. The ICMP is most often used by network control applications that are part of the TCP/IP software product itself, but ICMP can be used by authorized user processes as well. PING and TRACEROUTE are examples of network control applications that use the ICMP protocol.

IP Internet Protocol provides the packet delivery services for TCP, UDP, and ICMP. The IP layer protocol is unreliable (called a best-effort protocol). There is no guarantee that IP packets arrive, or that they arrive only once and are error-free. Such reliability is built into the TCP protocol, but not

© Copyright IBM Corp. 1989, 2010

into the UDP protocol. If you need reliable transport between two UDP applications, you must ensure that reliability is built into the UDP applications.

ARP/ND
The IPv4 networking layer uses the Address Resolution Protocol (ARP) to map an IP address into a hardware address. In the IPv6 networking layer, this mapping is performed by the Neighbor Discovery (ND function). On local area networks (LANs), such an address would be called a media access control (MAC) address.

RARP Reverse Address Resolution Protocol is used to reverse the operation of the ARP protocol. It maps a hardware address into an IPv4 address. Note that both ARP packets and RARP packets are not forwarded in IP packets, but are themselves media level packets. ARP and RARP are not used on all network types, as some networks do not need these protocols.

Understanding sockets concepts

A socket uniquely identifies the endpoint of a communication link between two application ports.

A port represents an application process on a TCP/IP host, but the port number itself does not indicate the protocol being used: TCP, UDP, or IP. The application process might use the same port number for TCP or UDP protocols. To uniquely identify the destination of an IP packet arriving over the network, you have to extend the port principle with information about the protocol used and the IP address of the network interface; this information is called a socket. A socket has three parts: protocol, local-address, local-port.

Figure 2 illustrates the concept of a socket.

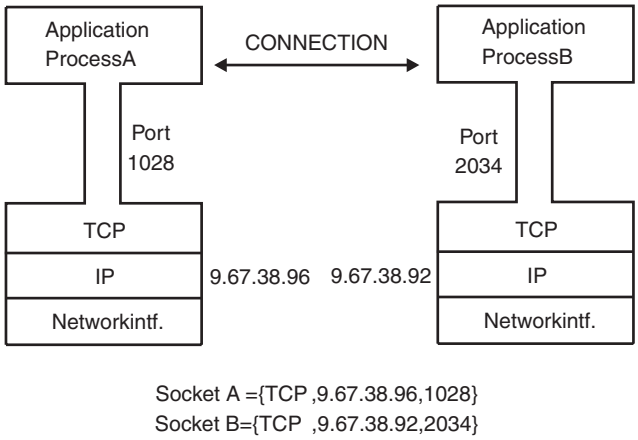


Figure 2. Socket concept

The term *association* is used to specify completely the two processes that comprise a connection:

(protocol,local-address,local-port,foreign-address,foreign-port).

The terms *socket* and *port* are sometimes used as synonyms, but note that the terms *port number* and *socket address* are not like one another. A port number is one of the

three parts of a socket address, and can be represented by a single number (for example, 1028) while a socket address can be represented by (tcp,myhostname,1028).

A socket descriptor (sometimes referred to as a socket number) is a binary integer that acts as an index to a table of sockets; the sockets are currently allocated to a given process. A socket descriptor represents the socket, but is not the socket itself.

Introducing TCP/IP concepts: Programming with sockets

A socket is an endpoint for communication able to be named and addressed in a network. From the perspective of the application program, it is a resource allocated by the address space; it is represented by an integer called the socket descriptor.

The socket interface was designed to provide applications a network interface that hides the details of the physical network. The interface is differentiated by the different services provided: Stream, datagram, and raw sockets. Each interface defines a separate service available to applications.

The MVS socket APIs provide a standard interface using the transport and internetwork layer interfaces of TCP/IP. These APIs support three socket types: stream, datagram, and raw. Stream and datagram socket types interface with the transport layer protocols; raw socket types interface with the network layer protocols. Choose the most appropriate interface for your application.

Introducing TCP/IP concepts: Selecting sockets

You can choose among the following types of sockets:

- Stream
- Datagram
- Raw

Stream sockets perform like streams of information. There are no record lengths or character boundaries between data, so communicating processes must agree on their own mechanisms for distinguishing information. Usually, the process sending information sends the length of the data, followed by the data itself. The process receiving information reads the length and then loops, accepting data until all of it has been transferred. Because there are no boundaries in the data, multiple concurrent read or write socket calls of the same type, on the same stream socket, will yield unpredictable results. For example, if two concurrent read socket calls are issued on the same stream socket, there is no guarantee of the order or amount of data that each instance will receive. Stream sockets guarantee to deliver data in the order sent and without duplication. The stream socket defines a reliable connection service. Data is sent without error or duplication and is received in the order sent. Flow control is built in to avoid data overruns. No boundaries are imposed on the data; the data is treated as a stream of bytes.

Stream sockets are most common because the burden of transferring the data reliably is handled by TCP/IP, rather than by the application.

The datagram socket is a connectionless service. Datagrams are sent as independent packets. The service provides no guarantees. Data can be lost or duplicated, and datagrams can arrive out of order. The size of a datagram is limited to the size able to be sent in a single transaction. Currently, the default value is 8192 bytes, and the maximum value is 65 535. The maximum size of a datagram is 65 535 for UDP and 65 535 bytes for raw.

The raw socket allows direct access to lower layer protocols, such as IP and the ICMP. This interface is often used to test new protocol implementation, because the socket interface can be extended and new socket types defined to provide additional services. For example, the transaction type sockets can be defined for interfacing to the Versatile Message Transfer Protocol (VMTP). [1],y Transaction-type sockets are not supported by TCP/IP. Because socket interfaces isolate you from the communication function of the different protocol layers, the interfaces are largely independent of the underlying network. In the MVS implementation of sockets, stream sockets interface with TCP, datagram sockets interface with UDP, and raw sockets interface with ICMP and IP.

Notes:

1. The TCP and UDP protocols cannot be used with raw sockets.
2. If you are communicating with an existing application, you must use the same protocols used by the existing application. For example, if you communicate with an application that uses TCP, you must use stream sockets.

You should consider the following factors for these applications:

- Reliability

  Stream sockets provide the most reliable connection. Datagrams and raw sockets are unreliable because packets can be discarded or duplicated during transmission. This characteristic might be acceptable if the application does not require reliability or if the application implements reliability beyond the socket interface.
- Performance

  Overhead associated with reliability, flow control, and connection maintenance degrades the performance of stream sockets so that they do not perform as well as datagram sockets.
- Data Transfer

  Datagram sockets limit the amount of data moved in a single transaction. If you send fewer than 2048 bytes of data at one time, use datagram sockets. When the amount of data in a single transaction is greater, use stream sockets.

If you are writing a new protocol to use on top of IP, or if you want to use the ICMP protocol, you must choose raw sockets; but to use raw sockets, you must be authorized by way of RACF® or APF.

Introducing TCP/IP concepts: Socket libraries

Figure 3 on page 7 illustrates the TCP/IP networking API relationship on z/OS.

1. David R. Cheriton and Carey L. Williamson, "MVSTP as the Transport Layer for High-Performance Distributed Systems," *IEEE Communications*, June 1989, Vol. 27, No. 6.

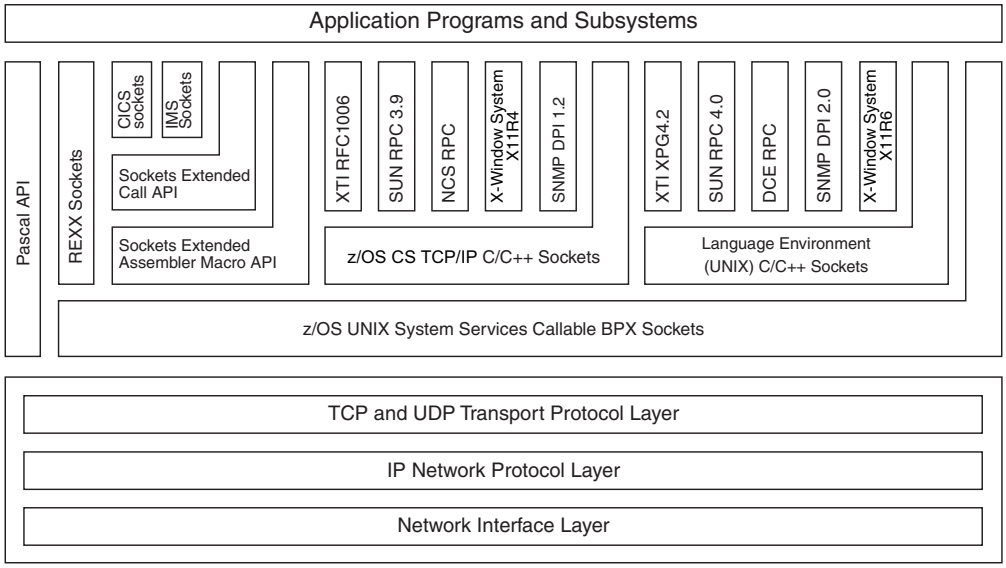


Figure 3. TCP/IP networking API relationship on z/OS

When we create a sockets program, we use something that generally is called a sockets library. A sockets library consists of both compile-time structures, statically linked support modules, and run-time support modules.

There are two main sockets execution environments in z/OS with available libraries:

- Native TCP/IP (implemented by TCP/IP in z/OS Communications Server)
- UNIX (implemented by z/OS UNIX System Services [Language Environment])

Native TCP/IP

A non-UNIX socket program can only use one TCP/IP protocol stack at a time. The native TCP/IP C socket library is not POSIX compliant and it should not be used for new C socket program development. The non-C native TCP/IP socket libraries (sockets extended: call and assembler macro, REXX sockets, CICS® sockets, and IMS™ sockets) are available for development of new socket application programs. The following TCP/IP Services APIs are included in this library:

Pascal API

The Pascal IPv4 socket application programming interface enables you to develop TCP/IP applications in the Pascal language. Supported environments are normal MVS address spaces. The Pascal programming interface is based on Pascal procedures and functions that implement conceptually the same functions as the C socket interface. The Pascal routines, however, have different names than the C socket calls. Unlike the other APIs, the Pascal API does not interface with z/OS UNIX System Services; it uses an internal interface to communicate with the TCP/IP protocol stack.

IMS sockets

The Information Management System (IMS) IPv4 socket interface supports development of client/server applications in which one part of the application executes on a TCP/IP-connected host and the other part executes as an IMS application program. The programming interface used by both application parts is the socket programming interface, and the communication protocols are either TCP, UDP, or RAW. For more information, see *z/OS Communications Server: IP IMS Sockets Guide*.

CICS sockets
The CICS socket interface enables you to write CICS applications that act as IPv4 or IPv6 clients or servers in a TCP/IP-based network. Applications can be written in C language, using the C sockets programming, or they can be written in COBOL, PL/I, or assembler, using the Extended Sockets programming interface. For more information, see *z/OS Communications Server: IP CICS Sockets Guide*.

z/OS CS TCP/IP C/C++ Sockets
The C/C++ Sockets interface supports IPv4 socket function calls that can be invoked from C/C++ programs.

Note: Use of the UNIX C socket library is encouraged.

Sockets Extended macro API
The Sockets Extended macro API is a generalized assembler macro-based interface to IPv4 and IPv6 socket programming. It includes extensions to the socket programming interface, such as support for asynchronous processing on most sockets function calls.

Sockets Extended Call Instruction API
The Sockets Extended Call Instruction API is a generalized call-based interface to IPv4 and IPv6 sockets programming. The functions implemented in this call interface resemble the C-sockets implementation, with some extensions similar to the sockets extended macro interface.

REXX sockets
The REXX sockets programming interface implements facilities for IPv4 and IPv6 socket communication directly from REXX programs by way of an address rxsocket function. REXX socket programs can execute in TSO, online, or batch.

UNIX
A UNIX socket program can use up to eight TCP/IP protocol stacks at once. The stacks may be a combination of any TCP/IP protocol stack that is supported by z/OS UNIX System Services. The following APIs are provided by the UNIX element of z/OS and are not addressed in detail in this publication:

z/OS C sockets
z/OS UNIX C sockets is used in the z/OS UNIX environment. Programmers use this API to create IPv4 and IPv6 applications that conform to the POSIX or XPG4 standard (a UNIX specification). Applications built with z/OS UNIX C sockets can be ported to and from platforms that support these standards. For more information, see *z/OS XL C/C++ Run-Time Library Reference*.

z/OS UNIX Assembler Callable Services
z/OS UNIX Assembler Callable Services is a generalized call-based interface to z/OS UNIX IPv4 and IPv6 sockets programming. The functions implemented in this call interface resemble the z/OS UNIX C sockets implementation, with some extensions similar to the sockets extended macro interface. For more information, see *z/OS UNIX System Services Programming: Assembler Callable Services Reference*.

Introducing TCP/IP concepts: Address families
Address families define different styles of addressing. All hosts in a given address family understand and use the same scheme for addressing socket endpoints. TCP/IP supports addressing families AF_INET and AF_INET6. See "Introducing TCP/IP concepts: Socket libraries" on page 6 to determine which APIs support the

AF_INET or both the AF_INET and AF_INET6 address families. The AF_INET domain defines addressing for the IPv4 internet domain. The AF_INET6 domain defines addressing for the IPv6 internet domain.

Introducing TCP/IP concepts: Addressing sockets in an Internet domain

This topic describes how to address sockets in an Internet domain.

Internet addresses

Internet addresses are 32-bit quantities (AF_INET) or 128-bit quantities (AF_INET6) that represent a network interface. Every Internet address within an administered AF_INET domain must be unique. Every Internet address within a *scope* for AF_INET6 domain must be unique. An internet host can also have multiple Internet addresses. In fact, a host has at least as many Internet addresses as it has network interfaces. For IPv4 interfaces, there must be one unique address per interface. However, the same is not true for IPv6 interfaces. See *z/OS Communications Server: IPv6 Network and Application Design Guide* for more information.

Ports

A port is used to differentiate among different applications using the same network interface. It is an additional qualifier used by the system software to get data to the correct application. Physically, a port is a 16-bit integer. Some ports are reserved for particular applications; they are labeled as well-known ports.

In the client/server model, the server provides a resource by listening for clients on a particular port. Some applications, such as FTP, SMTP, and Telnet, are standardized protocols and listen on a well-known port. Such standardized applications use the same port number on all TCP/IP hosts. For your client/server applications, however, you need a way to assign port numbers to represent the services you intend to provide. An easy way to define services and their ports is to enter them into data set *hlq*.ETC.SERVICES. In C, the programmer uses the getservbyname() function to determine the port for a particular service. Should the port number for a particular service change, only the *hlq*.ETC.SERVICES data set needs to be modified.

Note: Note that *hlq* is the high-level qualifier. z/OS Communications Server ships with a default *hlq* of *TCPIP*. Use this default or override it using the DATASETPREFIX statement in the PROFILE.TCPIP and TCPIP.DATA configuration files. TCP/IP is shipped with data set *hlq*.ETC.SERVICES that contains the well-known services of FTP, SMTP, and Telnet. Data set *hlq*.ETC.SERVICES is described in the *z/OS Communications Server: IP Configuration Reference*.

A socket program in an IP host identifies itself to the underlying TCP/IP protocol layers by port number.

A port number is a 16-bit integer ranging from 0 to 65 535. A port number uniquely identifies this application to the protocol underlying this TCP/IP host (TCP, UDP, or IP). Other applications in the TCP/IP network can contact this application by way of reference to the port number on this specific IP host.

Figure 4 on page 10 shows the port concept.

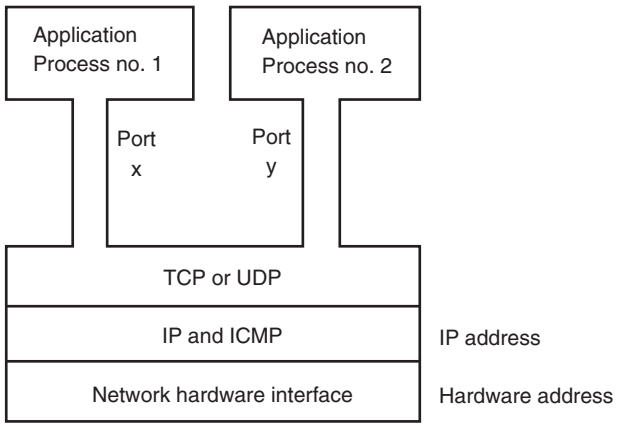


Figure 4. The port concept

Both server applications and client applications have port numbers. A server application uses a specific port number to uniquely identify this server application. The port number can be reserved to a particular server, so no other process ever uses it. In an IBM TCP/IP Services environment, you can do this using the PORT statement in the *hlq*.PROFILE.TCP/IP configuration data set. When the server application initializes, it uses the bind() socket call to identify its port number. A client application must know the port number of a server application in order to contact it.

Because advance knowledge of the client's port number is not needed, a client often leaves it to TCP/IP to assign a free port number when the client issues the connect() socket call to connect to a server. Such a port number is called an ephemeral port number; this means it is a port number with a short life. The selected port number is assigned to the client for the duration of the connection, and is then made available to other processes. It is the responsibility of the TCP/IP software to ensure that a port number is assigned to only one process at a time.

Well-known official Internet port numbers are in the range of 0 - 255. See http://www.iana.org/assignments/multicast-addresses for details. In addition, port numbers in the range of 256 - 1023 are reserved for other well-known services. Port numbers in the range of 1024 - 65 535, which are neither in-use nor reserved, are used when TCP/IP automatically assigns port numbers to client programs that do not use specific port numbers.

Figure 5 shows port number assignments.

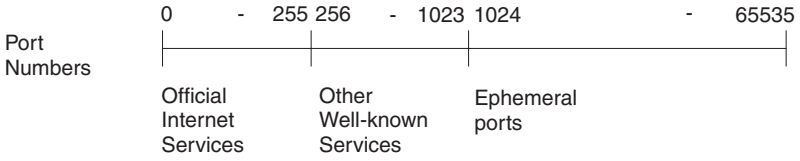


Figure 5. Port number assignments

Before you select a port number for your server application, consult the *hlq*.ETC.SERVICES data set. This data set is used to assign port numbers to server applications. The server application can use socket call getservbyname() to retrieve the port number assigned to a given server name. Add the names of your server applications to this data set and use socket call getservbyname(). With this technique, you avoid hard coding the port number into your server program. The

client program must know the port number of the server on the server host. There is no socket call to obtain that information from the server host. To compensate, synchronize the contents of data sets ETC.SERVICES on all TCP/IP hosts in your network. Client application can then use the getservbyname() socket call to query its local ETC.SERVICES data set for the port number of the server. Use this technique to develop your own local well-known services.

Network byte order

Ports and addresses are usually specified by calls using the network byte ordering convention. Network byte order is also known as big endian byte ordering, where the high order byte defines significance. Network byte ordering allows hosts using different architectures to exchange address information. See "accept()" on page 117, "bind()" on page 119, "htonl()" on page 162, "htons()" on page 163, "ntohl()" on page 175, and "ntohs()" on page 176 for more information about network byte order.

Notes:

1. The socket interface does not handle application data byte ordering differences. Application writers must handle byte order differences themselves, or use higher level interfaces such as remote procedure calls (RPC). For description of the RPC calls, see *z/OS Communications Server: IP Programmer's Guide and Reference*.
2. If you use the socket API, your application must handle the issues related to different data representations on different hardware platforms. For character based data, some hosts use ASCII, while other hosts use EBCDIC. Your application must handle translation between the two representations.

Maximum number of sockets

For most socket interfaces, the maximum number of sockets allowed per each connection between an application and the TCP/IP sockets interface is 65 535. The exceptions to this rule are the C sockets interface and the C sockets interface for CICS, where the maximum allowed for both of these interfaces is 2000.

Programmers need to be aware that for an application using a sockets interface that uses Sockets Transform (for example, the EZASMI macro API, the callable EZASOKET API, CICS Sockets, or IMS Sockets) approximately 68 bytes of storage per socket in the application's address space is allocated when the application connects to the TCP/IP sockets interface. Each time a REXX client opens a socket, approximately 208 bytes of storage is allocated. If an application using a sockets interface that uses sockets transform requests 65 535 sockets, then approximately 4.25 MB (65 535*68 bytes) of storage in the application's address space is allocated just for the socket array. If a REXX client opens 65 535 sockets, then approximately 13 MB (65 535*208 bytes) of storage is allocated for the socket chain. The monitoring and processing of this many sockets is also costly in terms of performance and CPU utilization.

The number of sockets than an application can open is also limited by the MAXFILEPROC UNIX System Services parameter in the BPXPRMxx parmlib member. This parameter determines the number of sockets each z/OS UNIX System Services process can have open. Each address space is usually a z/OS UNIX System Services process. Thus, in most cases the combined number of sockets opened by all the applications within an address space is limited to the MAXFILEPROC parameter. If MAXFILEPROC is 65 535 and two different applications within the same address space both request 65 535 sockets, then the two applications will not be able to concurrently have 65 535 sockets open. If one

of the applications has 65 000 sockets open, then the other application will not be able to have more than 535 sockets open even though it has allocated 65 535 sockets.

The number of sockets that an application can open in a particular addressing family is also limited by the MAXSOCKETS parameter in BPXPRMxx parmlib member's NETWORK statement that corresponds to the addressing family. This value determines how many sockets for a particular addressing family can be opened in the entire system. If MAXSOCKETS for the AF_INET addressing family is set to 60000 and there are already 50 000 AF_INET sockets open in the system, then a new application will not be able to open more than 10000 AF_INET sockets even if it requests a higher number when it connects to the TCP/IP sockets interface.

For details on the BPXPRMxx member, see the following publications:

- *z/OS UNIX System Services Planning*
- *z/OS MVS Initialization and Tuning Reference*
- *z/OS UNIX System Services File System Interface Reference*

AF_INET socket addresses in an Internet domain

A socket address in an Internet addressing family is comprised of four fields:

- The address family (AF_INET)
- The Internet address
- A port
- A character array

The structure of an Internet socket address is defined by the following *sockaddr_in* structure, which is found in header file IN.H:

```
struct in_addr
{
        u_long s_addr;
};
struct sockaddr_in
{
        short   sin_family;
        u_short sin_port;
        struct  in_addr sin_addr;
        char    sin_zero[8];
};
```

The *sin_family* field is set to AF_INET. The *sin_port* field is the port used by the application, in network byte order. *sin_addr* field specifies a 32-bit Internet address. The *sin_addr* field is the Internet address of the network interface used by the application; it is also in network byte order. The *sin_zero* field should be set to zeros.

AF_INET6 socket addresses in an Internet domain

See *z/OS Communications Server: IPv6 Network and Application Design Guide* for parts of the AF_INET6 family. The structure of an Internet socket address is defined by the following *sockaddr_in6* structure, which is found in header file IN.H:

```
struct in6_addr
{
   union
   {
     uint8_t_    S6_u8[16];
     uint32_t_   S6_u32[4];
   }
```

```
   _S6_un;
};

#define s6_addr_S6_un._S6_u8

#define SIN6_LEN

struct sockaddr_in6
{
        uint8_t          sin6_len;
        sa_family_t      sin6_family;
        in_port_t        sin6_port;
        uint32_t         sin6_flowinfo;
        struct in6_addr  sin6_addr;
        uint32_t         sin6_scope_id;
};
```

The *sin6_family* field is set to AF_INET6. The *sin6_port* field is a halfword binary field that is the port used by the application, in network byte order. The *sin6_addr* field specifies a 128-bit Internet address. The *sin6_addr* field is the Internet address of the network interface used by the application; it is also in network byte order. The *sin6_flowinfo* field is a fullword binary field specifying the traffic class and flow label. This field is currently not implemented. The *sin6_scope_id* field identifies a set of interfaces as appropriate for the scope of the address carried in the *sin6_addr* field.

Chapter 2. Organizing a TCP/IP application program

This information explains how to organize a TCP/IP application program. All examples are shown using an address family of AF_INET (IPv4). All concepts described below can also be applied to an address family of AF_INET6 (IPv6).

- Client and server socket programs
- Call sequence in socket programs
- Blocking, nonblocking, and asynchronous socket calls
- Testing a program using a miscellaneous server
- Testing a local machine using a loopback address
- Accessing required data sets

Client and server socket programs

The terms *client* and *server* are common within the TCP/IP community, and many definitions exist. In the TCP/IP context, these terms are defined as follows:

Server A process that waits passively for requests from clients, processes the work specified, and returns the result to the client that originated the request.

Client A process that initiates a service request.

The client and server distribution model is structured on the roles of master and slave; the client acts as the master and requests service from the server (the slave). The server responds to the request from the client. This model implies a one-to-many relationship; the server typically serves multiple clients, while each client deals with a single server.

No matter which socket programming interface you select, function is identical. The syntax might vary, but the underlying concept is the same.

While clients communicate with one server at a time, servers can serve multiple clients. When you design a server program, plan for multiple concurrent processes. Special socket calls are available for that purpose; they are called *concurrent servers*, as opposed to the more simple type of *iterative server*.

To distinguish between these generic socket program categories, the following terms are used:

- **Client program** identifies a socket program that acts as a client.
- **Iterative server program** identifies a socket program that acts as a server, and processes fully one client request before accepting another client request.
- **Concurrent server main program** identifies that part of a concurrent server that manages child processes, accepts client connections, and schedules client connections to child processes.
- **Concurrent server child program** identifies that part of a concurrent server that processes the client requests.

In a concurrent server main program, the child program might be active in many parallel child processes, each processing a client request. In an MVS environment, a process is either an MVS task, a CICS transaction, or an IMS transaction.

© Copyright IBM Corp. 1989, 2010

Client/server socket programs: Iterative server socket programs

An iterative server processes requests from clients in a serial manner; one connection is served and responded to before the server accepts a new client connection.

Figure 6 shows the iterative server main logic.

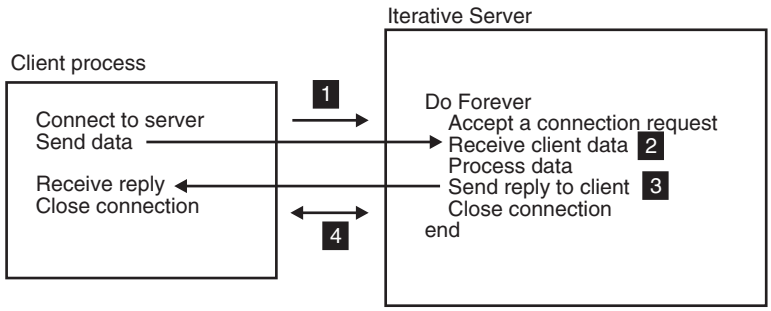


Figure 6. Iterative server main logic

The following list describes the iterative server socket process.

1. When a connection request arrives, it accepts the connection and receives the client data.
2. The iterative server processes the received data and does whatever has to be done to build a reply.
3. The server sends the data back to the client.
4. The iterative server closes the socket and waits for the next connection request from the network.

An MVS iterative server can be implemented as follows:

- As a batch job or MVS task started manually, or by automation software. The job remains active until it is closed by operator intervention.
- As a TSO transaction. For a production implementation, submit a job that executes a batch terminal monitor program (TMP).
- As a long-running CICS task. The task normally begins during CICS startup, but it can be started by an authorized CICS operator entering the appropriate CICS transaction code.
- As a batch message program (BMP) in IMS.

From a socket programming perspective, there is no difference between an iterative server that runs in a native MVS environment (batch job, started task, or TSO) and one that runs as a CICS task, or as a BMP under IMS.

You can terminate the server process in various ways. For jobs that execute in traditional MVS address spaces (batch job, started task, TSO, IMS BMP), you can implement functions in the server to enable an operator to use the MVS MODIFY command to signal stop; for example F SERVER,STOP. (This technique cannot be used for CICS tasks.) Alternatively, you can include a shutdown message in the application protocol. By doing so, you can develop a shutdown client program that connects to the server and sends a shutdown message. When the server receives a shutdown message from a socket client, it terminates itself.

Client/server socket programs: Concurrent server socket programs

A concurrent server accepts a client connection, delegates the connection to a child process of some kind, and immediately signals its availability to receive the next client connection.

The following list describes the concurrent server process.

1. When a connection request arrives in the main process of a concurrent server, it schedules a child process and forwards the connection to the child process.
2. The child process takes the connection from the main process.
3. The child process receives the client request, processes it, and returns a reply to the client.
4. The connection is closed, and the child process terminates or signals to the main process that it is available for a new connection.

You can implement a concurrent server in the following MVS environments:

- Native MVS (batch job, started task, or TSO). In this environment you implement concurrency by using traditional MVS subtasking facilities. These facilities are available from assembler language programs or from high-level languages that support multitasking or multithreading; for example, C/370™.
- CICS. The concurrent main process is started as a long-running CICS task that accepts connection requests from clients, and initiates child processes by way of the EXEC CICS START command. CICS sockets include a generic concurrent server main program called the CICS LISTENER.
- IMS. The concurrent main process is started as a BMP that accepts connection requests from clients and initiates child processes by way of the IMS message switch facilities. The child processes execute as IMS message processing programs (MPP). IMS sockets include a generic concurrent server main program called the IMS LISTENER.

In the iterative and concurrent server scenarios described above, client and server processes could have exchanged a series of request and reply sequences before closing the connection.

Client/server socket programs: Call sequence in socket programs

The following topics describe call sequence concepts for different types of socket sessions.

Call sequence in stream socket sessions

This topic describes a typical stream socket session.

Use stream sockets for both passive (server) and active (client) processes. While some calls are necessary for both types, others are role specific. See “Sample C socket programs” on page 221 for sample socket communication client and server programs. All connections exist until closed by the socket. During the connection, data is delivered, or an error code is returned by TCP/IP.

Figure 7 on page 18 shows the general sequence of calls for most socket routines using stream sockets.

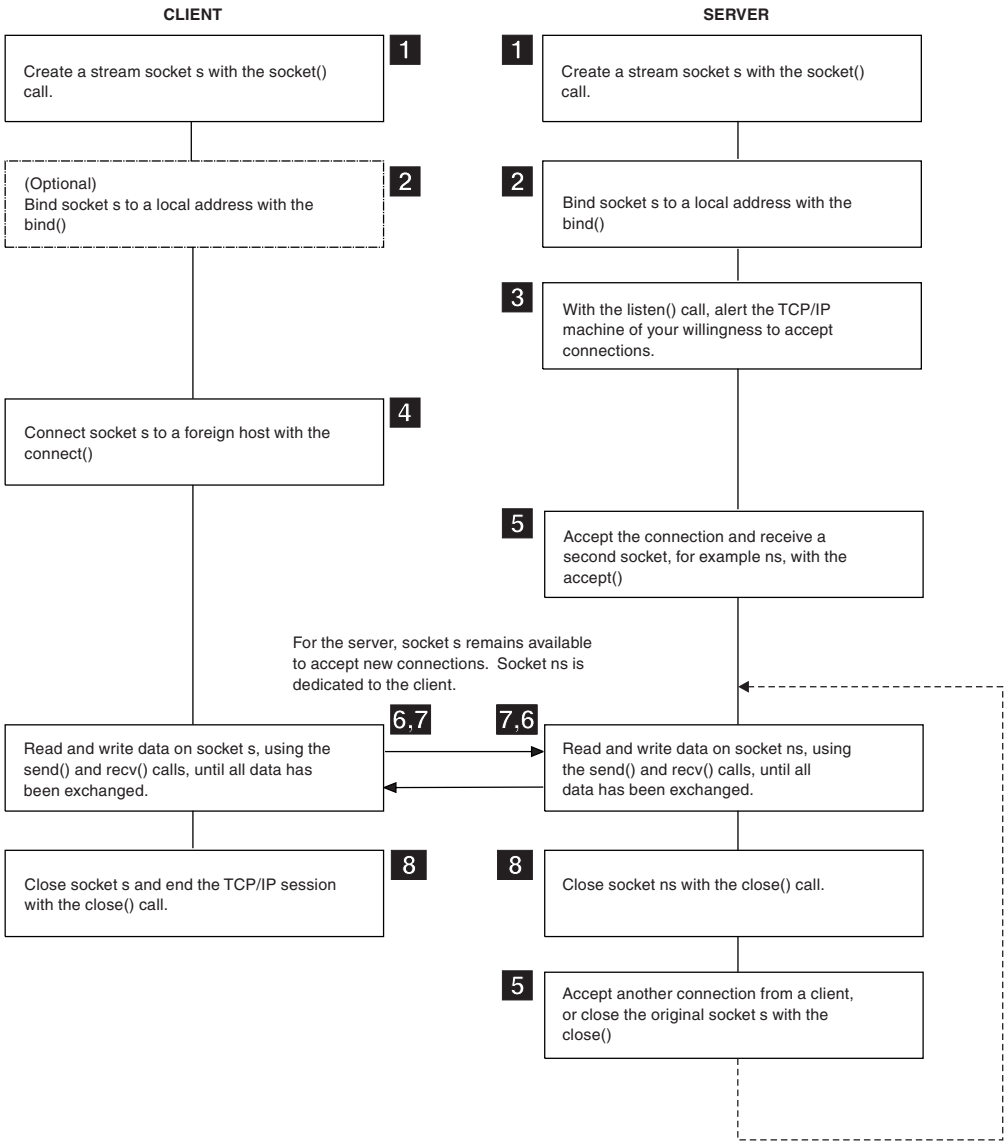


Figure 7. A typical stream socket session

Call sequence in datagram socket sessions

Datagram socket processes, unlike stream socket processes, are not clearly distinguished by server and client roles. The distinction lies in connected and unconnected sockets. An unconnected socket can be used to communicate with any host, but a connected socket can send data to and receive data from one host only.

Both connected and unconnected sockets transmit data without verification. After a packet has been accepted by the datagram interface, neither its integrity nor its delivery can be assured.

Figure 8 shows the general sequence of calls for socket routines using datagram sockets.

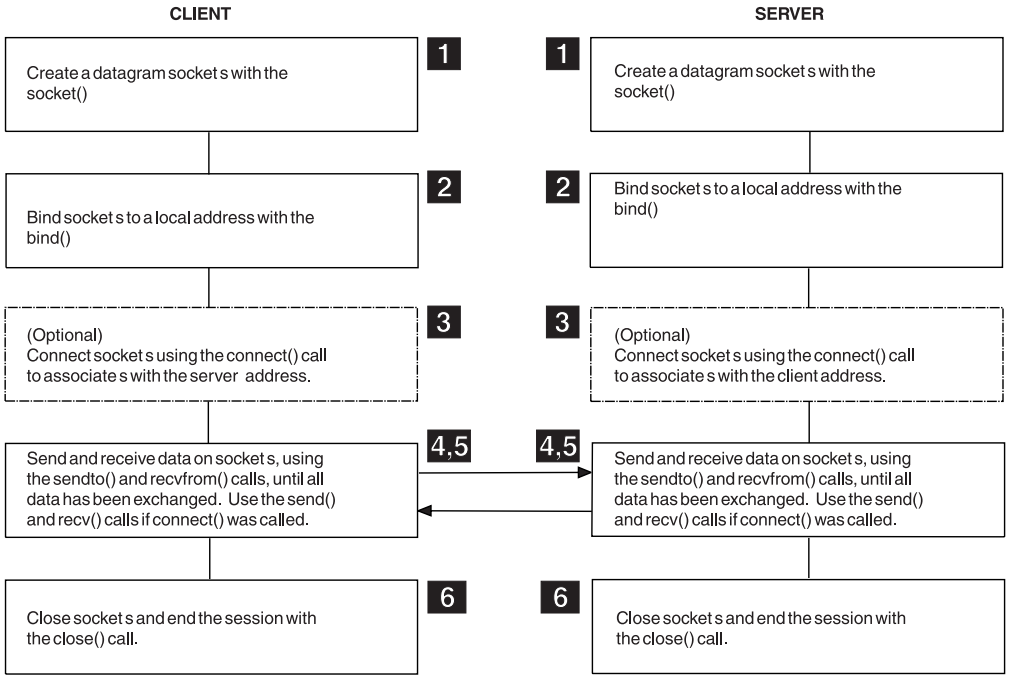


Figure 8. A typical datagram socket session

Client/server socket programs: Blocking, nonblocking, and asynchronous socket calls

A socket is in blocking mode when an I/O call waits for an event to complete. If the blocking mode is set for a socket, the calling program is suspended until the expected event completes.

If nonblocking is set by the FCNTL() or IOCTL() calls, the calling program continues even though the I/O call might not have completed. If the I/O call could not be completed, it returns with ERRNO EWOULDBLOCK. (The calling program should use SELECT() to test for completion of any socket call returning an EWOULDBLOCK.)

Note: The default mode is blocking.

If data is not available to the socket, and the socket is in blocking and synchronous modes, the READ call blocks the caller until data arrives.

All IBM TCP/IP Services socket APIs support nonblocking socket calls. Some APIs, in addition to nonblocking calls, support asynchronous socket calls.

Blocking

The default mode of socket calls is blocking. A blocking call does not return to your program until the event you requested has been completed. For example, if you issue a blocking recvfrom() call, the call does not return to your program until data is available from the other socket application. A blocking accept() call does not return to your program until a client connects to your socket program.

Nonblocking

Change a socket to nonblocking mode using the ioctl() call that specifies command FIONBIO and a full word (four byte) argument with a nonzero binary value. Any succeeding socket calls against the involved socket descriptor are nonblocking calls.

Alternatively, use the fcntl() call using the F_SETFL command and FNDELAY as an argument.

Nonblocking calls return to your program immediately to reveal whether the requested service was completed. An error number may mean that your call would have blocked had it been a blocking call.

If the call was, for example, a recv() call, your program might have implemented its own wait logic and reissued the nonblocking recv() call at a later time. By using this technique, your program might have implemented its own timeout rules and closed the socket, failing receipt of data from the partner program, within an application-determined period of time.

A new ioctl() call can be used to change the socket from nonblocking to blocking mode using command FIONBIO and a fullword argument of value 0 (F'0').

Asynchronous

Like nonblocking calls, asynchronous calls return control to your program immediately. But in this case, there is no need to reissue the call. Asynchronous calls are available with the macro API. For more information, see "Task management and asynchronous function processing" on page 267.

Table 1 lists the actions taken by the socket programming interface.

Table 1. Socket programming interface actions

Call type	Socket state	blocking	Nonblocking
Types of read() calls	Input is available	Immediate return	Immediate return
	No input is available	Wait for input	Immediate return with EWOULDBLOCK error number (select() exception: READ)
Types of write() calls	Output buffers available	Immediate return	Immediate return
	No output buffers available	Wait for output buffers	Immediate return with EWOULDBLOCK error number (select() exception: WRITE)
accept() call	New connection	Immediate return	Immediate return
	No connections queued	Wait for new connection	Immediate return with EWOULDBLOCK error number (select() exception: READ)
connect() call		Wait	Immediate return with EINPROGRESS error number (select() exception: WRITE)

Test pending activity on a number of sockets in a synchronous program by using the select() call. Pass the list of socket descriptors that you want to test for activity to the select() call; specify by socket descriptor the following type of activity you want test to find:

- Pending data to read
- Ready for new write
- Any exception condition

When you use select() call logic, you do not issue any socket call on a given socket until the select() call tells you that something has happened on that socket; for example, data has arrived and is ready to be read by a read() call. By using the select() call, you do not issue a blocking call until you know that the call cannot block.

The select() call can itself be blocking, nonblocking, or, for the macro API, asynchronous. If the call is blocking and none of the socket descriptors included in the list passed to the select() call have had any activity, the call does not return to your program until one of them has activity, or until the timer value passed on the select() call expires.

The select() call and selectex() call are available. The difference between select() and selectex() calls is that selectex() call allows you to include nonsocket related events in the list of events that can trigger the selectex() call to complete. You do so by passing one or more MVS event control blocks (ECBs) on the selectex() call. If there is activity on any of the sockets included in the select list, if the specified timer expires, or if one of the external events completes, the selectex() call returns to your program.

Typically, a server program waits for socket activity or an operator command to shut it down. By using the selectex() call, a shutdown ECB can be included in the list of events to be monitored for activity.

Client/server socket programs: Testing a program using a miscellaneous server

To test your program using either a stream or a datagram socket session, you can use the MISCSERV server. You must start MISCSERV before a client application can connect to it. If Ports 7, 9, or 19 are used by another application, or using another copy of MISCSERV, this MISCSERV command cannot operate properly. Available MISCSERV servers are:

Tool **Server description**

Echo Specify Port 7 when you want MISCSERV to return data exactly as it is received (stream and datagram sessions).

Discard
Specify Port 9 when you want MISCSERV to discard the data.

Character Generator
Specify Port 19 when you want MISCSERV to return random data regardless of the data it receives. For a stream session, data is returned continuously until you end the session; the received data stream is discarded. For a datagram session, random data is returned for each datagram received; the received datagram is discarded.

Note: The server uses MAXSOC=50. This value limits the sockets available to the server.

For more information, see RFC 862, RFC 863, RFC 864, and the *z/OS Communications Server: IP Configuration Reference*.

Client/server socket programs: Testing a local machine using a loopback address

You can use a local loopback address to test your local TCP/IP host without accessing the network. For the AF_INET family, the class A network address 127.0.0.0 is the default loopback address. For AF_INET6, the network address ::1 is the default loopback address. Depending on the address family, you can specify 127.0.0.0 (AF_INET) or ::1 (AF_INET6). Additional loopback addresses can be configured by your TCP/IP administrator.

You can use the loopback address with any TCP/IP command that accepts IP addresses, although you might find it particularly useful in conjunction with FTP and PING commands. When you issue a command with a loopback address, the command is sent from your local host client to the local TCP/IP host where it is recognized as a loopback address and is sent to your local host server.

Using a loopback address on commands allows you to test client and server functions on the same host for proper operation.

Note: Any command or data that you send using the loopback address never actually leaves your local TCP/IP host.

The information you receive reflects the state of your system and tests the client and server code for proper operation. If the client or server code is not operating properly, a command message is returned.

Client/server socket programs: Accessing required data sets

Table 2 lists the data sets and applications to which TCP/IP applications must have access to compile and link-edit.

Table 2. TCP/IP data sets and applications

Data set	Application
SEZACMAC	Client Pascal macros, C headers, and assembler macros
SEZACMTX	Sockets and Pascal API
SEZADPIL	SNMP DPI®
SEZALIBN	NCS
SEZAOLDX	X Release 10 compatibility routines
SEZANMAC	C headers and assembler macros for z/OS UNIX and TCP/IP Services APIs
SEZARNT1	Sockets, X11, and PEXlib (reentrant)
SEZARNT2	Athena widget (reentrant)
SEZARNT3	Motif widget (reentrant)
SEZARPCL	Remote procedure calls
SEZAXAWL	Athena widget set

Table 2. TCP/IP data sets and applications (continued)

Data set	Application
SEZAXMLB	OSF/Motif-based widget set
SEZAXTLB	Xt Intrinsics
SEZAX11L	Xlib, Xmu, Xext, and Xau routines

Part 2. Designing programs

Describes ways to design various types of programs including the following:

- Iterative server program
- Concurrent server program
- Client program
- Program to use datagram sockets
- Data transfer between sockets
- IPv6 programs
- Multicast programs

© Copyright IBM Corp. 1989, 2010

Chapter 3. Designing an iterative server program

This information uses an address family of AF_INET (IPv4). All of the concepts described can also be applied to an address family of AF_INET6 (IPv6).

- "Allocating sockets in an iterative server program"
- "Binding sockets in an iterative server program" on page 29
- "Listening for client connection requests in an iterative server program" on page 32
- "Accepting client connection requests in an iterative server program" on page 33
- "Transferring data between sockets in an iterative server program" on page 35
- "Closing a connection in an iterative server program" on page 35

Allocating sockets in an iterative server program

The server must allocate a socket to provide an endpoint to which clients connect. All commands that pass a socket address must be consistent with the address family specified when the socket was opened.

- If the socket was opened with an address family of AF_INET, then any command for that socket that includes a socket address must use an AF_INET socket address.
- If the socket was opened with AF_INET6, then any command for that socket that includes a socket address must use an AF_INET6 socket address.

A socket is actually an index into a table of connections to the TCP/IP address space, so socket numbers are usually assigned in ascending order. In C, the programmer issues the socket() call to allocate a new socket, as shown in the following example:

```
s = socket(AF_INET, SOCK_STREAM, 0);
```

The socket function requires specification of the address family (AF_INET), the type of socket (SOCK_STREAM), and the particular networking protocol to be used. When 0 is specified, the TCP/IP address space automatically uses the protocol appropriate to the socket type specified. A new socket is allocated and returned.

An application must first get a socket descriptor using the socket() call, as seen in the following example. For a complete description, see "socket()" on page 213.

```
int socket(int domain, int type, int protocol);
⋮
int s;
⋮
s = socket(AF_INET, SOCK_STREAM, 0);
```

The code fragment allocates socket descriptor *s* in the internet addressing family. The domain parameter is a constant that specifies the domain in which the communication is taking place. A domain is a collection of applications using a single addressing convention. The type parameter is a constant that specifies the type of socket; it can be SOCK_STREAM, SOCK_DGRAM, or SOCK_RAW. The protocol parameter is a constant that specifies the protocol to be used. This

© Copyright IBM Corp. 1989, 2010

parameter is ignored, unless type is set to SOCK_RAW. Passing 0 chooses the default protocol. If successful, the socket() call returns a positive integer socket descriptor.

The server obtains a socket by way of the socket call. You must specify the domain to which the socket belongs, and the type of socket you want.

Figure 9 lists the socket call() variables using the CALL API.

```
*-------------------------------------------------------------*
* Variables used for the SOCKET call                          *
*-------------------------------------------------------------*
 01  afinet                        pic 9(8) binary value 2.
 01  soctype-stream                pic 9(8) binary value 1.
 01  proto                         pic 9(8) binary value 0.
 01  socket-descriptor             pic 9(4) binary value 0.
*-------------------------------------------------------------*
* Get us a socket descriptor                                  *
*-------------------------------------------------------------*
   call 'EZASOKET' using soket-socket
     afinet
     soctype-stream
     proto
     errno
     retcode.
   if retcode < 0 then
     - process error -
   else
     Move retcode to socket-descriptor.
```

Figure 9. Socket call variables

The internet domain has a value of 2. A stream socket is requested by passing a type value of 1. The proto field is normally 0, which means that the socket API should choose the protocol to be used for the domain and socket type requested. In this example, the socket uses TCP protocols.

A socket descriptor representing an unnamed socket is returned from the socket() call. An unnamed socket has no port and no IP address information associated with it; only protocol information is available. The socket descriptor is a 2-byte binary field and must be passed on subsequent socket calls as such.

A socket is an inconvenient concept for a program because it consists of three different items: a protocol specification, a port number, and an IP address. To represent the socket conveniently, we use the socket descriptor.

The socket descriptor is not in itself a socket, but represents a socket and is used by the socket library routines as an index into the table of sockets owned by a given MVS TCP/IP client. On all socket calls that reference a specific socket, you must pass the socket descriptor that represents the socket with which you want to work.

Figure 10 on page 29 lists the MVS TCP/IP socket descriptors.

```
------------------------------------------------------------------------
Socket Descriptor    Socket
0                    Our listen socket
1                    Our connected socket
------------------------------------------------------------------------
```

Figure 10. MVS TCP/IP socket descriptor table

The first socket descriptor assigned to your program is 0 (for a sockets extended program). If your program is written in C, socket descriptors 0, 1, and 2 are reserved for std.in, std.out and std.err, and the first socket descriptor assigned for your AF_INET sockets is numeral 3 or higher.

When a socket is closed, the socket descriptor becomes available; it is returned as a new socket descriptor representing a new socket in response to a succeeding request for a socket.

Note: In reference documentation, the socket descriptor is normally represented by a single letter: `S`, or by two letters: `SD`.

When you possess the socket descriptor, you can request the socket address structure from the socket programming interface by way of call getsockname(). A socket does not include both port and IP addresses until after a successful bind(), connect(), or accept() call has been issued.

If your socket program is capable of handling sockets simultaneously, you must keep track of your socket descriptors. Build a socket descriptor table inside of your program to store information related to the socket and the status of the socket. This information is sometimes needed, and can help in debug situations.

Binding sockets in an iterative server program

At this point in the process, an entry in the table of communications has been reserved for your application. However, the socket has no port or IP address associated with it until you use the bind() function. The bind() function requires three parameters:

- The socket just given to the server.
- The number of the port to which the server is to provide service.
- The IP address of the network connection from which the server is to accept connection. If this address is 0, the server accepts connection requests from any address.

Binding with a known port number

In C, the server puts the port number and IP address into structure sockaddr_, *x*, passing it, and the socket, to the bind() function. For example:

```
bind(s, (struct sockaddr *)&x, sizeof(struct sockaddr));
```

After an application possesses a socket descriptor, it can explicitly bind() a unique address to that socket, as in the example listed in Figure 11 on page 30. For more information about binding, see “bind()” on page 119.

```
int bind(int s, struct sockaddr *name, int namelen);
.
.
.
int rc;
int s;
struct sockaddr_in myname;

   /* clear the structure to clear the sin_zero field */
   memset(&myname,; 0, sizeof(myname));
   myname.sin_family = AF_INET;
   myname.sin_addr = inet_addr("129.5.24.1"); /* specific interface */
   myname.sin_port = htons(1024);
:
   rc = bind(s, (struct sockaddr *) &myname, sizeof(myname));
```

Figure 11. An application using the bind() call

This example binds socket descriptor *s* to the address 129.5.24.1, and port 1024 to the internet domain. Servers must bind to an address and port to be accessible to the network. The example in Figure 11 lists two utility routines:

- Socket call inet_addr() takes an internet address in dotted decimal form and returns it in network byte order. For a description, see "inet_addr()" on page 164.
- Socket call htons() takes a port number in host byte order and returns the port number in network byte order. For a description, see "htons()" on page 163.

Binding using socket call gethostbyname

Figure 12 shows another example of socket call bind(). It uses the utility routine gethostbyname() to find the internet address of the host, rather than using socket call inet_addr with a specific address.

```
int bind(int s, struct sockaddr *name, int namelen);
.
.
.
int rc;
int s;
char *hostname = "myhost";
struct sockaddr_in myname;
struct hostent *hp;

   hp = gethostbyname(hostname);

   /* clear the structure to clear the sin_zero field */
   memset(&myname,0,sizeof(myname));
   myname.sin_family = AF_INET;
   myname.sin_addr.s_addr = *((unsigned long *)hp->h_addr);
   myname.sin_port = htons(1024);
:
rc = bind(s,(struct sockaddr *) &myname, sizeof(myname));
```

Figure 12. A bind() call using gethostbyname()

Binding a socket to a specific port number

By binding the socket to a specific port number, you avoid having an ephemeral port number assigned to the socket.

Servers find it inconvenient to have an ephemeral port number assigned, because clients have to connect to a different port number for every instance of the server. By using a predefined port number, clients can be developed to always connect to a given port number.

Client programs can use the socket call bind(), but client programs rarely benefit from using the same port number every time they execute.

Figure 13 shows a list of BIND call variables.

```
*-------------------------------------------------------------*
* Variables used for the BIND Call                           *
*-------------------------------------------------------------*
 01  server-socket-address.
     05  server-afinet              pic 9(4) binary value 2.
     05  server-port                pic 9(4) binary value 9998.
     05  server-ipaddr              pic 9(8) binary value 0.
     05  filler                     pic x(8) value low-value.
 01  socket-descriptor              pic 9(4) binary.
*-------------------------------------------------------------*
* Bind socket to our server port number                       *
*-------------------------------------------------------------*
   call 'EZASOKET' using soket-bind
      socket-descriptor
      server-socket-address
      errno
      retcode.
   if retcode < 0 then
      - process error -
```

Figure 13. Variables used for the BIND call

Before you issue this call, you must build a socket address structure for your own socket using the following information:

- The address family is two, indicating (AF_INET). See *z/OS Communications Server: IPv6 Network and Application Design Guide* for a description of binding to an AF_INET6 socket.
- Port number for your server application. For a sockets extended program, you have to create a predefined port number; this is either a constant in your program, or a variable passed to your program as an initialization parameter. If you develop your socket program in C, you can issue a getservbyname() call to locate the port number reserved for your server application in data set *hlq*.ETC.SERVICES.
- IP address on which your server application is to accept incoming requests. If your application is executing on a multihomed host, and you want to accept incoming requests over all available network interfaces, you must set this field to binary zeros.
- For TCP connections, 0 allows a server to accept incoming connections to the specified port regardless of which destination IP address for this host is used.
- For UDP, 0 allows a server to receive all datagrams destined for the specified port and any destination address for this host.
- For TCP and UDP client applications, specifying a 0 address for the BIND() indicates that TCP/IP will select the source IP address to be used.

Normally, the IP address is set to INADDR_ANY, but there are situations in which you might want to use a specific IP address. Consider the case of a TCP/IP system address space having been configured with two virtual IP addresses (VIPA). One VIPA address is returned by the named server when clients resolve one host name,

and the other VIPA address is returned by the name server when clients resolve the other host name. In fact, both host names represent the same TCP/IP system address space, but the host names can be used to represent two different major socket applications on that MVS host. If your Server A and your Server B can generate a very high amount of network traffic, your network administrator might want to implement what is known as session traffic splitting. This means that IP traffic for one server comes in on one network adapter while traffic for the other server comes in on another adapter. To facilitate such a setup, you must be able to bind the server listener socket to one of the two VIPA addresses.

At this point in the process, you have not told TCP/IP anything about the purpose of the socket you obtained. You are free to use it as a client to issue connect requests to servers in the IP network, or use it to become a server yourself. In terms of the socket, it is, at the moment, active; this is the default status for a newly created socket.

Listening for client connection requests in an iterative server program

After the bind is issued, the server has been specified a particular IP address and port. It now must notify the TCP/IP address space that it intends to listen for connections on this socket. The listen() function puts the socket into passive open mode and allocates a backlog queue for pending connections. In passive open mode, the socket is open to client contact. For example:

```
listen(s, backlog_number);
```

The server gives to the socket on which it will be listening the number of requests that can be queued (the backlog_number). If a connection request arrives before the server can process it, the request is queued until the server is ready.

When you call listen, you inform TCP/IP that you intend to be a server and accept incoming requests from the IP network. By doing so, socket status is changed from active status to passive.

A passive socket does not initiate a connection; it waits for clients to connect to it.

The listen() call variables are shown in Figure 14.

```
*-------------------------------------------------------------*
* Variables used by the Listen Call                          *
*-------------------------------------------------------------*
 01  backlog-queue                 pic 9(8) binary value 10.
 01  socket-descriptor             pic 9(4) binary.
*-------------------------------------------------------------*
* Issue passive open via Listen call                         *
*-------------------------------------------------------------*
   call 'EZASOKET' using soket-listen
   socket-descriptor
   backlog-queue
   errno
   retcode.
 if retcode < 0 then
    - process error -
```

Figure 14. Variables used by the listen call

The backlog queue value is used by the TCP/IP system address space when a connect request arrives and your server program is busy processing the previous client request. TCP/IP queues new connection requests to the number you specify

in the backlog queue parameter. If additional connection requests arrive, they are silently ignored by TCP/IP, since there is a limit to the size of the backlog queue parameter.

The system-wide limit is set in the TCP/IP system address space PROFILE.TCP/IP configuration data set by parameter SOMAXCONN. The default value of SOMAXCONN is ten, but you can configure it higher as follows:

```
;
; ************************************************************
; *  Set the listen queue to a maximum of 100                *
; ************************************************************
;
SOMAXCONN 100
```

The value you specify on the listen() call in the backlog parameter cannot exceed the value set for SOMAXCONN in TCPIP.PROFILE. If you specify a backlog parameter of 200 and SOMAXCONN is set to 20, no error is returned, but your backlog queue size will be set to 20 instead of the 200 you requested.

There is a C header file called SOCKET.H (datasetprefix.SEZACMAC member SOCKET) in which there is a variable called SOMAXCONN. The shipped value of this variable is 10, as illustrated below:

```
/*
 *Maximum queue length specifiable by listen
/*
#define SOMAXCONN        10
```

The listen () call does not establish connections; it merely changes the socket to a passive state, so it is prepared to receive connection requests coming from the IP network. If a connection request for this server arrives between the time of the listen() call and the succeeding accept() call, it is queued according to the backlog value passed on the listen() call.

Accepting client connection requests in an iterative server program

To this point in the process, the server has allocated a socket, bound the socket to an IP address and port, and issued a passive open. The next step is for the server to connect with a client. The accept() call blocks the server until a connection request arrives; if there are connection requests in the backlog queue, a connection is established with the first client in the queue. The following is an example of the accept() call:

```
client_sock = accept(s);
```

The server passes its socket to the accept call. When the connection is established, the accept call returns a new socket representing the connection with the client. When the server wishes to communicate with the client, or to end the connection, it uses this new socket, `client_sock`. The original socket *s* is now ready to accept connection to other clients. The original socket is still allocated, bound, and passively opened. To accept another connection, the server calls accept() again. By repeatedly calling accept(), the server can establish simultaneous sessions with multiple clients.

The accept() call dequeues the first queued connection request or blocks the caller until a connection request arrives over the IP network.

The accept() call uses the variables listed in Figure 15 on page 34.

```
*-------------------------------------------------------------*
* Variables used by the ACCEPT Call                          *
*-------------------------------------------------------------*
   01  client-socket-address.
       05  client-afinet             pic 9(4) binary value 0.
       05  client-port               pic 9(4) binary value 0.
       05  client-ipaddr             pic 9(8) binary value 0.
       05  filler                    pic x(8) value low-value.
   01  accepted-socket-descriptor    pic 9(4) binary value 0.
   01  socket-descriptor             pic 9(4) binary.
*-------------------------------------------------------------*
* Start iterative server loop with a blocking Accept Call    *
*-------------------------------------------------------------*
  call 'EZASOKET' using soket-accept
    socket-descriptor
    client-socket-address
    errno
    retcode.
  if retcode < 0 then
     - process error -
  else
     Move retcode to accepted-socket-descriptor.
```

Figure 15. Variables used by the ACCEPT call

This call works with the following socket descriptors:

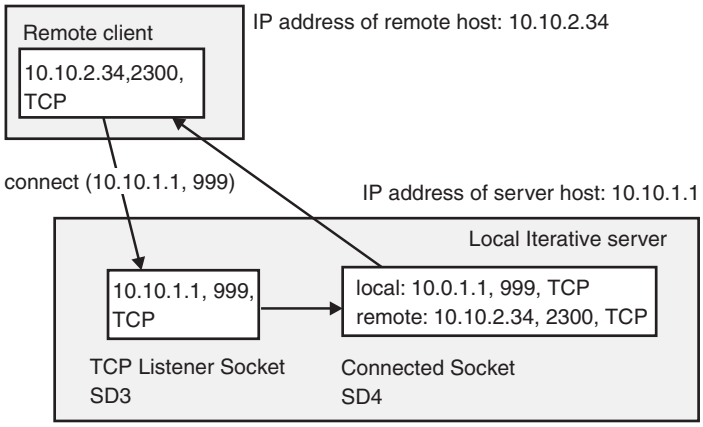
- The first socket descriptor represents the socket that was obtained, bound to the server port and (optionally) the IP address, and changed to the passive state using the listen() call.
- The accept() call returns a new socket descriptor, to represent a complete association:

  ```
  Accepted_socket_descriptor represents:
  {TCP, server IP address, server port, client IP address, client port}
  ```

The original socket, which was passed to the accept() call, is unchanged and is still representing our server half association only:

```
Original_socket_descriptor represents:
{TCP, server IP address, server port}
```

When control returns to your program, the socket address structure passed on the call has been filled with the socket address information of the connecting client. Figure 16 on page 35 illustrates the socket states.



Socket Descriptor Table for the local Iterative server

Descriptor#	Local part (IP addr, port, protocol)	Remote part (IP addr, port, protocol)
SD3	10.0.1.1, 999, TCP	
SD4	10.0.1.1, 999, TCP	10.10.2.34, 2300, TCP

Figure 16. Socket states

When a socket is created, we know the protocol we are going to use with this socket, but nothing else. When a server calls the bind() function, a local address is assigned to the socket, but the socket still only represents a half-association; the remote address is still empty. When the client connects to the listener socket and a new socket is created, this new socket represents a fully bound socket possessing both a local address (that of the listener socket) and a remote address (that of the client socket). Figure 16 illustrates a fully bound socket.

Subsequent socket calls for the exchange of data between the client and the server use the new socket descriptor. The original socket descriptor remains unused until the iterative server has finished processing the client request and closed the new socket. The iterative server then reissues the accept() call using the original socket descriptor and waits for a new connection.

Transferring data between sockets in an iterative server program

See Chapter 7, "Transferring data between sockets," on page 63.

Closing a connection in an iterative server program

Closing a socket imposes some problems because the TCP protocol layer must ensure that all data has been successfully transmitted and received before the socket resources can be safely freed at both ends.

The following topics describe various ways to close a connection.

Active and passive closing in an iterative server program

The program that initiates the closedown process by issuing the first close() call is said to initiate an active close. The program that closes in response to the initiation is said to initiate a passive close.

Figure 17 illustrates socket closing.

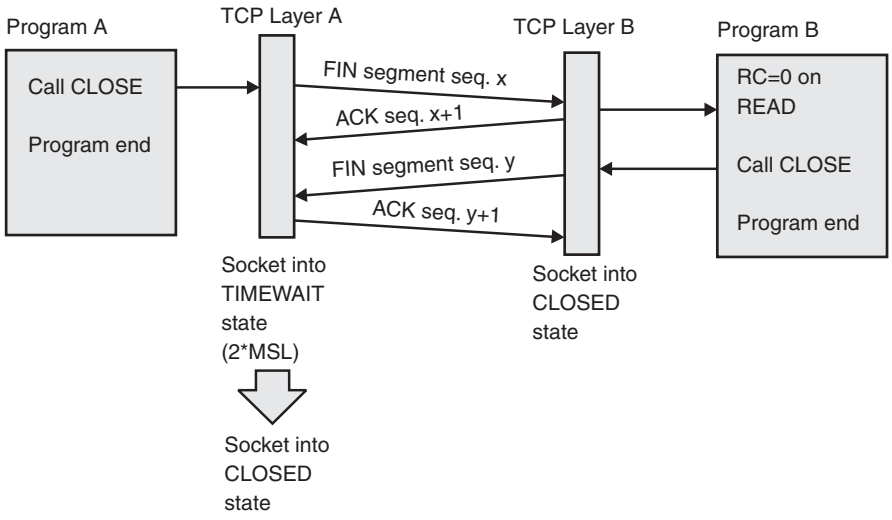


Figure 17. Closing sockets

In Figure 17, Program A initiates the active close, while Program B initiates the passive close. When a program calls the close socket function, the TCP protocol layer sends a segment known as FIN (FINish). When Program B receives the final acknowledgment segment, it knows that all data has been successfully transferred and that Program A has received and processed the FIN segment. The TCP protocol layer for Program B can then safely remove the resources that were occupied by the Program socket. The TCP protocol layer for Program A sends an acknowledgment to the FIN segment it received from Program B, but the Program A TCP protocol layer does not know whether that ACK segment arrived at the Program B TCP protocol layer. It must wait a reasonable amount of time to see whether the FIN segment from Program B is retransmitted, indicating that Program B never received the final ACK segment from Program A. In that case, Program A must be able to retransmit the final ACK segment. The Program A socket cannot be freed until this time period has elapsed. The time period is defined as twice the maximum segment life time, normally in the range of one to four minutes, depending on the TCP implementation.

If Program A is the client in a TCP connection, this TIMEWAIT state does not create any major problems. A client normally uses an ephemeral port number; if the client restarts before the TIMEWAIT period has elapsed, it is merely assigned another ephemeral port number. If Program A, on the other hand, is the server in a TCP connection, this TIMEWAIT state does create a problem. A server binds its socket to a predefined port number; if the server tries to restart and bind the same port number before the TIMEWAIT period has elapsed, it receives an EADDRINUSE error code on the bind() call. This situation could arise when a server crashes and you try to restart it before the TIMEWAIT period has elapsed. You must wait to restart your server.

If the server cannot wait for one to four minutes, you can use the setsockopt() call in the server to specify SO_REUSEADDR before it issues the bind() call. In that case, the server will be able to bind its socket to the same port number it was using before, even if the TIMEWAIT period has not elapsed. However, the TCP protocol layer still prevents it from establishing a connection to the same partner

socket address. As clients normally initiate connections and clients use ephemeral port numbers, the likelihood of this is low.

Shutdown call in an iterative server program

If you want to close the stream in one direction only, use the shutdown socket call instead of the close() call. On the shutdown() call, you can specify the direction in which the stream is to be closed.

When a shutdown() call is issued for receive and there is unread data queued to the socket, the connection is aborted. If data arrives inbound on a connection that has been shut down for receive, the connection is aborted. When the connection is aborted, all outstanding socket calls on the socket will be posted with an ECONNABORTED error. The abort discards all unsent and unreceived data on the local and remote end of the connection, and the connection is destroyed. The application should issue a close() on the socket.

See Table 3 for a list of the effect on read and write calls when the stream is shut down in one or both directions.

Table 3. Effect of shutdown socket call

	Local program		Remote program	
Socket calls in local program	**Shutdown SEND**	**Shutdown RECEIVE**	**Shutdown RECEIVE**	**Shutdown SEND**
Write calls	Error number EPIPE on first call		Error number EPIPE on second call*	
Read calls		Zero length return code		Zero length return code
* If you issue two write calls immediately, both might be successful, and an EPIPE error number might not be returned until a third write call is issued.				

Linger option in an iterative server program

By default, a close socket call returns control to your program immediately, even where there is unsent data on the socket. This data will be transmitted by the TCP protocol layer, but your program is not notified of any error. This is true of both blocking and nonblocking sockets.

You can request that no control be returned to your program before unsent data has been transmitted and acknowledged by the receiver. To do so, issue the SO_LINGER option on call setsockopt. Before you issue the actual close() call, pass the following option value fields:

ONOFF
This full word is used to enable or disable the SO_LINGER option. Any nonzero value enables the option; a 0 value disables it.

LINGER
This is the linger time, in seconds; this is the maximum delay the close call observes. If data is successfully transmitted before this time expires, control is returned to your program. If this time interval expires before data has been successfully transmitted, control is returned to your program also. You cannot distinguish between the two return events.

Note: If you set a 0 linger time, the connection cannot close in an orderly manner, but stops, resulting in a RESET segment being sent to the connection partner. Also, if the aborting socket is in nonblocking mode, the close call is treated as though no linger option had been set.

Chapter 4. Designing a concurrent server program

This information describes concurrent server programs. All examples are shown using an address family of AF_INET (IPv4). All concepts also can be applied to an address family of AF_INET6 (IPv6). These programs include the following:

- "Concurrent servers in native MVS environment"
- "MVS subtasking considerations in a concurrent server program" on page 40
- "Understanding the structure of a concurrent server program" on page 44
- "Selecting requests in a concurrent server program" on page 45
- "Client connection requests in a concurrent server program" on page 51
- "Transferring data between sockets in a concurrent server program" on page 55
- "Closing a concurrent server program" on page 55

For the MVS address space examples presented in this topic, the more traditional MVS subtasking facilities are used; the main process and the child process operate as tasks within the same address space.

You can implement your concurrent server in an IMS, a CICS, or a traditional MVS address space environment, but unlike the implementation of an iterative server, the implementation of a concurrent server is unique to its environment. In this topic, the implementation of a concurrent server in an MVS address space is used as an example.

A server handling more than one client simultaneously acts like a dispatcher. The server receives client requests and then creates and dispatches tasks to handle each client.

In the UNIX operating system, a new process is dispatched using the fork() system call after the server has established the connection; this new process automatically inherits the socket attached to the client. In MVS, an independent task is started using the supervisor call instruction ATTACH. A server can complete the call after each connection is established (similar to the UNIX operating system), or it can repeatedly request an ATTACH when it begins execution, and pass clients to tasks that already exist. In either case, the server must manually give the new socket to the subtask. Because each task has its own socket table, it is not sufficient to pass only the socket number to the subtask; for example, socket Number 4 for Task A is not the same as socket Number 4 for Task B. You must specify the task as well as the socket number.

Concurrent servers in native MVS environment

The concurrent server is complicated to implement. Logic must be split into a main program and a child program. In addition, you have to manage all processes within your application.

In the MVS environment, you implement such logic by means of the UNIX fork() call. Because this call is not available in a traditional MVS environment, you must improvise.

© Copyright IBM Corp. 1989, 2010

In the UNIX environment, the fork function is implemented using APPC/MVS to schedule and initiate a child process in an MVS address space other than the address space of the original process.

Note: For simplicity, the scope of our applications is limited to the AF_INET addressing family and stream sockets.

If you want to implement a high-performance server application that creates or accesses MVS resource of various kinds (especially MVS data sets), you will probably implement your server as a concurrent server in an MVS address space. This address space can be TSO, batch, or started task.

To implement concurrence in an MVS address space, use MVS multitasking facilities. This limits available programming interfaces to the sockets extended assembler macro programming interface or to C sockets.

For the sockets extended assembler macro interface, use standard MVS subtasking facilities: ATTACH and DETACH assembler macros.

For C sockets, use the subtasking facilities that are part of the IBM implementation of C in an MVS environment.

The following topics show sockets extended assembler macro examples to illustrate the implementation of a concurrent server in an MVS address space environment.

MVS subtasking considerations in a concurrent server program

Using multiple tasks in a single address space brings unique challenges that apply equally to assembler programming and to high-level languages that support subtasking.

For example, tasks might be concurrently dispatched on different processors, for example, running your application on an *n*-way system. Two or more tasks might execute in parallel, one perhaps passing the other.

Access to shared storage areas in a concurrent server program

If two tasks access the same storage area, you need full control over the use of the storage area unless the storage is read-only. If the storage area is used to pass parameters between the tasks, you must serialize access to the shared resource (the storage area).

In an MVS environment, you can use MVS latching services or traditional enqueue and dequeue system calls to access the shared resource. For MVS latching services, use the ISGLOBT and ISGLREL callable services. In assembler, use the ENQ and DEQ macros for enqueue and dequeue functions.

Figure 18 on page 41 illustrates access to a shared storage area.

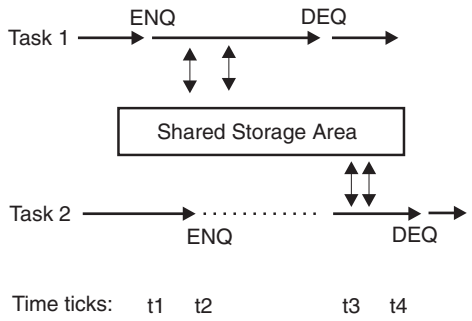


Figure 18. Serialized access to a shared storage area

The following steps describe this process.

1. At time t1, Task 1 issues a serialize request by means of an enqueue call. On the enqueue() call it passes two character fields to uniquely identify the resource in question. The literal value of these two fields does not matter; the other tasks must use these same values when they access this storage area. As no other task has issued an enqueue for the resource in question, Task 1 gets access to it and continues to modify the storage area.
2. At time t2, Task 2 needs to access the same storage area, and issues an enqueue() call using the same resource names used by Task 1. Because Task 1 has enqueued, Task 2 is placed in a wait and stays there until Task 1 releases the resource.
3. At time t3, Task 1 releases the resource with a dequeue system() call, and Task 2 is immediately taken out of its wait and begins to modify the shared storage area.
4. At time t4, Task 2 has finished updating the shared storage area and releases the resource with a dequeue system() call. (In this example, we assumed we need serialized access only when the tasks need to update information in the shared storage area.)

There are situations in which this assumption does not suffice. If you use a storage area to pass parameters to some kind of service task inside your address space, you must ensure that the service task has read the information and acted on it before another task in your address space tries to pass information to the service task using the same storage area, like running a log or trace. This is illustrated in Figure 19 on page 42.

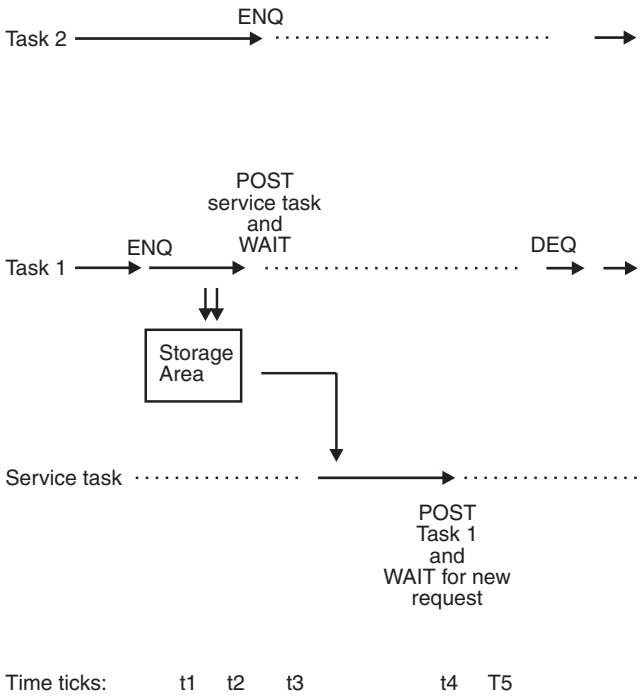


Figure 19. Synchronized use of a common service task

Follow these steps to synchronize a common service task:

1. At time t1, Task 1 gains access to the common storage area to implicitly use the service task in question.
2. At time t2, Task 2 also needs to use the service task services, but it is placed into a wait, because Task 1 already has the resource.
3. At time t3, Task 1 has finished placing values into the common storage area, and signals the service task to start processing it. This is done with a POST system call. Immediately following this call, Task 1 enters a wait, where it stays until the service task has completed its processing. The service task starts, processes the data in the common storage, and prints.
4. At time t4, the service task has finished its work and signals to Task 1 that Task 1 can continue, while the service task enters a new wait and waits for a new work request.
5. At time t5, Task 1 releases the lock it obtained at time t1, and Task 2 is immediately taken out of its wait and starts filling its values into the common storage area before posting the same service task to process a new request.

This technique is relatively simple. It can be made more complicated, and more efficient, by using internal request queues so the requesting task does not need to wait for the service task to complete the active request.

When you use the enqueue system call, you have the option to test whether a resource is available. In some situations, you might choose this to avoid the wait at a particular point in your processing, so you can divert to some other actions when the resource is not available.

Data set access in MVS

When you access MVS data sets in a multitasking environment, observe these general rules:

- A given DD-name can be used by only one open data control block (DCB) at a time. If you need to have more DCBs open for the same data set, you must use different DD names. This strategy works best for read access only.
- Only the task that opens a DCB can issue read and write requests using that DCB. You cannot let your main task open a DCB, and then have your subtasks issue read or write requests to that DCB. You can deal with this by using the technique described, but include a special services task that opens a DCB to a particular data set. Other tasks then issue requests to this service task for access to the data set. Such a service task is generally called a data services task (DST). One very common implementation of a DST is the example used above: print log and trace information to a sysout file.
- Authorization checking for access to a data set is done when the data set is opened, not for every read or write request. If you develop a multitasking server where you establish task level security environments for each transaction entering your server, you must plan to authorize access to the information in a data set owned by a DST. You can, of course, open and close the data set for each transaction, but that might degrade performance.

Task and workload management in a concurrent server program

When a program is started by MVS, it runs as the main task of the address space in which it was started. In the examples in this topic, the main task is used as the main process of our concurrent server implementation. The child processes are then started as subtasks to the main.

Generally, there are two ways to manage your processes:

- Each time a connection request arrives, a new subtask is started. The subtask makes one connection and then terminates.
- During initialization, the main task starts a number of subtasks. Each subtask initializes and enters wait-for-work status. When a connection request arrives, the main process selects the first subtask waiting for work and schedules the connection to that subtask. The subtask processes the connection and, when complete, reenters wait-for-work status.

The second process is most efficient because it limits the overhead of creating new tasks to one time during server startup. But, it is also more complicated to implement than the other process because of the following:

- You must decide on the number of server subtasks to be started during initialization. If more connection requests arrive than you have server subtasks available, you must include code to deal with that situation. (Reject the connection or dynamically change the number of subtasks in your concurrent server address space. This is called workload management.)
- The subtasks must be reusable and include logic to enter wait-for-work status; they must be able to process connection requests serially.
- The main process must be able to manage situations in which a server subtask abends or terminates.
- To achieve a graceful shutdown, you must implement a technique to terminate subtasks in an orderly manner. A simple technique is to post the subtask from

the main process with a return code. For example, use a return code of 0 for work and some other value for termination.

In the concurrent MVS server example (Figure 20 on page 45), the technique using a pool of subtasks that waited for work was presented. We did not implement a dynamic increase of subtasks, but sent a negative reply back to the requester when no server subtasks were available.

Security considerations in a concurrent server program

When you start your server address space in MVS, a security environment is established for that address space. This environment is based on the user ID of your batch job or TSO user, or based on the started task user ID associated with the started task procedure named in the RACF started task table (ICHRIN03).

Unless you specify otherwise, all tasks in your address space execute under the security environment of the address space. MVS resources access authorization is based on the MVS address space security environment.

If this setup does not meet your needs, MVS allows you to build and delete task-level security environments using the RACROUTE REQUEST=VERIFY function in MVS. The task must run in an authorized state.

Reentrant code in a concurrent server program

Reentrant code is not required but is efficient. Non-reentrant code is loaded into virtual storage as many times as subtasks requiring it are started. Reentrant code is loaded once.

High-level languages usually make reentrancy a compile option. In assembler language, it might be more complicated; however, good use of macros for program initiation and termination can simplify the process.

Understanding the structure of a concurrent server program

Figure 20 on page 45 shows the basic logic in a multitasking concurrent server.

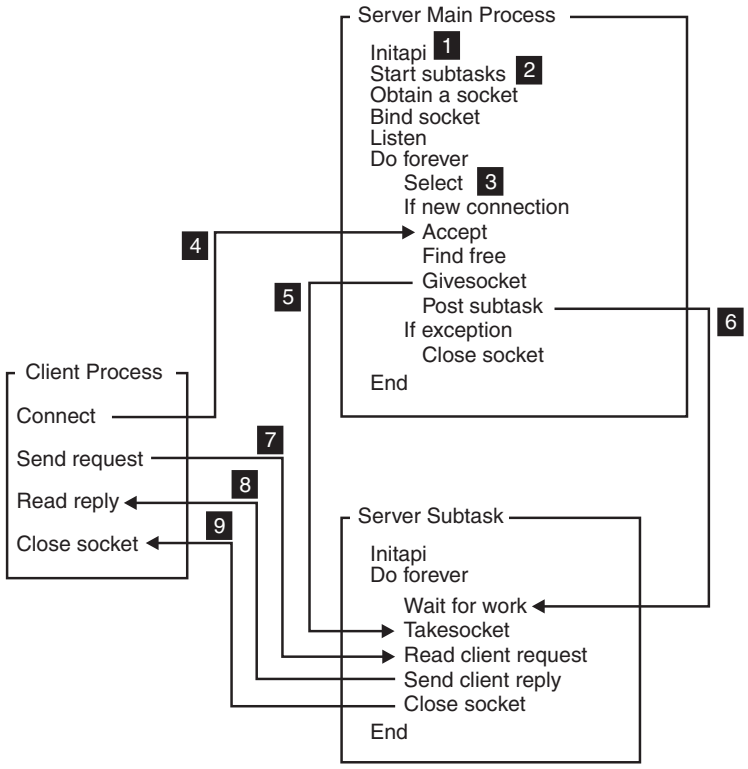


Figure 20. Concurrent server in an MVS address space

Selecting requests in a concurrent server program

At this point in the process, the server is ready to handle requests on this port from any client on a network from which the server is accepting connections. Until this point however, it had been assumed that the server was handling one socket only. Now, an application is not limited to one socket. Typically, a server listens for clients on a particular socket, but it allocates a new socket for each client it handles. For maximum performance, a server should operate only on those sockets ready for communication. The select() call allows an application to test for activity on a group of sockets.

To test any number of sockets with one call to select(), place the sockets to test into a bit set, passing the bit set to the select() call. A bit set is a string of bits where each member of the set is represented by 0 or 1. If the members bit is 0, the member is not in the set; if the members bit is 1, the member is in the set. For example, if socket 3 is a member of a bit set, then bit 3 is set; otherwise, bit 3 is cleared.

In C language, the following functions are used to manipulate the bit sets:

FD_SET
: Sets the bit corresponding to a socket.

FD_ISSET
: Tests whether the bit corresponding to a socket is set or cleared.

FD_ZERO
: Clears the entire bit set.

If a socket is active, it is ready for read or write data. If the socket is not active, an exception condition might have occurred. Therefore, the server specifies three bit sets of sockets in its call to the select() call as follows:

- One bit set for sockets on which to receive data
- One bit set for sockets on which to write data
- Any sockets with exception conditions

The select() call tests each socket in each bit set for activity and returns only those sockets that are active.

A server that processes many clients at once can be written to process only those clients that are ready for activity.

When all initialization is complete, and the server main process is ready to enter normal work, it builds a bit mask for a select() call. The select() call is used to test pending activity on a list of socket descriptors owned by this process. Before issuing the select() call, construct three bit strings representing the sockets you want to test, as follows:

- Pending read activity
- Pending write activity
- Pending exceptional activity

The length of a bit string must be expressed as a number of fullwords. If the highest socket descriptor you want to test is socket descriptor number 3, you must pass a 4-byte bit string, because this is the minimum length. If the highest number is 32, you must pass 8 bytes (2 fullwords).

The number of fullwords in each select mask can be calculated as follows:

```
INT(highest socket descriptor / 32) + 1
```

Table 4 shows the first fullword passed using a bit string.

Table 4. First fullword passed in a bit string select()

Socket descriptor numbers represented by byte	Bit 0	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7
Byte 0	31	30	29	28	27	26	25	24
Byte 1	23	22	21	20	19	18	17	16
Byte 2	15	14	13	12	11	10	9	8
Byte 3	7	6	5	4	3	2	1	0

Using standard assembler numbering notation, the leftmost bit or byte is relative to 0.

If you want to test socket descriptor number 5 for pending read activity, you raise bit 2 in byte 3 of the first fullword (X'00000020'). To test both socket descriptors 4 and 5, raise both bit 2 and bit 3 in byte 3 of the first fullword (X'00000030').To test socket descriptor Number 32, pass 2 fullwords, where the numbering scheme for the second fullword resembles that of the first. Socket descriptor Number 32 is bit 7 in byte 3 of the second fullword. To test socket descriptors Number 5 and Number 32, pass 2 fullwords with the following content: X'0000002000000001'. The

bits in the second fullword represent the socket descriptor numbers shown in Table 5.

Table 5. Second fullword passed in a bit string using select()

Socket descriptor numbers represented by byte	Bit 0	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7
Byte 4	63	62	61	60	59	58	57	56
Byte 5	55	54	53	52	51	50	49	48
Byte 6	47	46	45	44	43	42	41	40
Byte 7	39	38	37	36	35	34	33	32

Subsequent mask words continue this pattern; word 3 for sockets 64-95, word 4 for sockets 96-127, and so on.

To set and test these bits in an another way, use the following assembler macro, found in file SEZACMAC:

```
.*********************************************************************
.*                                                                   *
.* Part Name:          TPIMASK                                       *
.*                                                                   *
.* SMP/E Distribution Name:  EZABCTPI                                *
.*                                                                   *
.* Component Name:     SOK                                           *
.*                                                                   *
.* Copyright:    Licensed Materials - Property of IBM                *
.*               This product contains "Restricted Materials of IBM"*
.*               5645-001 5655-HAL (C) Copyright IBM Corp. 1996.     *
.*               All rights reserved.                                *
.*               US Government Users Restricted Rights -             *
.*               Use, duplication or disclosure restricted by        *
.*               GSA ADP Schedule Contract with IBM Corp.            *
.*               See IBM Copyright Instructions.                     *
.*                                                                   *
.* Status:             TCP/IP for MVS                                *
.*                                                                   *
.* Function:           Macro used to set or test bits in the         *
.*                     read, write and exception masks used          *
.*                     in the SELECT/SELECTEX macro or calls.        *
.*                                                                   *
.* Part Type:          MACRO - assembler                             *
.*                                                                   *
.* Usage:                                                            *
.*                     TPIMASK SET,MASK=READMASK,SD=SOCKDESC         *
.*                          or TEST, or WRITEMASK,                   *
.*                                   or EXCEPTMASK,                  *
.*                                                                   *
.*                     SET  - Set the SD bit on in MASK              *
.*                     TEST - Test SD bit in MASK for on/off         *
.*                            Follow the macro invocation with:      *
.*                            BE (Branch Equal) - Bit was on         *
.*                            BNE (Branch Not Equal) - Bit was off   *
.*                                                                   *
.* Change Activity:                                                  *
.* CFD List:                                                         *
.*                                                                   *
.* $xn= workitem  release  date  pgmr:  description                  *
.*                                                                   *
.* End CFD List:                                                     *
.*                                                                   *
.*********************************************************************
         MACRO
         TPIMASK &TYPE,        SET or TEST bit setting                X
               &MASK=,         Read, Write or Except array            X
               &SD=            Socket descriptor TOR PARAMETER
         SR    14,14           Clear Reg14
         AIF   ('&SD'(1,1) EQ '(').SDREG
         LH    15,&SD          Get Socket Descriptor
         AGO   .SDOK
.SDREG ANOP
         LR    15,&SD          Get Socket Descriptor
```

Figure 21. To set/test bits for SELECT calls (Part 1 of 2)

```
.SDOK ANOP
         D     14,=A(32)       Divide by 32, R15 = word bit is in
         SLL   15,2            Multiply word by word length: 4
         AIF   ('&MASK'(1,1) EQ '(').MASKREG
         LA    1,&MASK         Mask starts here
         AGO   .MASKOK
.MASKREG ANOP
         LR    1,&MASK         Mask starts here
.MASKOK  ANOP
         AR    15,1            Increment to word bit is in
         LA    1,1             Set rightmost bit on
         SLL   1,0(14)         Shift left remainder from division
         O     1,0(15)         Or with word from mask
         AIF   ('&TYPE' EQ 'SET').DOSET
         C     1,0(15)         If equal, bit was set on
         MEXIT
.DOSET ANOP
         ST    1,0(15)         Update new mask after SET
         MEND
```

Figure 21. To set/test bits for SELECT calls (Part 2 of 2)

If you develop your program using another programming language, you might be able to benefit from the EZACIC06 routine, which is provided as part of TCP/IP Services. This routine translates between a character string mask (1 byte per flag) and a bit string mask (1 bit per flag). If you use the select() call in COBOL, EZACIC06 can be very useful.

Build the three bit strings for the socket descriptors you want to test, and the select() call passes back three corresponding bit strings with bits raised for those of the tested socket descriptors with activity pending. Test the socket descriptors using the following sample:

```
*-------------------------------------------------------------------*
* Test for socket descriptor activity with the SELECT call          *
*-------------------------------------------------------------------*
         EZASMI TYPE=SELECT,       *Select call                       C
               MAXSOC=TPIMMAXD,    *Max. this many descr. to test     C
               TIMEOUT=SELTIMEO,   *One hour timeout value            C
               RSNDMSK=RSNDMASK,   *Read mask                         C
               RRETMSK=RRETMASK,   *Returned read mask                C
               WSNDMSK=WSNDMASK,   *Write mask                        C
               WRETMSK=WRETMASK,   *Returned write mask               C
               ESNDMSK=ESNDMASK,   *Exception mask                    C
               ERETMSK=ERETMASK,   *Returned exception mask           C
               ECB=ECBSELE,        *Post this ECB when activity occurs C
               ERRNO=ERRNO,        *- ECB points to an ECB plus 100   C
               RETCODE=RETCODE,    *- bytes of workarea for socket    C
               ERROR=EZAERROR      *- interface to use.
         ICM   R2,15,RETCODE       *If Retcode < zero it is
         BM    EZAERROR            *- an error
*
SELMASKS DS    0F
RSNDMASK DC    XL8'00000000'       *Read mask
RRETMASK DC    XL8'00000000'       *Returned read mask
WSNDMASK DC    XL8'00000000'       *Write mask
WRETMASK DC    XL8'00000000'       *Returned write mask
ESNDMASK DC    XL8'00000000'       *Exception mask
ERETMASK DC    XL8'00000000'       *Returned exception mask
*
NOSELCD  DC    A(0)                *Keep track of selected sd's
SELTIMEO DC    A(3600,0)           *One hour timeout
ECBSELE  DC    A(0)                *Select ECB
         DC    100X'00'            *Required by EZASMI
*
TPIMMAXD DC    AL4(50)             *Maximum descriptor number
```

```
*
ERRNO    DC    A(0)               *Error number from EZASMI
RETCODE  DC    A(0)               *Returncode from EZASMI
```

In the above select() call, the asynchronous facilities of the socket assembler macro interface is used. By placing an ECB parameter on the EZASMI macro call, the select() call does not block the process; we receive control immediately, even if none of the specified socket descriptors had activity. Use this technique to enter a wait, which waits for a series of events of which the completion of a select() call is just one. In the sample application, the main process was placed into a wait from which it would return when any of the following events occurred:

- Socket descriptor activity occurred, and the select() call was posted.
- One of your subtasks terminated unexpectedly.
- The MVS operator issued a MODIFY command to stop the server.

The number of socket descriptors with pending activity is returned in the RETCODE field. You must process all selected socket descriptors before you issue a new select() call. A selected socket descriptor is selected only once.

When a connection request is pending on the socket for which the main process issued the listen() call, it is reported as a pending read.

When the main process has given a socket, and the subtask has taken the socket, the main process socket descriptor is selected with an exception condition. The main process is expected to close the socket descriptor when this happens.

Applications can handle multiple sockets. In such situations, use the select() call to determine the sockets that have data to be read, those that are ready for data to be written, and the sockets that have pending exceptional conditions. An example of how the select() call is used is shown in Figure 22.

```
fd_set readsocks;
fd_set writesocks;
fd_set exceptsocks;
struct timeval timeout;
int number_of_sockets;
int number_found;
:
:
/* set bits in read write except bit masks.
* To set mask for a descriptor's use
* FD_SET(s, &readsocks)
* FD_SET(s, &writesocks)
* FD_SET(s, &exceptsocks)
*
* set number of sockets to be checked (plus 1)
* number_of_sockets = x;
*/
:
:
number_found = select(number_of_sockets,
          &readsocks, &writesocks, &exceptsocks, &timeout)
```

Figure 22. An application using the select() call

In this example, the application uses bit sets to indicate that the sockets are being tested for certain conditions, and also indicates a timeout. If the timeout parameter is NULL, the call does not wait for any socket to become ready. If the timeout parameter is nonzero, the select() call waits for the amount of time required for at least one socket to become ready under the indicated condition. This process is

useful for applications servicing multiple connections that cannot afford to block, thus waiting for data on one connection. For a description, see “select()” on page 186.

Client connection requests in a concurrent server program

As shown in Figure 20 on page 45, the listener socket is selected with a pending read. Then, a new connection request arrives, and the following socket() call must accept.

Figure 23 illustrates this type of connection request.

```
*-------------------------------------------------------------------*
* ACCEPT the connection from a client                                *
*-------------------------------------------------------------------*
    EZASMI   TYPE=ACCEPT,   *Accept new connection                C
             S=TPIMSNO,     *On listener socket descriptor        C
             NAME=SOCSTRUC, *Returned client socket structure     C
             ERRNO=ERRNO,                                         C
             RETCODE=RETCODE,C                                       C
             ERROR=EZAERROR
    ICM      R15,15,RETCODE  *OK ?
    BM       EZAERROR        *- No, error indicated
    STH      R15,NEWSOC      *Returned new socket descriptor
*
SOCSTRUC DS  0F              *ACCEPT Socket address structure
SSTRFAM  DC  AL2(2)          *TCP/IP Addressing family
SSTRPORT DC  AL2(0)          *Port number
SSTRADDR DC  AL4(0)          *IP Address
SSTRRESV DC  8X'00'          *Reserved
*
TPIMSNO  DC  AL2(0)          *Listen socket descriptor
*
NEWSOC   DC  AL2(0)          *Returned socket descriptor
*
ERRNO    DC  A(0)            *Error number from EZASMI
RETCODE  DC  A(0)            *Returncode from EZASMI
```

Figure 23. Accepting a client connection

The accept call returns a new socket descriptor representing the connection with the client. The original listen socket descriptor is available to a new select() call.

Passing sockets in a concurrent server program

This topic contains concepts and tasks information about passing sockets.

Common interface concepts

To help you better understand socket passing, the following topics explain common interface concepts.

- **Blocking versus nonblocking**

  A socket is in blocking mode when an I/O() call waits for an event to complete. If blocking mode is set for a socket, the calling program is suspended until the expected event completes.

  If nonblocking is set by calls FCNTL() or IOCTL(), the calling program continues even though the I/O() call might not have completed. If the I/O() call could not be completed, it returns with ERRNO 35 (EWOULDBLOCK). The calling program should use select() to test for completion of any socket call returning an ERRNO 35.

  The default mode is blocking.

- If data is not available for the socket, and the socket is in blocking and synchronous modes, the read() call blocks the caller until data arrives.
- **Concurrent servers versus iterative servers**

  An iterative server handles one client at a time. A concurrent server receives connection requests from multiple clients and creates subtasks to process those client requests.

  When a subtask is created, the concurrent server gets a new socket, passes the new socket to the subtask, and disassociates itself from the connection. (The CICS listener program is an example of a concurrent server.)

  – To pass a socket, the concurrent server first calls givesocket(). If the subtask address space name and subtask ID are specified in the givesocket() call, only a subtask having a matching address space and subtask ID can take the socket. If this field is set to blanks, any MVS address space requesting a socket can take this socket.
  – The concurrent server starts the subtask and passes to it the socket descriptor and concurrent server ID obtained from earlier socket() and getclientid() calls.
  – The subtask calls takesocket() using the concurrent server ID and socket descriptor.
  – The concurrent server issues the select() call to test the socket for the takesocket-completion exception condition.
  – When takesocket() has successfully completed, the concurrent server issues the close() call to free the socket.
- If the queue has no pending connection requests, accept() blocks the socket when blocking mode is set on. You can set the socket to nonblocking by calling FCNTL or IOCTL.
- Issuing a select() call before the accept() call ensures that a connection request is pending. Using the select() call in this way prevents the accept() call from blocking.
- TCP/IP does not screen clients, but you can control the connection requests accepted by closing a connection immediately after you determine the identity of the client.
- A given TCP/IP host can have multiple aliases and multiple host internet addresses.

A server handling more than one client simultaneously acts like a dispatcher at a messenger service. A messenger dispatcher gets telephone calls from people who want items delivered, and the dispatcher sends out messengers to do the work. In a similar manner, the server receives client requests, and then spawns tasks to handle each client.

Tasks can pass sockets with the givesocket() and takesocket() calls. The task passing the socket uses givesocket(), and the task receiving the socket uses takesocket(). The following topics describe these processes.

givesocket and takesocket

In the UNIX operating system, a new process is dispatched with the fork() system call after the server has established the connection; the new process automatically inherits the socket attached to the client. In MVS, an independent task is started using the attach() supervisor call instruction. A server can perform an attach() call for a subtask after each connection is established in a way similar to the UNIX operating system, or it can request an attach() several times when it begins execution and pass clients to tasks that already exist. In either case, the server must manually give the new socket to the subtask. Because each task has its own socket

table, it is not sufficient to pass only the socket number to the subtask. Socket Number 4 for Task A is not the same as socket Number 4 for Task B.

For C programs using TCP/IP Services, each task is given a unique 8-byte name. The task uses the getclientid() call to determine its unique name. The main server task passes the following arguments to the givesocket() call:
- The socket number it wants to give
- Its own name
- The name of the task to which it wants to give the socket

If the server does not know the name of the subtask to receive the socket, it blanks out the name of the subtask. The first subtask calling takesocket() using the server unique name receives the socket. However, the subtask must know the main task unique name, and the number of the socket it is to receive. This information can be passed in a common work area that you define.

When takesocket() acquires the socket, it assigns a new socket number for the subtask to use, but the new socket number represents the same line of communication as the parent socket. The transferred socket can be referred to as socket Number 4 by the parent task, and as socket Number 3 by the subtask. However, both sockets represent the same connection to the TCPIP address space.

After the socket has successfully been transferred, the TCPIP address space posts an exception condition on the parent socket. The parent uses the select() call to test for this condition. After the notification, the parent task must issue close() call on its socket to deallocate the socket.

Appendix A, "Multitasking C socket sample program," on page 869 contains examples of a server, a subtask, and a client. Three examples are written in C, and one example is written in System/370 assembler language.

The C sample programs are included as members of the file SEZAINST partitioned data set. The member names are:
- MTCSRVR
- MTCCSUB
- MTCCLNT

For information about the JCL needed to use the multitasking facility (MTF), see *IBM C/370 User's Guide*.

Giving a socket to a subtask

The socket represented by the new socket descriptor has to be passed to an available subtask. Which technique the main process uses to find an available subtask is not important. Assume that the main process has located an available subtask to which it gives the socket by way of a givesocket() call as shown in Figure 24 on page 54:

```
*--------------------------------------------------------------------*
*Give socket to subtask                                              *
*--------------------------------------------------------------------*
      MVC   CLNNAME,TPIMCNAM    *Our Client ID Address Space Name
      MVC   CLNTASK,TPISTCBE    *Give to this subtask
      EZASMI TYPE=GIVESOCKET,   *Givesocket                        C
            S=NEWSOC,           *Give this socket descriptor       C
            CLIENT=CLNSTRUC,    *- to a specific child process     C
            ERRNO=ERRNO,                                           C
            RETCODE=RETCODE,                                       C
            ERROR=EZAERROR
            ICM   R15,15,RETCODE *OK ?
            BM    EZAERROR       *- No, tell about it.
*
*      CLNSTRUC DS    0F         *GIVESOCKET: Client structure
CLNFAM   DC    A(2)              *TCP/IP Addressing family
CLNNAME  DC    CL8' '            *Address space name of target
CLNTASK  DC    CL8' '            *Task ID of child process subtask
CLNRESV  DC    XL20'00'          *Reserved
*
NEWSOC   DC    AL2(0)            *Socket descriptor from Accept
*
ERRNO    DC    A(0)              *Error number from EZASMI
RETCODE  DC    A(0)              *Returncode from EZASMI
```

Figure 24. Giving a socket to a subtask

If you are programming in C, you might not be able to determine the full client ID of the subtask. In that case, you can pass the task ID field as eight blanks on the givesocket() call, which means that any task within your own address space can take the socket, but only the task to which you pass the socket descriptor number will actually take it.

After you have issued the givesocket() call, you must include the given socket descriptor in the exception select mask on the next select() call.

Your main process is now ready to wake up the selected subtask by way of a post system call.

If no other sockets were selected on the previous select() call, your main process can build a new set of select masks, and issue a new select() call.

Taking sockets from the main process

As shown in Figure 20 on page 45, the subtask is reactivated by the post() call issued from the main process, and immediately issues a takesocket() call to receive the socket passed from the main process. Figure 25 on page 55 illustrates this process.

```
*--------------------------------------------------------------------*
* Take socket from main process                                      *
*--------------------------------------------------------------------*
   EZASMI TYPE=TAKESOCKET,    *Takesocket                              C
          CLIENT=TPIMCLNI,    *Main task client id structure           C
          SOCRECV=TPISSOD,    *Main task socket descriptor             C
          ERRNO=ERRNO,                                                 C
          RET CODE=RETCODE,                                            C
          ERROR=EZAERROR
   ICM    R15,15,RETCODE      *Did we do well ?
   BM     EZAERROR            *- No, deal with it.
   STH    R15,TPISNSOD        *Server subtask socket descr.no
*
TPIMCLNI DS    0C              *Main task client id
TPIMCDOM DC    A(0)            *Domain: AF-INET
TPIMCNAM DC    CL8' '          *Our address space name
TPIMCTSK DC    CL8' '          *Main task TCB address in EBCDIC
         DC    20X'00'         *Reserved (part of clientid)
*
TPISSOD  DC    AL2(0)          *Parent socket descr. no.
TPISNSOD DC    AL2(0)          *Subtask socket descr. no.
```

Figure 25. Taking sockets from the main process

In order to take a socket, the subtask must know the client ID of the task that gave the socket, and the socket descriptor used by that task. These values must be passed to the subtask from the main process before a takesocket() call can be issued.

On the takesocket() call, you specify the full client ID of the process that gave the socket, and you specify the socket descriptor number used by the process that gave the socket.

A new socket descriptor number to be used by the subtask is returned in the RETCODE when the takesocket() call is successful. As soon as your subtask has taken the socket, the main process is posted in its pending select with a pending exception activity; this means that the main process must close its socket descriptor.

In Figure 25, the client sends its request to the subtask, which processes it and sends back a reply.

Finally, the client process and the server subtask close their sockets, and the server subtask reenters wait-for-work status.

Transferring data between sockets in a concurrent server program

See Chapter 7, “Transferring data between sockets,” on page 63.

Closing a concurrent server program

See Chapter 3, “Designing an iterative server program,” on page 27.

Chapter 5. Designing a client program

This information explains how to design a client program. All examples are shown using an address family of AF_INET (IPv4). All concepts also can be applied to an address family of AF_INET6 (IPv6).

- "Allocating a socket in a client program"
- "Connecting to a server in a client program"
- "Transferring data between sockets in a client program" on page 59
- "Closing a client program" on page 59

Allocating a socket in a client program

From their own perspective, clients must first issue the socket() call to allocate a socket from which to communicate as follows:

```
s = socket(AF_INET, SOCK_STREAM, 0);
```

For more information, see "Allocating sockets in an iterative server program" on page 27.

Connecting to a server in a client program

To connect to a server, the client must know the server name. This topic describes how to determine a server name and connect to that server.

Note: Examples are written in C language and REXX.

To connect to the server, the client places the port number and the IP address of the server into a sockaddr_in structure like the bind() call. If the client does not know the server IP address, but it does know the server host name, the gethostbyname() call is called to translate the host name into its IP address. Any trailing blanks will be removed from the specified name prior to trying to resolve it to an IP address.

The client then calls connect() as shown in the following C language example of the connect() call:

```
connect(s, name, namelen);
```

When the connection is established, the client uses its socket to communicate with the server.

If you need to determine a server name while writing in REXX and you know only the host name, you must resolve the host name into one or more IP addresses using the gethostbyname() call as shown in Figure 26 on page 58:

© Copyright IBM Corp. 1989, 2010

```
 /*-------------------------------------------------------------------*/
 /* Find IP addresses of server host                                  */
 /*-------------------------------------------------------------------*/
 servipaddr = DoSocket('Gethostbyname', tpiserver)
 if sockrc <> 0 then do
    say 'Gethostbyname failed, rc='sockrc
    say sockval
    x=Doclean
    exit(sockrc)
end
```

Figure 26. Finding the IP address of a server host using gethostbyname()

The REXX gethostbyname() call returns a list of IP addresses if the host is multiply defined as a home host. You can parse the REXX string and place the IP addresses into a REXX stem variable using the following piece of REXX code:

```
 /*-------------------------------------------------------------------*/
 /* Parse returned IP address list                                    */
 /*-------------------------------------------------------------------*/
 numips = words(servipaddr)
 do i = 1 to numips
   sipaddr.i = word(servipaddr, i)
 end
 sipaddr.0 = numips
```

When you issue a connect call to an IP address currently not available, your connect call eventually times out with an error number of 60 (ETIMEDOUT). The socket you used on such a failed connect call cannot be reused for another connect() call. You have to close the existing socket and get a new socket before you reissue the connect call using the next IP address in the list of IP addresses returned by the gethostbyname() call.

The connect call can be placed in a loop that terminates when a connect is successful, or the list of IP addresses is exhausted. The following sample illustrates this process.

```
 /*-------------------------------------------------------------------*/
 /*                                                                   */
 /* Get a socket and try to connect to the server                     */
 /*                                                                   */
 /* If connect fails (ETIMEDOUT), we must close the socket,           */
 /* get a new one and try to connect to the next IP address           */
 /* in the list, we received on the gethostbyname call.               */
 /*                                                                   */
 /*-------------------------------------------------------------------*/
i=1
connected = 0
do until (i > sipaddr.0 | connected)
   sockdescr = DoSocket('Socket')
   if sockrc <> 0 then do
      say 'Socket failed, rc='sockrc
      exit(sockrc)
   end
   name = 'AF_INET '||tpiport||' '||sipaddr.i
   sockval = DoSocket('Connect', sockdescr, name)
   if sockrc = 0 then do
      connected = 1
   end
   else do
      sockval = DoSocket('Close', sockdescr)
      if sockrc <> 0 then do
         say 'Close failed, rc='sockrc
         exit(sockrc)
      end
   end
```

```
   i = i + 1
end
if connected then do
   say 'Connect failed, rc='sockrc
   exit(sockrc)
end
```

Transferring data between sockets in a client program

See Chapter 7, “Transferring data between sockets,” on page 63.

Closing a client program

See Chapter 3, “Designing an iterative server program,” on page 27.

Chapter 6. Designing a program to use datagram sockets

This information explains how to design a program to use datagram sockets. All examples are shown using an address family of AF_INET (IPv4). All concepts also can be applied to an address family of AF_INET6 (IPv6). Topics include:

- "Datagram socket characteristics"
- "Understanding datagram socket program structure"
- "Allocating a datagram socket" on page 62
- "Binding datagram sockets to port numbers" on page 62
- "Streamline data transfer using connect call" on page 62
- "Transferring data between datagram sockets" on page 62

Datagram socket characteristics

The most significant characteristics of datagram sockets follow:

- Datagram sockets are connectionless.

  There is no connection setup affected by the UDP protocol layer. No data is exchanged between sending and receiving UDP protocol layers until your application issues its first send call.

  If your UDP server program has not been started or it resides on a host that cannot be reached from your client host, your client UDP application can wait forever to receive a reply to the datagram it sent to a UDP server. You have to implement timeout logic in your client UDP program to recognize this situation.
- The UDP protocol layer does not implement reliability functions.

  The implicit significance of this fact is that a datagram sent from one UDP program to another might never arrive. Neither the sending program nor the target program ever learns from the UDP protocol layer that such a condition exists.

  If your UDP application must be reliable, you must add reliability code to your UDP client and server programs. Such code must include the ability to detect missing datagrams, datagrams arriving out of sequence, duplicate datagrams, and corrupt datagrams.

  You can use TCP protocols instead of UDP protocols if your application must be reliable.
- Unlike a TCP socket, where there is no one-to-one relationship between send() and recv() calls, UDP socket send corresponds exactly to a UDP socket recv() call.

Understanding datagram socket program structure

The datagram socket program terms client and server can be misleading. Two socket programs that have each bound a socket to a local address can send any number of datagrams to each other in any sequence. The program that sends the first data will act as a client. Any datagram sent to a destination address for which no program has bound a socket is lost. Care must be taken so that the program you intend to be the client does not begin sending datagrams until the server program has bound its socket to the destination address expected.

© Copyright IBM Corp. 1989, 2010

Typically, the structure for a datagram socket resembles the iterative server discussed in Chapter 3, “Designing an iterative server program,” on page 27.

Allocating a datagram socket

See “Allocating sockets in an iterative server program” on page 27.

Binding datagram sockets to port numbers

The server program must bind its socket to a predefined server port number, so the clients know the port to which they should send their datagrams. In the socket address structure that the server passes on the bind() call, it can specify if it will accept datagrams from the available network interfaces, or whether only from a specific network interface. This is done by setting the IP address field of the socket address structure to either INADDR_ANY, or a specific IP address.

The client program needs to bind its socket to a local address if it wants the server program to be able to return a datagram to it. In contrast to the server, the client does not need to specify a specific port number on the bind() call; an ephemeral port number chosen by the UDP protocol layer is sufficient. This is called a dynamic bind.

Streamline data transfer using connect call

While you can use the connect() call on a datagram socket, it does not act for a datagram socket as it acts for a stream socket.

On a connect() call, you specify the remote socket address with which you want to exchange datagrams. This serves the following purposes:

- On succeeding calls to send datagrams, you can use the send() call without specifying a destination socket address; the datagram is sent to the socket address you specified on the connnect() call.
- On succeeding calls to receive datagrams, only datagrams that originate from the socket address specified on the connect() call are passed to your program from the UDP protocol layer.

Note: A connect() call for a datagram socket does not establish a connection. No data is exchanged over the IP network as the result of the connect() call. The functions performed are local, and control is returned immediately to your application.

Transferring data between datagram sockets

See Chapter 7, “Transferring data between sockets,” on page 63.

Chapter 7. Transferring data between sockets

This topic contains information about transferring data between sockets. All examples are shown using an address family of AF_INET (IPv4). All concepts also can be applied to an address family of AF_INET6 (IPv6). The following topics are included:

- "Transferring data between sockets: Streams and messages"
- Data representation

  AF_INET6 (IPv6) sockets can communicate with AF_INET (IPv4) sockets using mapped addresses. See *z/OS Communications Server: IPv6 Network and Application Design Guide* for details.
- Using send() and recv() calls
- Using sendto() and recvfrom() calls

Transferring data over a datagram socket is similar to working with MVS records. You send and receive data records. One send() call results in exactly one recv() call.

If your sending program sends a datagram of 8192 bytes, and your receiving program issues a recv() call in which it specifies a buffer size of, for example, 4096 bytes, it will receive the 4096 bytes it requested. The remaining 4096 bytes in the datagram are discarded by the UDP protocol layer without further notification to either sender or receiver.

z/OS Communications Server includes a performance enhancement that when both the source and destination of a packet are known to and managed by a single TCP/IP stack, the IP layer can be bypassed. This provides an overall pathlength savings when processing such packets, and the decrease in pathlength through the stack results in an overall throughput improvement for applications that reside on the same MVS systems and communicate with each other through the same TCP/IP stack. Socket application programmers can take advantage of this performance enhancement by using a non-loopback home address when sending data between applications that reside on the same MVS system and communicate with each other through the same TCP/IP stack. See *z/OS Communications Server: New Function Summary* for additional information.

Transferring data between sockets: Streams and messages

This topic describes how to design an application protocol so that the partner program can divide the receive stream into individual messages.

Some socket applications are simple, and the receiver can continue to receive data until the sender closes the socket, for example, a simple file transfer application. Most applications are not that simple and usually require that the stream can be divided into a number of distinct messages.

A message exchanged between two socket programs must imbed information so that the receiver can decide how many bytes to expect from the sender and (optionally) what to do with the received message.

A few common techniques are used to imbed information about the length of a message into the stream, as follows:

© Copyright IBM Corp. 1989, 2010

- The message type identifier technique

  If your messages are fixed length, you can implement a message ID per message type worked with. Each message type has a predefined length that is known by your client and server programs. If you place the message ID at the start of each message, the receiving program can determine how long the message is if it knows the content of the first few bytes in the message. This is illustrated in Figure 27:

```
*-------------------------------------------------------------*
* Layout of a message between TPI client and TPI server       *
*-------------------------------------------------------------*
 01  tpi-message.
     05  tpi-message-id            pic x.
     88  tpi-request-add       value '1'.
     88  tpi-request-update    value '2'.
     88  tpi-request-update    value '2'.
     88  tpi-request-query     value '3'.
     88  tpi-request-query     value '3'.
     88  tpi-request-delete    value '4'.
     88  tpi-query-reply       value 'A'.
     88  tpi-response          value 'B'.
     05  tpi-constant          pic x(4).
     88  tpi-identifier        value 'TPI '.
```

Figure 27. Layout of a message between a TPI client and a TPI server

  Each message ID is associated with a fixed length known to your application.

- The record descriptor word (RDW) technique

  If your messages are variable length, you can implement a length field in the beginning of each message. Normally, you would implement the length in a halfword binary length with the value encoded in network byte order, but you can implement it as a text field, as shown in Figure 28.

```
*-------------------------------------------------------------*
* Transaction Request Message segment                         *
*-------------------------------------------------------------*
01  TRM-message.
    05  TRM-message-length   pic 9(4) Binary Value 20.
    05  filler                     pic x(2) Value low-value.
    05  TRM-identifier             pic x(8) Value '*TRNREQ*'.
    05  TRM-trancode               pic x(8) Value '?????'.
```

Figure 28. Transaction request message segment

- The end-of-message marker technique

  A third technique most often seen in C programs is to send a null-terminated string. A null-terminated string is a string of bytes terminated by a byte of binary 0. The receiving program reads whatever data is on the stream and then loops through the received buffer separating each record at the point where a null-byte is found. When the received records have been processed, the program issues a new read for the next block of data on the stream.

  If your messages contain only character data, you can designate any non-display byte value as your end-of-message marker. Although this technique is most often seen in C programs, it can be used with any programming language.

- The TCP/IP buffer flushing technique

  This technique is based on the observed behavior of the TCP protocol, where a send() call followed by a recv() call forces the sending TCP protocol layer to flush its buffers and forward whatever data might exist on the stream to the receiving TCP protocol layer. You can use this method to implement a

half-duplex, flip-flop application protocol, where your two partner programs acknowledge the receipt of each message with, for example, a 1-byte application acknowledgment message.

Figure 29 shows the TCP buffer flush technique.

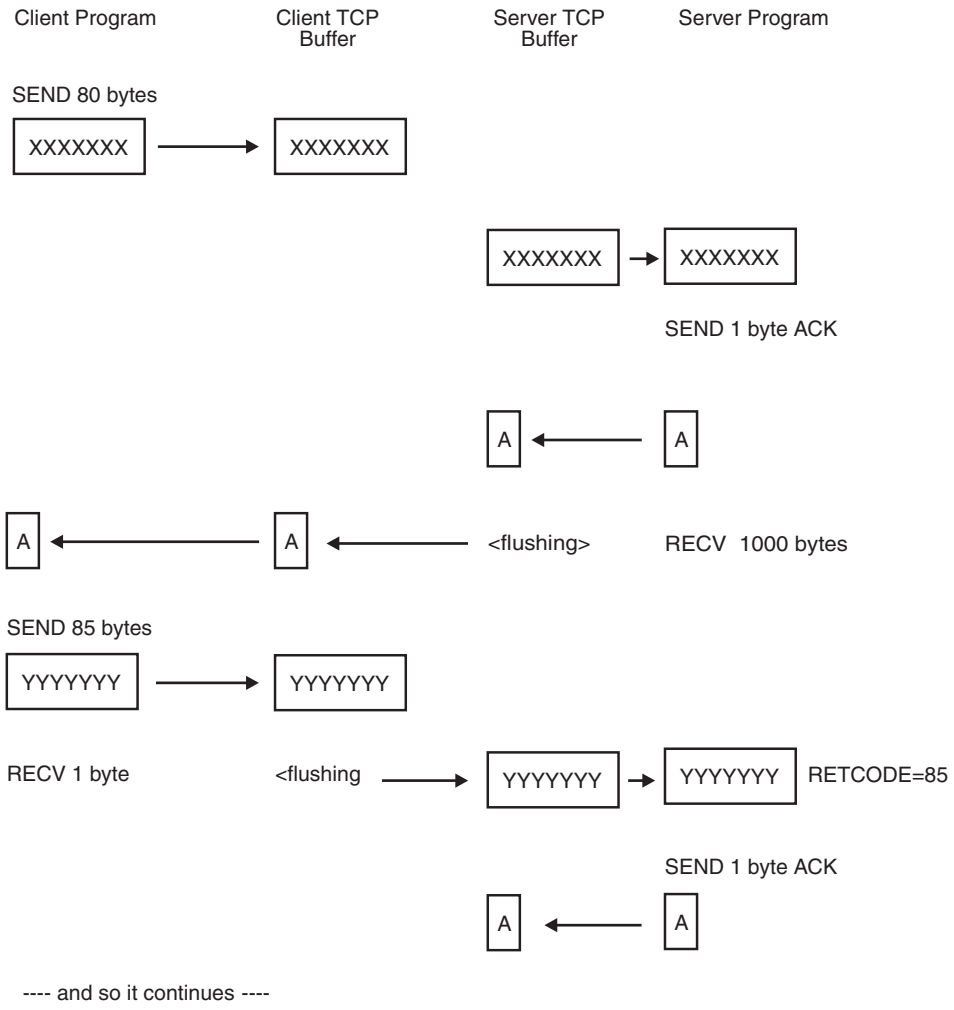


Figure 29. The TCP buffer flush technique

In Figure 29, the client sends an 80-byte message. The server has issued a recv() call for 1000 bytes, but receives only the 80 bytes (RETCODE=80). This presents a problem because there is no guarantee the server will receive the full 80-byte message on its receive call. It might only receive 30 bytes, but with this technique it has no way of knowing that it is missing another 50 bytes. The smaller the messages are, the less likely the server will receive only a part of the full message.

Note: This technique is widely used, but you should use it only in controlled environments, or in programs where you use non-blocking socket calls to implement your own timeout logic.

The message type identifier and the record descriptor word techniques require that the receiving program be able to learn the content of the first bytes in the message before it reads the entire message.

If this is a problem for your application, use the peek flag on a recv socket() call.

A recv() call with the peek flag on does not remove the data from the TCP buffers, but copies the number of bytes you requested into the application buffer you specified on the recv() call.

For example, if your message length field or message ID field is located within the first 5 bytes of each message, issue the following recv() call:

```
*-------------------------------------------------------------*
* Peek buffer and length fields for RECV call                *
*-------------------------------------------------------------*
01  soket-recv                    pic x(16) value 'RECV'.
01  recv-flag-peek                pic 9(8) binary value 2.
01  recv-peek-len                 pic 9(8) binary value 5.
01  recv-peek-buffer.
    05  message-id                pic x value space.
        88  tpi-query-reply       value 'A'.
        88  tpi-response          value 'B'.
    05  message-constant          pic x(4).
        88  tpi-identifier        value 'TPI'.
01  socket-descriptor             pic 9(4) binary value  0.
01  errno                         pic 9(8) binary value  0.
01  retcode                       pic s9(8) binary value 0.
*-------------------------------------------------------------*
* Peek at first 5 bytes of client data                       *
*-------------------------------------------------------------*
   call 'EZASOKET' using soket-recv
       socket-descriptor
       recv-flag-peek
       recv-peek-len
       recv-peek-buffer
       errno
       retcode.
   if retcode < 0 then
      - process error -
   if retcode = 0 then
      - process client closed socket -
   if not TPI-identifier then
      - translate recv-peek-buffer from ASCII to EBCDIC -
```

The recv() call blocks until some bytes have been received or the sender closes its socket. The above example is not complete since you cannot be sure that you actually received the 5 bytes requested. Your call might come back to you with only 1 byte received. In order to manage the situation, you need to repeat your recv() call until all 5 bytes have been received and recognized as such.

If the other half of the connection closes the socket, the recv() call returns 0 in the *retcode* field.

The data is copied into your application program buffer only, but it is still available to a recv() call, in which you can specify the full length of the message you now know to be available.

Transferring data between sockets: Data representation

If you use the socket API, your application must handle the issues related to different data representations occurring on different hardware platforms. For character-based data, some hosts use ASCII, while other hosts use EBCDIC. Translation between the two representations must be handled by your application.

For integers, some hardware platforms use big endian byte order (S/370/390, Motorola style), while others use little endian byte order (Intel® style). An example of the difference between big and little endian byte orders is shown in Figure 30 on page 67

page 67.

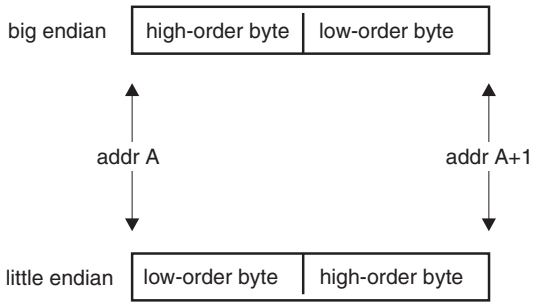


Figure 30. Big or little endian byte order for a 2-byte integer

IBM S/370 and IBM S/390-based computers all use big endian byte order, while the IBM PS/2 uses the little endian byte order. TCP/IP has defined a network byte order standard to be used for all 16-bit and 32-bit integers that appear in protocol headers. This network byte order is based on the big endian byte order. This is the reason you find the following in the C-socket interface:

htons Translates a short integer (two bytes) from host byte order to network byte order

ntohs Translates a short integer from network byte order to host byte order

htonl Translates a long integer (four bytes) from host byte order to network byte order

ntohl Translates a long integer from network byte order to host byte order

The socket-based application should manage the application data portion of a message. If you develop a server that serves clients on different hardware platforms, define your own standard and implement it as part of your application protocol.

In some cases, it is easier to base your messages on text data. If you, as part of your message design, define a fixed text string in the beginning of each message, your application can test the contents of this string and decide whether the data is in EBCDIC or ASCII. If the data is in ASCII, you can translate the full message from ASCII to EBCDIC on input, and translate from EBCDIC to ASCII on output from MVS. An example of this design is the transaction request message (TRM) format used by the IMS Listener program. Bytes 4 to 11 have a fixed value of *TRNREQ*, which is used both to distinguish this message from other messages and to find out whether the client is transmitting data in ASCII or EBCDIC.

If you mix text data and binary data in your messages, be sure to only apply translation between ASCII and EBCDIC to the text fields in your message.

If you use binary integer fields in your messages, you can use the network byte order standard that TCP/IP uses for all integers in protocol headers. If you design your messages according to the network byte order standard, your MVS programs do not need to translate or rearrange the bytes in binary integer fields. Your programs executing on little endian hosts must use the integer conversion routines to convert integers between local format and the format used in the messages they exchange with your MVS programs.

Text data and 2- and 4-byte binary integers are easy to handle in a heterogeneous computer environment. In more complex data types like floating point numbers or packed decimal, it becomes much more complicated because there is no generally accepted standard and there is no easy support for transformation between the formats. If you include these data types in your messages, be sure that the partner program knows how to interpret them. If the two computer systems use the same architecture, this is valid. If you exchange messages by way of socket programs between two MVS systems, you do not need to be concerned about conversion.

Using send() and recv() calls

This topic provides information about sending and receiving calls.

The send() and recv() call conversation

Client and server communicate using send() and recv() as shown below:

```
num = send(s, addr_of_data, len_of_data, 0);
num = recv(s, addr_of_buffer, len_of_buffer, 0);
```

The send() and recv() calls specify:

- The socket *s* on which to communicate
- The address in storage of the buffer that contains, or will contain, the data (addr_of_data, addr_of_buffer)
- The size of this buffer (len_of_data, len_of_buffer)
- A flag that tells how the data is to be sent

Flag 0 tells TCP/IP to transfer the data normally. The server uses the socket that is returned from the accept() call.

These functions return the amount of data that was sent or received. Because stream sockets send and receive information in streams of data, it can take more than one send() or recv() to transfer all of the data. It is up to the client and the server to agree on some mechanism to signal that all of the data has been transferred.

When the conversation is over, both the client and the server call close() to end the connection. Close() also deallocates the socket, freeing its space in the table of connections. To end a connection with a specific client, the server closes the socket returned by accept(). If the server closes its original socket, it can no longer accept new connections, but it can still converse with the clients to which it is connected. The close() call is represented as follows:

```
close(s);
```

If you are writing a client application, you might want to verify the processes the server will use. Both client applications and the servers with which they communicate must be aware of the sequence of events each will follow.

Using socket calls in a network application

You can use the following example to write a socket network application. The example is written using C socket syntax conventions, but the principles described apply to all of the following APIs:

- TCP/IP C socket API
- X/Open Transport Interface
- Macro API for IPv4 or IPv6 that is written in z/OS assembler language

- Call instruction API for IPv4 or IPv6 socket applications
- z/OS Communications Server socket API for REXX
- Pascal language for IPv4 socket API

Clients and servers wanting to transfer data have many calls from which to choose. The read() and write(), readv() and writev(), and the send() and recv() calls can be used only on sockets that are connected. The sendto() and recvfrom(), and sendmsg() and recvmsg() calls can be used at any time. The example listed in Figure 31 illustrates the use of send() and recv() calls:

```
int send(int socket, char *buf, int buflen, int flags);
int recv(int socket, char *buf, int buflen, int flags);
.
.
.
int bytes_sent;
int bytes_received;
char data_sent[256];
char data_received[256];
int s;
.
.
.
bytes_sent = send(s, data_sent, sizeof(data_sent), 0);
.
.
.
bytes_received = recv(s, data_received, sizeof(data_received), 0);
```

Figure 31. An application using the send() and recv() calls

The example in Figure 31 shows an application sending data to a connected socket and receiving data in response. The flags field can be used to specify additional options to send() or recv(), such as sending out-of-band data. For more information about these routines, see the following:

- "read()" on page 177
- "readv()" on page 178
- "recv()" on page 180
- "send()" on page 192
- "write()" on page 218
- "writev()" on page 219

There are three groups of calls to use for reading and writing data over sockets:

read and write
: These calls can only be used with connected sockets. No processing flags can be passed on these calls.

recv and send
: These calls also work with connected sockets only. You can pass processing flags on these calls:
  - NOFLAG — read or write data as a read call or a write call would.
  - OOB — read or write Out Of Band data (expedited data).
  - PEEK — peek at data, but do not remove data from the buffers.

recvfrom and sendto
: These calls work with both connected and non-connected sockets. You can

pass addressing information directly (as parameters) on these calls. The available flags are the same as those for recv and send.

A connected socket is either a stream socket for which a connection has been established, or it is a datagram socket for which you have issued a connect() call to specify the remote datagram socket address.

Reading and writing data from and to a socket

Stream sockets during read and write calls might behave in a way that you would expect to be an error. The read() call might return fewer bytes, and the write() call may write fewer bytes, than requested. This is not an error, but a normal situation that your programs must deal with when they read or write data over a socket.

You might need to use a series of read calls to read a given number of bytes from a stream socket. Each successful read() call returns in the retcode field the number of bytes actually read. If you know you have to read, for example, 4000 bytes and the read call returns 2500, you have to reissue the read call with a new requested length of 4000 minus the 2500 already received (1500).

If you develop your program in COBOL, the following example shows an implementation of such logic. In this example, the message to be read has a fixed size of 8192 bytes:

```
 *-------------------------------------------------------------*
 * Variables used by the READ call                             *
 *-------------------------------------------------------------*
 01  read-request-read              pic 9(8) binary value 0.
 01  read-request-remaining         pic 9(8) binary value 0.
 01  read-buffer.
     05  read-buffer-total          pic x(8192) value space.
     05  read-buffer-byte redefines read-buffer-total
                                    pic x occurs 8192 times.
*-------------------------------------------------------------*
* Read 8K block from server                                    *
*-------------------------------------------------------------*
    move zero to read-request-read.
    move 8192 to read-request-remaining.
    Perform until read-request-remaining = 0
       call 'EZASOKET' using soket-read
          socket-descriptor
          read-request-remaining
          read-buffer-byte(read-request-read + 1)
          errno
          retcode
       if retcode < 0 then
          - process error and exit -
       end-if
       add retcode to read-request-read
       subtract retcode from read-request-remaining
       if retcode = 0 then
          Move zero to read-request-remaining
       end-if
    end-perform.
```

An actual execution of the program, following the above logic, used four read calls to retrieve 8K of data. The first call returned 1960 bytes, the second call 3920 bytes, the third call 1960 bytes and the final call 352 bytes. It is not possible to predict how many calls will be needed to retrieve the message. That depends on the internal buffer utilization of a TCP/IP. In some cases, only two calls were needed to retrieve 8K of data.

It is good programming practice, whenever you know the number of bytes to read, to issue read calls imbedded in logic, which is similar to the method described above.

If you work with short messages, you usually receive the full message on the first read() call, but there is no guarantee.

The behavior of a write() call is similar to that of a read() call. You might need to repeat more write() calls to write out all the data you want written. The following example illustrates this technique.

```
*-------------------------------------------------------------*
* Buffer and length fields for write operation               *
*-------------------------------------------------------------*
01  send-request-sent              pic 9(8) binary value 0.
01  send-request-remaining         pic 9(8) binary value 0.
01  send-buffer.
    05  send-buffer-total          pic x(8192) value space.
    05  send-buffer-byte redefines send-buffer-total
                                   pic x occurs 8192 times.
*-------------------------------------------------------------*
* Send 8K data block                                         *
*-------------------------------------------------------------*
    move 8192 to send-request-remaining.
    move 0 to send-request-sent.
    Perform until send-request-remaining = 0
       call 'EZASOKET' using soket-write
            socket-descriptor
            send-request-remaining
            send-buffer-byte(send-request-sent + 1)
            errno
            retcode
       if retcode < 0 then
            - process error and exit -
       end-if
       add retcode to send-request-sent
       subtract retcode from send-request-remaining
    if retcode = 0 then
       Move zero to send-request-remaining
    end-if
 end-perform.
```

Using sendto() and recvfrom() calls

If the socket is not in a connected state, additional address information must be passed to sendto() and can be (optionally) returned from recvfrom(). An example of the sendto() and recvfrom() calls is listed in Figure 32 on page 72:

```
int sendto(int socket, char *buf, int buflen, int flags,
           struct sockaddr *addr, int addrlen);
int recvfrom(int socket, char *buf, int buflen, int flags,
           struct sockaddr *addr, int *addrlen);
.
.
.
int bytes_sent;
int bytes_received;
char data_sent[256];
char data_received[256];
struct sockaddr_in to;
struct sockaddr from;
int addrlen;
int s;
.
.
.
memset(&to, 0, sizeof(to));
to.sin_family = AF_INET;
to.sin_addr   = inet_addr("129.5.24.1");
to.sin_port   = htons(1024);
.
.
.
bytes_sent = sendto(s, data_sent, sizeof(data_sent), 0,
           (struct sockaddr*)&to, sizeof(to));
.
.
.
addrlen = sizeof(from); /* must be initialized */
bytes_received = recvfrom(s, data_received,
   sizeof(data_received), 0, &from, &addrlen)
```

Figure 32. An application using the sendto() and recvfrom() Calls

The sendto() and recvfrom() calls take additional parameters to allow the caller to specify the recipient of the data, or to be notified of the sender of the data. See “recvfrom()” on page 182, “sendmsg()” on page 194, and “sendto()” on page 196 for more information about these additional parameters. Usually, sendto() and recvfrom() are used for datagram sockets, and send() and recv() are used for stream sockets.

Chapter 8. Designing IPv6 programs

The following contain details on how to enable an IPv6 application:

- *z/OS Communications Server: IPv6 Network and Application Design Guide*
- RFC 2553, *Basic Socket Interface Extensions for IPv6*. The Basic Socket API extension covers the socket calls that the majority of TCP/IP applications use.
- See "Introducing TCP/IP concepts: Socket libraries" on page 6 for information on which APIs support IPv6.
- See Appendix C, "Address family cross reference," on page 911 for information on which commands support IPv6. Refer to the description and syntax for each command that was enhanced for IPv6 support.

© Copyright IBM Corp. 1989, 2010

Chapter 9. Designing multicast programs

This topic describes IP multicasting and how an application can exploit multicasting using the TCP/IP socket APIs. IP multicasting concepts in IPv4 and IPv6 protocols are very similar; however there are some differences, such as the IP addresses used for multicasting with each protocol. The topic that follows introduces the basic concepts for IP multicasting with an emphasis on IPv4. However, most of the concepts described here apply to IPv6 multicast applications as well. A more detailed description of IPv6 multicast options follows in the next topic.

IPv4 has three types of IP addresses: unicast, broadcast, and multicast. When an IP datagram is sent to an individual IP address, it is called a unicast IP datagram. The process of sending the datagram is called unicasting. Unicasting is used when two IP nodes are communicating with each other.

When an IP datagram is sent to all nodes on a specific network, it is called broadcasting. Broadcasting support can be both limited and directed.

Multicasting is used to send an IP datagram to a group of systems identified by a class D address. The class D address is used as the destination address. When an application program requests that it receive datagrams with a particular class D destination IP address, it is said to have joined a multicast group. Multicast datagrams (datagrams with a class D destination address) are discarded by a host system unless an application on that host has joined the matching multicast group. The UDP application must bind in order to receive multicast datagrams, after which the application can then receive an IP datagram. The application can receive an IP datagram in two ways:

- The application must bind to the same port that is being used by the sender of the multicast datagram.
- The application can bind to a unicast address, inaddr_any, or to a class D address. However, if multiple applications need to receive datagrams for the same multicast group, they should bind to the class D address and set the SO_REUSEADDR socket option.

When a host is added to a group that group is referred to as a *host group*. A host group may span multiple networks. Hosts may join and leave a host group as necessary and there is no restriction to the number of hosts involved in a group. A host does not have to belong to a group to send a message to that group. Any hosts on an IP Internet can join a multicast group. The hosts need not be on a single LAN and may be separated by routers. When an application joins a group, it joins the multicast group on a specific interface. Routers use this information to determine if multicast datagrams should be forwarded from one interface to another.

Routers and hosts use a multicast routing protocol called Internet Group Management Protocol (IGMP) to share information about multicast groups. Through this protocol, hosts inform routers when they join or leave a multicast group. Routers can query hosts about groups they have joined and use this information in determining whether to forward multicast datagrams. Some multicast group addresses are referred to as permanent host groups. These addresses are assigned by the Internet Assigned Numbers Authority group as

© Copyright IBM Corp. 1989, 2010

well-known addresses similar to the well-known TCP and UDP port numbers. For example, 224.0.0.1 means all systems on this subnet, and 224.0.0.2 means all routers on this subnet. For a review of The Internet Assigned Number RFC to familiarize yourself with more of the well-known standard multicast address see http://www.iana.org/assignments/multicast-addresses for IPv4 multicast address assignments and RFC 2375 for IPv6 multicast address assignments.

Note: z/OS (OMPROUTE) does not support a multicast routing protocol.

Designing multicast programs: Multicast source filters

Source filter APIs enable an application to filter the datagrams that it receives based on the source address. There are two categories of source filter APIs: Basic and advanced. Both categories enable multicast receiver applications to designate the unicast addresses (source addresses) and the multicast group (destination address).

Basic (delta-based) APIs

Some applications need the simplicity of a delta-based API in which each function call specifies a single source address to be added to or removed from the filter. Such applications typically fall into the following types:

Any-source multicast

By default, all source addresses are accepted. Individual source addresses can be turned off and back on as needed. This type is also known as the exclude mode, because the source filter contains a list of excluded sources. The following SETSOCKOPT options are included.

Address family	SETSOCKOPT options
IPv4	IP_ADD_MEMBERSHIP
	IP_BLOCK_SOURCE
	IP_DROP_MEMBERSHIP
	IP_UNBLOCK_SOURCE
Protocol independent	MCAST_BLOCK_SOURCE
	MCAST_JOIN_GROUP
	MCAST_LEAVE_GROUP
	MCAST_UNBLOCK_SOURCE

Source-specific multicast

Only the source addresses that are specified in a list are accepted. The list is initially empty; IP addresses can be added to or deleted from the list one at a time. This filter type also is known as the include mode, because the source filter contains a list of included sources. The following SETSOCKOPT options are included.

Address family	SETSOCKOPT options
IPv4	IP_ADD_SOURCE_MEMBERSHIP
	IP_DROP_MEMBERSHIP
	IP_DROP_SOURCE_MEMBERSHIP
Protocol independent	MCAST_JOIN_SOURCE_GROUP
	MCAST_LEAVE_GROUP
	MCAST_LEAVE_SOURCE_GROUP

Advanced (full-state) APIs

These APIs enable an application to use a source filter that is comprised of zero or more source addresses. The application can retrieve the current filter or replace it with a new filter. The following IOCTL commands are included:

- SIOCGIPMSFILTER

- SIOCGMSFILTER
- SIOCSIPMSFILTER
- SIOCSMSFILTER

Consider the following points about multicast source filters:

- Sockets cannot mix IPv4 group-membership APIs with protocol-independent group-membership APIs. Within each API type, delta-based options cannot be mixed with full-state options. Mixing these calls for the same socket results in an EINVAL error.
- The number of groups that can be joined depends on the socket type; there is a maximum of 20 groups for UDP sockets and a maximum of 256 groups for RAW sockets. Exceeding this limit results in an ETOOMANYREFS error.
- Within each group or group and interface pair, an application can use calls for only one type of basic API, either any-source multicast or source-specific multicast. Mixing options will result in an EINVAL error. However, an application can use different methods for different sockets.
- If the filter mode is set to include and the source list is empty, then the entry corresponding to the requested interface and multicast address is deleted, if present. If no such entry is present, then the request is ignored.
- For each socket, you can specify a maximum of 64 source filters for each multicast address and interface address pair. If the call causes the number of filters to exceed this maximum, an ENOBUFS error is returned.

Tip: z/OS UNIX Assembler Callable Services and z/OS Language Environment® C/C++ APIs also support the multicast source filter APIs. See *z/OS XL C/C++ Run-Time Library Reference* and *z/OS UNIX System Services Programming: Assembler Callable Services Reference* for more information.

Designing multicast programs: IPv4 multicast options

IPv4 multicast supports the following socket options for the Macro, Callable, and REXX Sockets APIs:

- IP_ADD_MEMBERSHIP
- IP_ADD_SOURCE_MEMBERSHIP
- IP_BLOCK_SOURCE
- IP_DROP_MEMBERSHIP
- IP_DROP_SOURCE_MEMBERSHIP
- IP_MULTICAST_IF
- IP_MULTICAST_LOOP
- IP_MULTICAST_TTL
- IP_UNBLOCK_SOURCE

IPv4 multicast supports the following socket options for the C Sockets API:

- IP_ADD_MEMBERSHIP
- IP_DROP_MEMBERSHIP
- IP_MULTICAST_IF
- IP_MULTICAST_LOOP
- IP_MULTICAST_TTL

Use the C, Macro, Callable, or REXX Sockets API SETSOCKOPT call to set these options. Use the C, Macro, Callable or REXX Sockets API GETSOCKOPT call to get

the current settings. The status of the IP_ADD_MEMBERSHIP, IP_DROP_MEMBERSHIP, IP_ADD_SOURCE_MEMBERSHIP, IP_DROP_SOURCE_MEMBERSHIP, IP_BLOCK_SOURCE, and IP_UNBLOCK_SOURCE options are exceptions, because they are SETSOCKOPT options only.

IP_ADD_MEMBERSHIP and IP_DROP_MEMBERSHIP

Use the IP_ADD_MEMBERSHIP option to join an IPv4 multicast group on a local IPv4 interface. Use the SETSOCKOPT API and specify the address of the IP_MREQ structure that contains these addresses. The application can join multiple multicast groups on a single socket; it also can join the same group on multiple interfaces on the same socket. However, there is a maximum limit of 20 groups for a single UDP socket, and there is a maximum limit of 256 groups for a single RAW socket. The stack chooses a default multicast interface if an interface with the value 0 is passed. The format of the IP_MREQ structure is in the BPXYSOCK macro. The assembler program example in Figure 33 shows this socket option using the EZASMI macro:

```
*********************************************************************
*                                                                   *
*               Issue INITAPI to connect to interface               *
*                                                                   *
*********************************************************************
         POST  ECB,1              NEXT IS ALWAYS SYNCH
         EZASMI TYPE=INITAPI,     ISSUE INITAPI MACRO                  X
               SUBTASK=SUBTASK,   SPECIFY SUBTASK IDENTIFIER           X
               MAXSOC=MAXSOC,     SPECIFY MAXIMUM NUMBER OF SOCKETS    X
               MAXSNO=MAXSNO,     (HIGHEST SOCKET NUMBER ASSIGNED)     X
               ERRNO=ERRNO,       (SPECIFY ERRNO FIELD)                X
               RETCODE=RETCODE,   (SPECIFY RETCODE FIELD)              X
               APITYPE=APITYPE,   (SPECIFY APITYPE FIELD)              X
               ERROR=ERROR        ABEND IF ERROR ON MACRO
         BAL   R14,RCCHECK         --> DID IT WORK?
*********************************************************************
*                                                                   *
*        Issue SOCKET Macro to obtain a datagram socket descriptor  *
*                                                                   *
*********************************************************************
         EZASMI TYPE=SOCKET,      ISSUE SOCKET MACRO                   X
               AF='INET',         INET OR IUCV                         X
               SOCTYPE='DATAGRAM', DATAGRAM(UDP)                       X
               PROTO=ZERO,        PROTOCOL                             X
               ERRNO=ERRNO,       (SPECIFY ERRNO FIELD)                X
               RETCODE=RETCODE,   (SPECIFY RETCODE FIELD)              X
               ERROR=ERROR        ABEND IF MACRO ERROR
         BAL   R14,RCCHECK        CHECK FOR SUCCESSFUL CALL
*-------------------------------------------------------------------*
*        Get socket descriptor number                               *
*-------------------------------------------------------------------*
         STH   R8,S               SAVE RETCODE (=SOCKET DESCRIPTOR)
*********************************************************************
*                                                                   *
*        ISSUE GETHOSTID CALL                                       *
*                                                                   *
*********************************************************************
         EZASMI TYPE=GETHOSTID,   ISSUE GETHOSTID MACRO                X
               RETCODE=RETCODE,   (SPECIFY RETCODE FIELD)              X
               ERROR=ERROR        ABEND IF MACRO ERROR
         BAL   R14,RCCHECK        CHECK FOR SUCCESSFUL CALL
         ST    R8,ADDR            SAVE OUR ID
*********************************************************************
*                                                                   *
*        Issue SETSOCKOPT to allow multiple application on the same *
*            stack to bind to the same multicast address and port.  *
*                                                                   *
*********************************************************************
         EZASMI TYPE=SETSOCKOPT,  ISSUE SETSOCKOPT                     X
               S=S,               SOCKET DESCRIPTOR                    X
               OPTLEN=OPTLEN4,    OPTION LENGTH                        X
               OPTNAME='SO_REUSEADDR', OPTION NAME                     X
               OPTVAL=OPTVALON,   OPTION VALUE                         X
               RETCODE=RETCODE,   (SPECIFY RETCODE FIELD)              X
               ERROR=ERROR        ABEND IF MACRO ERROR
         BAL   R14,RCCHECK         --> CHECK IT
```

Figure 33. IP_ADD_MEMBERSHIP and IP_DROP_MEMBERSHIP (Part 1 of 4)

```
*********************************************************************
*                                                                   *
*        Issue BIND socket                                          *
*                                                                   *
*********************************************************************
         MVC   PORT(2),PORTS      Load port #
         MVC   ADDRESS(4),ADDR    Load IP address
         EZASMI TYPE=BIND,        ISSUE BIND MACRO                   X
               S=S,               DATAGRAM                           X
               NAME=NAME,         SOCKET ADDRESS STRUCTURE           X
               RETCODE=RETCODE,   (SPECIFY RETCODE FIELD)            X
               ERROR=ERROR        ABEND IF MACRO ERROR
         BAL   R14,RCCHECK        CHECK FOR SUCCESSFUL CALL

*
* Here you will add code to set the multicast interface, time-to-live,
* or determine if outgoing datagrams are copied to loopback.  See the
* next sections for the details.
*

*********************************************************************
*                                                                   *
*        Issue SETSOCKOPT - IP_ADD_MEMBERSHIP                       *
*                                                                   *
*********************************************************************
         MVC   IMR_MULTIADD,MY_MULTICAST_ADDRESS
         MVC   IMR_INTERFAC,MY_MULTICAST_INTERFACE
         EZASMI TYPE=SETSOCKOPT,  ISSUE SETSOCKOPT                  X
               S=S,               SOCKET DESCRIPTOR                  X
               OPTLEN=OPTLEN8,    OPTION LENGTH                      X
               OPTNAME='IP_ADD_MEMBERSHIP', OPTION NAME              X
               OPTVAL=IP_MREQ,    OPTION VALUE                       X
               RETCODE=RETCODE,   (SPECIFY RETCODE FIELD)            X
               ERROR=ERROR        ABEND IF MACRO ERROR
         BAL   R14,RCCHECK         --> CHECK IT

*
* Here your program will perform normal processing such as sending or
* receiving message.
*
```

Figure 33. IP_ADD_MEMBERSHIP and IP_DROP_MEMBERSHIP (Part 2 of 4)

```
*********************************************************************
*                                                                   *
*        Issue SETSOCKOPT - IP_DROP_MEMBERSHIP                      *
*                                                                   *
*********************************************************************
         MVC   IMR_MULTIADD,MY_MULTICAST_ADDRESS
         MVC   IMR_INTERFAC,MY_MULTICAST_INTERFACE
         EZASMI TYPE=SETSOCKOPT,  ISSUE SETSOCKOPT                  X
               S=S,               SOCKET DESCRIPTOR                  X
               OPTLEN=OPTLEN8,    OPTION LENGTH                      X
               OPTNAME='IP_DROP_MEMBERSHIP', OPTION NAME             X
               OPTVAL=IP_MREQ,    OPTION VALUE                       X
               RETCODE=RETCODE,   (SPECIFY RETCODE FIELD)            X
               ERROR=ERROR        ABEND IF MACRO ERROR
         BAL   R14,RCCHECK         --> CHECK IT
```

Figure 33. IP_ADD_MEMBERSHIP and IP_DROP_MEMBERSHIP (Part 3 of 4)

```
*********************************************************************
*                                                                   *
*        Terminate Connection to API                                *
*                                                                   *
*********************************************************************
         POST  ECB,1              FOLLOWING IS ALWAYS SYNCH
         EZASMI TYPE=TERMAPI      ISSUE EZASMI MACRO FOR TERMAPI API
*
* GETSOCKOPT and SETSOCKOPT parms
*
OPTLEN1  DC    F'1'
OPTLEN4  DC    F'4'
OPTLEN8  DC    F'8'
OPTLEN12 DC    F'12'
*
OPTVAL4  DC    CL4' '
SAMEINTERFACE DC F'0'
SAMESUBNET DC  F'1'
SAMESITE DC    F'32'
SAMEREGION DC  F'64'
OPTVALON DC    F'1'               OPTVAL field ON
OPTVALOFF DC   F'0'               OPTVAL field OFF
*
* BIND PARMS
*
         CNOP  0,4
NAME     DC    0CL16' '           SOCKET NAME STRUCTURE
         DC    AL2(2)             FAMILY
PORT     DC    H'0'               PORT
ADDRESS  DC    F'0'               IP ADDRESS
         DC    XL8'00'            RESERVED
ADDR     DC    AL1(224),AL1(9),AL1(9),AL1(9) IP ADDRESS TO BIND
PORTS    DC    H'11007'           PORT TO BIND
*
* My multicast address, source, and interface
*
MY_MULTICAST_ADDRESS DC AL1(224),AL1(9),AL1(9),AL1(9)                  X
                                 Multicast address
MY_MULTICAST_INTERFACE DC AL1(204),AL1(59),AL1(83),AL1(19) Internet
*                                                          address
MY_MULTICAST_SOURCE DC AL1(203),AL1(12),AL1(83),AL1(19) Internet
*                                                          address
* Multicast Interface
MULTIFA DC    AL1(204),AL1(59),AL1(83),AL1(19) Internet Address
*
MULTIFO  DC    CL4' '            SOCKET MULTICAST INTERFACE OUTPUT
         BPXYSOCK DSECT=NO,LIST=YES
     IP_MREQ          DS 0F                                  01-BPXYSOCK
     IMR_MULTIADDR    DS CL4       IP MULTICAST ADDR OF GROUP   01-BPXYSOCK
     IMR_INTERFACE    DS CL4       LOCAL IP ADDR OF INTERFACE   01-BPXYSOCK
     IP_MREQ_SOURCE   DS 0F                                  01_BPXYSOCK
     IMRS_MULTIADDR   DS CL4       IP MULTICAST ADDR OF GROUP   01_BPXYSOCK
     IMRS_SOURCEADDR  DS CL4       IP ADDRESS OF SOURCE         01_BPXYSOCK
     IMRS_INTERFACE   DS CL4       LOCAL IP ADDR OF INTERFACE   01_BPXYSOCK
```

Figure 33. IP_ADD_MEMBERSHIP and IP_DROP_MEMBERSHIP (Part 4 of 4)

To remove the host from the multicast host group you must issue a SETSOCKOPT call with the IP_DROP_MEMBERSHIP option. Using this call is similar to using the IP_ADD_MEMBERSHIP option; both use the IP_MREQ structure to declare the IPv4 multicast address and the local IPv4 address interface. You can also use the IP_DROP_MEMBERSHIP option to remove all sources for a given multicast group (see Figure 33 on page 80).

While the application is a member of the multicast host group, datagrams can be sent or received as required. To see the multicast groups that are joined on an interface, use the Netstat DEvlinks/-d command. To see the multicast groups that are joined on a socket, use the Netstat ALL/-A command.

IP_ADD_SOURCE_MEMBERSHIP and IP_DROP_SOURCE_MEMBERSHIP

Use the IP_ADD_SOURCE_MEMBERSHIP option to join an IPv4 multicast group on an IPv4 interface and specify the IPv4 source-filter address. Set these values by using the SETSOCKOPT API and specifying the address of the IP_MREQ_SOURCE structure that contains these addresses. The application can join multiple source multicast groups on a single socket and can also join the same group on multiple interfaces on the same socket. However, there is a maximum limit of 20 groups per single UDP socket and there is a maximum limit of 256 groups per single RAW socket. The stack chooses a default multicast interface if an interface with the value 0 is passed. The format of the IP_MREQ_SOURCE structure is in the BPXYSOCK macro. The assembler program example in Figure 34 shows this socket option using the EZASMI macro:

```
*********************************************************************
*                                                                   *
*        Issue SETSOCKOPT - IP_ADD_SOURCE_MEMBERSHIP                *
*                                                                   *
*********************************************************************
         MVC   IMRS_MULTIADD,MY_MULTICAST_ADDRESS
         MVC   IMRS_SOURCEADDR,MY_MULTICAST_SOURCE
         MVC   IMRS_INTERFAC,MY_MULTICAST_INTERFACE
         EZASMI TYPE=SETSOCKOPT,  ISSUE SETSOCKOPT                  X
               S=S,               SOCKET DESCRIPTOR                 X
               OPTLEN=OPTLEN12,   OPTION LENGTH                     X
               OPTNAME='IP_ADD_SOURCE_MEMBERSHIP', OPTION NAME      X
               OPTVAL=IP_MREQ_SOURCE,    OPTION VALUE               X
               RETCODE=RETCODE,   (SPECIFY RETCODE FIELD)           X
               ERROR=ERROR        ABEND IF MACRO ERROR
         BAL   R14,RCCHECK         --> CHECK IT
*
* Here your program will perform normal processing such as sending or
* receiving message.
*
```

Figure 34. IP_ADD_SOURCE_MEMBERSHIP and IP_DROP_SOURCE_MEMBERSHIP (Part 1 of 2)

```
*********************************************************************
*                                                                   *
*        Issue SETSOCKOPT - IP_DROP_SOURCE_MEMBERSHIP               *
*                                                                   *
*********************************************************************
         MVC   IMR_MULTIADD,MY_MULTICAST_ADDRESS
         MVC   IMRS_SOURCEADDR,MY_MULTICAST_SOURCE
         MVC   IMRS_INTERFAC,MY_MULTICAST_INTERFACE
         EZASMI TYPE=SETSOCKOPT,  ISSUE SETSOCKOPT                  X
               S=S,               SOCKET DESCRIPTOR                 X
               OPTLEN=OPTLEN12,   OPTION LENGTH                     X
               OPTNAME='IP_DROP_SOURCE_MEMBERSHIP', OPTION NAME     X
               OPTVAL=IP_MREQ_SOURCE,    OPTION VALUE               X
               RETCODE=RETCODE,   (SPECIFY RETCODE FIELD)           X
               ERROR=ERROR        ABEND IF MACRO ERROR
         BAL   R14,RCCHECK         --> CHECK IT
```

Figure 34. IP_ADD_SOURCE_MEMBERSHIP and IP_DROP_SOURCE_MEMBERSHIP (Part 2 of 2)

To remove the host from the source multicast host group you must issue a SETSOCKOPT call with the IP_DROP_SOURCE_MEMBERSHIP option. Using this call is similar to using the IP_ADD_SOURCE_MEMBERSHIP option; both use the IP_MREQ_SOURCE structure to declare the IPv4 multicast address, IPv4 source address, and the local IPv4 address interface.

While the application is a member of the source multicast host group, datagrams can be sent or received as required. To see the multicast groups that are joined on an interface, use the Netstat DEvlinks/-d command. To see the multicast groups that are joined on a socket, use the Netstat ALL/-A command.

IP_BLOCK_SOURCE and IP_UNBLOCK_SOURCE

The IP_BLOCK_SOURCE socket option enables the application to block IPv4 multicast packets that have a source address that matches the given IPv4 source address. The specified multicast group must have been joined previously. The IP_UNBLOCK_SOURCE socket option enables the application to unblock a previously blocked source for a given multicast group.

To block or unblock IPv4 multicast packets, use the SETSOCKOPT API and specify the IP_MREQ_SOURCE structure containing IPv4 multicast address, IPv4 source address, and the local IPv4 interface address. The format of the IP_MREQ_SOURCE structure is in the BPXYSOCK macro. The assembler program example in Figure 35 shows this socket option using the EZASMI macro:

```
*********************************************************************
*                                                                   *
*        Issue SETSOCKOPT - IP_BLOCK_SOURCE                         *
*                                                                   *
*********************************************************************
         MVC   IMRS_MULTIADD,MY_MULTICAST_ADDRESS
         MVC   IMRS_SOURCEADDR,MY_MULTICAST_SOURCE
         MVC   IMRS_INTERFAC,MY_MULTICAST_INTERFACE
         EZASMI TYPE=SETSOCKOPT,  ISSUE SETSOCKOPT                  X
               S=S,               SOCKET DESCRIPTOR                 X
               OPTLEN=OPTLEN12,   OPTION LENGTH                     X
               OPTNAME='IP_BLOCK_SOURCE', OPTION NAME               X
               OPTVAL=IP_MREQ_SOURCE,    OPTION VALUE               X
               RETCODE=RETCODE,   (SPECIFY RETCODE FIELD)           X
               ERROR=ERROR        ABEND IF MACRO ERROR
         BAL   R14,RCCHECK         --> CHECK IT
*
* Here your program will perform normal processing such as sending or
* receiving message.
*
```

Figure 35. IP_BLOCK_SOURCE and IP_UNBLOCK_SOURCE (Part 1 of 2)

```
*********************************************************************
    *                                                                 *
    *        Issue SETSOCKOPT - IP_UNBLOCK_SOURCE                     *
    *                                                                 *
    *******************************************************************
            MVC   IMRS_MULTIADD,MY_MULTICAST_ADDRESS
            MVC   IMRS_SOURCEADDR,MY_MULTICAST_SOURCE
            MVC   IMRS_INTERFAC,MY_MULTICAST_INTERFACE
            EZASMI TYPE=SETSOCKOPT,  ISSUE SETSOCKOPT                  X
                  S=S,               SOCKET DESCRIPTOR                 X
                  OPTLEN=OPTLEN12,   OPTION LENGTH                     X
                  OPTNAME='IP_UNBLOCK_SOURCE', OPTION NAME             X
                  OPTVAL=IP_MREQ_SOURCE,    OPTION VALUE               X
                  RETCODE=RETCODE,   (SPECIFY RETCODE FIELD)           X
                  ERROR=ERROR        ABEND IF MACRO ERROR
            BAL   R14,RCCHECK         --> CHECK IT
```

Figure 35. IP_BLOCK_SOURCE and IP_UNBLOCK_SOURCE (Part 2 of 2)

While the application is a member of the multicast host group, datagrams can be sent or received as required. To see the multicast groups that are joined on an interface, use the Netstat DEvlinks/-d command. To see the multicast groups that are joined on a socket, use the Netstat ALL/-A command.

IP_MULTICAST_IF

In order to control which interface multicast datagrams will be sent on, the API provides the IP_MULTICAST_IF socket option. This option can be used to set the interface for sending outbound multicast datagrams from the sockets application. Multicast datagrams can be transmitted on only one interface at a time. You can determine the interface being used by the way of the GETSOCKOPT API with IP_MULTICAST_IF as the OPTNAME. Figure 36 illustrates the use of IP_MULTICAST_IF by the use of the SETSOCKOPT and GETSOCKOPT APIs.

```
*********************************************************************
*                                                                   *
*        Issue SETSOCKOPT/GETSOCKOPT - IP_MULTICAST_IF              *
*                                                                   *
*********************************************************************
         EZASMI TYPE=SETSOCKOPT,  ISSUE SETSOCKOPT                  X
               S=S,               SOCKET DESCRIPTOR                 X
               OPTLEN=OPTLEN4,    OPTION LENGTH                     X
               OPTNAME='IP_MULTICAST_IF', OPTION NAME               X
               OPTVAL=MULTIF,     OPTION VALUE                      X
               RETCODE=RETCODE,   (SPECIFY RETCODE FIELD)           X
               ERROR=ERROR        ABEND IF MACRO ERROR
         BAL   R14,RCCHECK         --> CHECK IT
         XC    MULTIFO,MULTIFO
         EZASMI TYPE=GETSOCKOPT,  ISSUE GETSOCKOPT                  X
               S=S,               SOCKET DESCRIPTOR                 X
               OPTLEN=OPTLEN4,    OPTION LENGTH                     X
               OPTNAME='IP_MULTICAST_IF', OPTION NAME               X
               OPTVAL=MULTIFO,    OPTION VALUE                      X
               RETCODE=RETCODE,   (SPECIFY RETCODE FIELD)           X
               ERROR=ERROR        ABEND IF MACRO ERROR
         BAL   R14,RCCHECK         --> CHECK IT
```

Figure 36. IP_MULTICAST_IF

IP_MULTICAST_LOOP

The API uses IP_MULTICAST_LOOP socket option to enable or disable the loopback of outgoing multicast datagrams. The default is enabled. This option is used to enable an application with multiple senders and receivers on a system to loop datagrams back so that each process receives the transmissions of the other senders on the system. Figure 37 illustrates the use of IP_MULTICAST_IF by the use of the SETSOCKOPT and GETSOCKOPT APIs.

```
*********************************************************************
*                                                                   *
*        Issue SETSOCKOPT/GETSOCKOPT - IP_MULTICAST_LOOP ENABLED    *
*                                                                   *
*********************************************************************
         EZASMI TYPE=SETSOCKOPT,  ISSUE SETSOCKOPT                  X
               S=S,               SOCKET DESCRIPTOR                 X
               OPTLEN=OPTLEN1,    OPTION LENGTH                     X
               OPTNAME='IP_MULTICAST_LOOP', OPTION NAME             X
               OPTVAL=OPTVALON,   OPTION VALUE                      X
               RETCODE=RETCODE,   (SPECIFY RETCODE FIELD)           X
               ERROR=ERROR        ABEND IF MACRO ERROR
         BAL   R14,RCCHECK         --> CHECK IT
*
         XC    OPTVAL4,OPTVAL4
         EZASMI TYPE=GETSOCKOPT,  ISSUE GETSOCKOPT                  X
               S=S,               SOCKET DESCRIPTOR                 X
               OPTLEN=OPTLEN1,    OPTION LENGTH                     X
               OPTNAME='IP_MULTICAST_LOOP', OPTION NAME             X
               OPTVAL=OPTVAL4,    OPTION VALUE                      X
               RETCODE=RETCODE,   (SPECIFY RETCODE FIELD)           X
               ERROR=ERROR        ABEND IF MACRO ERROR
         BAL   R14,RCCHECK         --> CHECK IT
```

Figure 37. IP_MULTICAST_LOOP (Part 1 of 2)

```
*********************************************************************
*                                                                   *
*        Issue SETSOCKOPT/GETSOCKOPT - IP_MULTICAST_LOOP DISABLED   *
*                                                                   *
*********************************************************************
         EZASMI TYPE=SETSOCKOPT,  ISSUE SETSOCKOPT                  X
               S=S,               SOCKET DESCRIPTOR                 X
               OPTLEN=OPTLEN1,    OPTION LENGTH                     X
               OPTNAME='IP_MULTICAST_LOOP', OPTION NAME             X
               OPTVAL=OPTVALOFF,  OPTION VALUE                      X
               RETCODE=RETCODE,   (SPECIFY RETCODE FIELD)           X
               ERROR=ERROR        ABEND IF MACRO ERROR
         BAL   R14,RCCHECK         --> CHECK IT
         XC    OPTVAL4,OPTVAL4
         EZASMI TYPE=GETSOCKOPT,  ISSUE GETSOCKOPT                  X
               S=S,               SOCKET DESCRIPTOR                 X
               OPTLEN=OPTLEN1,    OPTION LENGTH                     X
               OPTNAME='IP_MULTICAST_LOOP', OPTION NAME             X
               OPTVAL=OPTVAL4,    OPTION VALUE                      X
               RETCODE=RETCODE,   (SPECIFY RETCODE FIELD)           X
               ERROR=ERROR        ABEND IF MACRO ERROR
         BAL   R14,RCCHECK         --> CHECK IT
```

Figure 37. IP_MULTICAST_LOOP (Part 2 of 2)

IP_MULTICAST_TTL

The IP_MULTICAST_TTL socket option allows the application to primarily limit the lifetime of the packet in the Internet and prevent it from circulating indefinitely. This option also serves to allow the application to specify administrative boundaries. This administrative region is specified in terms such as "this site", "this company", or "this state", and is relative to the starting point of the packet. The region associated with a multicast packet is called its *scope*. The default value is 1, meaning multicast is available only to the local subnet. Figure 38 illustrates the use of IP_MULTICAST_TTL by the use of the SETSOCKOPT and GETSOCKOPT APIs.

```
*********************************************************************
*                                                                   *
*        Issue SETSOCKOPT/GETSOCKOPT - IP_MULTICAST_TTL             *
*                                                                   *
*********************************************************************
*
* SET TTL TO SAME SITE
*
         EZASMI TYPE=SETSOCKOPT,  ISSUE SETSOCKOPT                  X
               S=S,               SOCKET DESCRIPTOR                 X
               OPTLEN=OPTLEN1,    OPTION LENGTH                     X
               OPTNAME='IP_MULTICAST_TTL', OPTION NAME              X
               OPTVAL=SAMESITE,   OPTION VALUE                      X
               RETCODE=RETCODE,   (SPECIFY RETCODE FIELD)           X
               ERROR=ERROR        ABEND IF MACRO ERROR
         BAL   R14,RCCHECK         --> CHECK IT
*
* DISPLAY TTL, SHOULD BE 32
*
         XC    OPTVAL4,OPTVAL4
         EZASMI TYPE=GETSOCKOPT,  ISSUE GETSOCKOPT                  X
               S=S,               SOCKET DESCRIPTOR                 X
               OPTLEN=OPTLEN1,    OPTION LENGTH                     X
               OPTNAME='IP_MULTICAST_TTL', OPTION NAME              X
               OPTVAL=OPTVAL4,    OPTION VALUE                      X
               RETCODE=RETCODE,   (SPECIFY RETCODE FIELD)           X
               ERROR=ERROR        ABEND IF MACRO ERROR
         BAL   R14,RCCHECK         --> CHECK IT
```

Figure 38. IP_MULTICAST_TTL

Designing multicast programs: IPv6 multicast options

To enable your application to support the IPv6 version of multicast support, the following socket options will be discussed:

- IPV6_JOIN_GROUP
- IPV6_LEAVE_GROUP
- IPV6_MULTICAST_IF
- IPV6_MULTICAST_LOOP
- IPV6_MULTICAST_HOPS

Use the Macro, Callable, and REXX Sockets API SETSOCKOPT call to set these options. Use the Macro, Callable, or REXX Sockets API GETSOCKOPT call to get the current settings. The status of the IPV6_JOIN_GROUP and IPV6_LEAVE_GROUP are exceptions as they are SETSOCKOPT options only.

If you want to enable your application to support the IPv6 multicast source filter, see "Designing multicast programs: Protocol-independent multicast options" on page 95.

IPV6_JOIN_GROUP and IPV6_LEAVE_GROUP

IPV6_JOIN_GROUP is used to join a multicast group. This is accomplished by using the SETSOCKOPT API and specifying the address of the IPV6_MREQ structure containing the IPv6 multicast address and the local IPv6 multicast interface index. The stack chooses a default multicast interface if an interface index of 0 is passed. The values specified in the IPV6_MREQ structure used by IPV6_JOIN_GROUP and IPV6_LEAVE_GROUP must be symmetrical. The format of the IPV6_MREQ structure can be found in the BPXYSOCK macro.

The assembler program example in Figure 39 illustrates this socket option in EZASMI Macro form:

```
*********************************************************************
*                                                                   *
*        Issue INITAPI to connect to interface                      *
*                                                                   *
*********************************************************************
         POST  ECB,1              NEXT IS ALWAYS SYNCH
         EZASMI TYPE=INITAPI,     ISSUE INITAPI MACRO                X
               SUBTASK=SUBTASK,   SPECIFY SUBTASK IDENTIFIER         X
               MAXSOC=MAXSOC,     SPECIFY MAXIMUM NUMBER OF SOCKETS  X
               MAXSNO=MAXSNO,     (HIGHEST SOCKET NUMBER ASSIGNED)   X
               ERRNO=ERRNO,       (SPECIFY ERRNO FIELD)              X
               RETCODE=RETCODE,   (SPECIFY RETCODE FIELD)            X
               APITYPE=APITYPE,   (SPECIFY APITYPE FIELD)            X
               ERROR=ERROR        ABEND IF ERROR ON MACRO
         BAL   R14,RCCHECK        --> DID IT WORK?
*********************************************************************
*                                                                   *
*        Issue SOCKET Macro to obtain a socket descriptor           *
*                                                                   *
*********************************************************************
         EZASMI TYPE=SOCKET,      ISSUE SOCKET MACRO                 X
               AF='INET6',        INET OR IUCV                       X
               SOCTYPE='DATAGRAM', DATAGRAM(UDP)                     X
               PROTO=ZERO,        PROTOCOL                           X
               ERRNO=ERRNO,       (SPECIFY ERRNO FIELD)              X
               RETCODE=RETCODE,   (SPECIFY RETCODE FIELD)            X
               ERROR=ERROR        ABEND IF MACRO ERROR
         BAL   R14,RCCHECK        CHECK FOR SUCCESSFUL CALL
*-------------------------------------------------------------------*

*        Get socket descriptor number
*-------------------------------------------------------------------*
         STH   R8,S               SAVE RETCODE (=SOCKET DESCRIPTOR)
*********************************************************************
*                                                                   *
*        ISSUE GETHOSTID CALL                                       *
*                                                                   *
*********************************************************************
         EZASMI TYPE=GETHOSTID,   ISSUE GETHOSTID MACRO              X
               RETCODE=RETCODE,   (SPECIFY RETCODE FIELD)            X
               ERROR=ERROR        ABEND IF MACRO ERROR
         BAL   R14,RCCHECK        CHECK FOR SUCCESSFUL CALL
         ST    R8,ADDR            SAVE OUR ID
```

Figure 39. IPV6_JOIN_GROUP and IPV6_LEAVE_GROUP (Part 1 of 3)

```
*********************************************************************
*                                                                   *
*        Issue SETSOCKOPT to allow multiple application on the same *
*            stack to bind to the same multicast address and port.  *
*                                                                   *
*********************************************************************
         EZASMI TYPE=SETSOCKOPT,  ISSUE SETSOCKOPT                  X
               S=S,               SOCKET DESCRIPTOR                 X
               OPTLEN=OPTLEN4,    OPTION LENGTH                     X
               OPTNAME='SO_REUSEADDR', OPTION NAME                  X
               OPTVAL=OPTVALON,   OPTION VALUE                      X
               RETCODE=RETCODE,   (SPECIFY RETCODE FIELD)           X
               ERROR=ERROR        ABEND IF MACRO ERROR
         BAL   R14,RCCHECK         --> CHECK IT

*********************************************************************
*                                                                   *
*        Issue BIND socket                                          *
*                                                                   *
*********************************************************************
         MVC   PORT(2),PORTS      Load port #
         MVC   ADDRESS(16),ADDR   Load IPv6 internet address
         EZASMI TYPE=BIND,        ISSUE BIND MACRO                  X
               S=S,               DATAGRAM                          X
               NAME=NAME,         SOCKET ADDRESS STRUCTURE          X
               RETCODE=RETCODE,   (SPECIFY RETCODE FIELD)           X
               ERROR=ERROR        ABEND IF MACRO ERROR
         BAL   R14,RCCHECK        CHECK FOR SUCCESSFUL CALL

*
* Here you will add code to set the multicast interface, hops,
* or determine if outgoing datagrams are copied to loopback. See the
* next sections for the details.
*

*********************************************************************
*                                                                   *
*        Issue SETSOCKOPT - IPV6_JOIN_GROUP                         *
*                                                                   *
*********************************************************************

*
* Either hard code a multicast address and index or use the
* SIOCGIFNAMEINDEX IOCTL to obtain the interface index from the stack.
*

         MVC   IV6MR_MULTIADD,MY_MULTICAST_ADDRESS
         MVC   IV6MR_INTERFAC,MY_MULTICAST_INTERFACE
         EZASMI TYPE=SETSOCKOPT,  ISSUE SETSOCKOPT                  X
               S=S,               SOCKET DESCRIPTOR                 X
               OPTLEN=OPTLEN20,   OPTION LENGTH                     X
               OPTNAME='IPV6_JOIN_GROUP', OPTION NAME               X
               OPTVAL=IPV6_MREQ,  OPTION VALUE                      X
               RETCODE=RETCODE,   (SPECIFY RETCODE FIELD)           X
               ERROR=ERROR        ABEND IF MACRO ERROR
         BAL   R14,RCCHECK         --> CHECK IT

*
* Here your program will perform normal processing such as sending or
* receiving messages.
*
```

Figure 39. IPV6_JOIN_GROUP and IPV6_LEAVE_GROUP (Part 2 of 3)

```
*********************************************************************
*                                                                   *
*        Issue SETSOCKOPT - IPV6_LEAVE_GROUP                        *
*                                                                   *
*********************************************************************

*
* Either hard code a multicast address and index or use the
* SIOCGIFNAMEINDEX IOCTL to obtain the interface index from the stack.
*

         MVC   IV6MR_MULTIADD,MY_MULTICAST_ADDRESS
         MVC   IV6MR_INTERFAC,MY_MULTICAST_INTERFACE
         EZASMI TYPE=SETSOCKOPT,  ISSUE SETSOCKOPT                  X
               S=S,               SOCKET DESCRIPTOR                 X
               OPTLEN=OPTLEN20,   OPTION LENGTH                     X
               OPTNAME='IPV6_LEAVE_GROUP', OPTION NAME              X
               OPTVAL=IPV6_MREQ,  OPTION VALUE                      X
               RETCODE=RETCODE,   (SPECIFY RETCODE FIELD)           X
               ERROR=ERROR        ABEND IF MACRO ERROR
         BAL   R14,RCCHECK         --> CHECK IT
*********************************************************************
*                                                                   *
*        Terminate Connection to API                                *
*                                                                   *
*********************************************************************
         POST  ECB,1              FOLLOWING IS ALWAYS SYNCH
         EZASMI TYPE=TERMAPI      ISSUE EZASMI MACRO FOR TERMAPI
*
* GETSOCKOPT and SETSOCKOPT parms
*
OPTLEN1  DC    F'1'
OPTLEN4  DC    F'4'
OPTLEN8  DC    F'8'
OPTLEN20 DC    F'20'
OPTVAL4  DC    CL4' '
SAMEINTERFACE DC F'0'
SAMESUBNET DC  F'1'
SAMESITE DC    F'32'
SAMEREGION DC  F'64'
OPTVALON DC    F'1'               OPTVAL field ON
OPTVALOFF DC   F'0'               OPTVAL field OFF
*
* BIND PARMS
*
NAME     DC    0CL16' '           SOCKET NAME STRUCTURE
         DC    AL2(2)             FAMILY
PORT     DC    H'0'               PORT
FLOWINFO DC    F'0'               FLOWINFO
ADDRESS  DC    F'0'               IP ADDRESS
SCOPEID  DC    F'0'               SCOPEID
ADDR     DC    XL16'FF020101010101010505050505050505' IP ADDR TO BIND
PORTS    DC    H'11007'           PORT TO BIND
*
* My Multicast address and interface
*
MY_MULTICAST_ADDRESS DC XL16'FF020101010101010505050505050505'         X
                               Multicast Address
MY_MULTICAST_INTERFACE DC XL4'0000000E' Interface Index
*
MULTIFO  DC    CL4' '            SOCKET MULTICAST INTERFACE OUTPUT   *
*
         BPXYSOCK DSECT=NO,LIST=YES
IPV6_MREQ        DS 0F                                      01-BPXYS
IPV6MR_MULTIADDR DS CL16       IPv6 Addr                    01-BPXYS
IPV6MR_INTERFACE DS F          Interface Index              01-BPXYS
```

Figure 39. IPV6_JOIN_GROUP and IPV6_LEAVE_GROUP (Part 3 of 3)

IPV6_LEAVE_GROUP is used to remove a host from the multicast group. You must issue a SETSOCKOPT API and specify the address of the IPV6_MREQ structure containing the IPv6 multicast address and the local IPv6 multicast interface index. See also Figure 39 on page 90.

While the application is a member of the multicast host group, datagrams may be sent or received as required. To see the multicast groups that are joined on an interface, use the Netstat DEvlinks/-d command. To see the multicast groups that are joined on a socket, use the Netstat ALL/-A command.

IPV6_MULTICAST_IF

In order to control which interface multicast datagrams will be sent on, the API provides the IPV6_MULTICAST_IF socket option. This option can be used to set the interface for sending outbound multicast datagrams from the sockets application. Multicast datagrams can be transmitted on only one interface at a time. You can determine the interface being used by the way of the GETSOCKOPT API with IPV6_MULTICAST_IF as the OPTNAME. The IPV6_MULTICAST_IF socket option requires that the option value be the value of the IPv6 interface index.

Figure 40 illustrates the use of IPV6_MULTICAST_IF by the use of the SETSOCKOPT and GETSOCKOPT APIs.

```
*********************************************************************
*                                                                   *
*        Issue SETSOCKOPT/GETSOCKOPT - IPV6_MULTICAST_IF            *
*                                                                   *
*********************************************************************
         EZASMI TYPE=SETSOCKOPT,  ISSUE SETSOCKOPT                  X
               S=S,               SOCKET DESCRIPTOR                 X
               OPTLEN=OPTLEN4,    OPTION LENGTH                     X
               OPTNAME='IPV6_MULTICAST_IF', OPTION NAME             X
               OPTVAL=MY_MULTICAST_INTERFACE, OPTION VALUE          X
               RETCODE=RETCODE,   (SPECIFY RETCODE FIELD)           X
               ERROR=ERROR        ABEND IF MACRO ERROR
         BAL   R14,RCCHECK         --> CHECK IT
         XC    MULTIFO,MULTIFO
         EZASMI TYPE=GETSOCKOPT,  ISSUE GETSOCKOPT                  X
               S=S,               SOCKET DESCRIPTOR                 X
               OPTLEN=OPTLEN4,    OPTION LENGTH                     X
               OPTNAME='IPV6_MULTICAST_IF', OPTION NAME             X
               OPTVAL=MULTIFO,    OPTION VALUE                      X
               RETCODE=RETCODE,   (SPECIFY RETCODE FIELD)           X
               ERROR=ERROR        ABEND IF MACRO ERROR
         BAL   R14,RCCHECK         --> CHECK IT
```

Figure 40. IPV6_MULTICAST_IF

IPV6_MULTICAST_LOOP

The API uses IPV6_MULTICAST_LOOP socket option to enable or disable the loopback of outgoing multicast datagrams. The default is enabled. This option is used to enable an application with multiple senders and receivers on a system to loop datagrams back so that each process receives the transmissions of the other senders on the system. Figure 41 illustrates the use of IPV6_MULTICAST_LOOP by the use of the SETSOCKOPT and GETSOCKOPT APIs.

```
*************************************************************************
*                                                                       *
*        Issue SETSOCKOPT/GETSOCKOPT - IPV6_MULTICAST_LOOP ENABLED      *
*                                                                       *
*************************************************************************
         EZASMI TYPE=SETSOCKOPT,  ISSUE SETSOCKOPT                     X
               S=S,               SOCKET DESCRIPTOR                    X
               OPTLEN=OPTLEN1,    OPTION LENGTH                        X
               OPTNAME='IPV6_MULTICAST_LOOP', OPTION NAME              X
               OPTVAL=OPTVALON,   OPTION VALUE                         X
               RETCODE=RETCODE,   (SPECIFY RETCODE FIELD)              X
               ERROR=ERROR        ABEND IF MACRO ERROR
         BAL   R14,RCCHECK         --> CHECK IT
*
         XC    OPTVAL4,OPTVAL4
         EZASMI TYPE=GETSOCKOPT,  ISSUE GETSOCKOPT                     X
               S=S,               SOCKET DESCRIPTOR                    X
               OPTLEN=OPTLEN1,    OPTION LENGTH                        X
               OPTNAME='IPV6_MULTICAST_LOOP', OPTION NAME              X
               OPTVAL=OPTVAL4,    OPTION VALUE                         X
               RETCODE=RETCODE,   (SPECIFY RETCODE FIELD)              X
               ERROR=ERROR        ABEND IF MACRO ERROR
         BAL   R14,RCCHECK         --> CHECK IT
```

Figure 41. IPV6_MULTICAST_LOOP (Part 1 of 2)

```
*************************************************************************
*                                                                       *
*        Issue SETSOCKOPT/GETSOCKOPT - IPV6_MULTICAST_LOOP DISABLED     *
*                                                                       *
*************************************************************************
         EZASMI TYPE=SETSOCKOPT,  ISSUE SETSOCKOPT                     X
               S=S,               SOCKET DESCRIPTOR                    X
               OPTLEN=OPTLEN1,    OPTION LENGTH                        X
               OPTNAME='IPV6_MULTICAST_LOOP', OPTION NAME              X
               OPTVAL=OPTVALOFF,  OPTION VALUE                         X
               RETCODE=RETCODE,   (SPECIFY RETCODE FIELD)              X
               ERROR=ERROR        ABEND IF MACRO ERROR
         BAL   R14,RCCHECK         --> CHECK IT
            :
            :
         XC    OPTVAL4,OPTVAL4
         EZASMI TYPE=GETSOCKOPT,  ISSUE GETSOCKOPT                     X
               S=S,               SOCKET DESCRIPTOR                    X
               OPTLEN=OPTLEN1,    OPTION LENGTH                        X
               OPTNAME='IPV6_MULTICAST_LOOP', OPTION NAME              X
               OPTVAL=OPTVAL4,    OPTION VALUE                         X
               RETCODE=RETCODE,   (SPECIFY RETCODE FIELD)              X
               ERROR=ERROR        ABEND IF MACRO ERROR
         BAL   R14,RCCHECK         --> CHECK IT
```

Figure 41. IPV6_MULTICAST_LOOP (Part 2 of 2)

IPV6_MULTICAST_HOPS

The IPV6_MULTICAST_HOPS socket option allows the application to primarily limit the lifetime of the packet in the Internet and prevent it from circulating indefinitely. The default value is 1, meaning multicast is available only to the local subnet.

Figure 42 illustrates the use of IPV6_MULTICAST_HOPS by the use of the SETSOCKOPT and GETSOCKOPT APIs.

```
*********************************************************************
*                                                                   *
*        Issue SETSOCKOPT/GETSOCKOPT - IPV6_MULTICAST_HOPS          *
*                                                                   *
*********************************************************************
*
* SET TTL TO SAME SITE
*
         EZASMI TYPE=SETSOCKOPT,  ISSUE SETSOCKOPT                  X
               S=S,               SOCKET DESCRIPTOR                 X
               OPTLEN=OPTLEN1,    OPTION LENGTH                     X
               OPTNAME='IPV6_MULTICAST_HOPS', OPTION NAME           X
               OPTVAL=SAMESITE,   OPTION VALUE                      X
               RETCODE=RETCODE,   (SPECIFY RETCODE FIELD)           X
               ERROR=ERROR        ABEND IF MACRO ERROR
         BAL   R14,RCCHECK         --> CHECK IT
*
* DISPLAY HOPS, SHOULD BE 32
*
         XC    OPTVAL4,OPTVAL4
         EZASMI TYPE=GETSOCKOPT,  ISSUE GETSOCKOPT                  X
               S=S,               SOCKET DESCRIPTOR                 X
               OPTLEN=OPTLEN1,    OPTION LENGTH                     X
               OPTNAME='IPV6_MULTICAST_HOPS', OPTION NAME           X
               OPTVAL=OPTVAL4,    OPTION VALUE                      X
               RETCODE=RETCODE,   (SPECIFY RETCODE FIELD)           X
               ERROR=ERROR        ABEND IF MACRO ERROR
         BAL   R14,RCCHECK         --> CHECK IT
```

Figure 42. IPV6_MULTICAST_HOPS

Designing multicast programs: Protocol-independent multicast options

The following socket options enable your application to support IPv4 and IPv6 multicast:

- MCAST_BLOCK_SOURCE
- MCAST_JOIN_GROUP
- MCAST_JOIN_SOURCE_GROUP
- MCAST_LEAVE_GROUP
- MCAST_ LEAVE_SOURCE_GROUP
- MCAST_UNBLOCK_SOURCE

Use the Macro, Callable, and REXX Sockets API SETSOCKOPT call to set these options.

MCAST_JOIN_GROUP and MCAST_LEAVE_GROUP

Use the MCAST_JOIN_GROUP socket option to join a multicast group and set the IPv4 or IPv6 multicast address and the local interface index. Use the SETSOCKOPT API and specify the address of the GROUP_REQ structure that contains the address and the interface index. The application can join multiple multicast groups

on a single socket and can also join the same group on multiple interfaces on the same socket. However, there is a maximum limit of 20 groups per single UDP socket and there is a maximum limit of 256 groups per single RAW socket. The stack chooses a default multicast interface if the interface index 0 is passed. The format of the GROUP_REQ structure is in the BPXYSOCK macro. The assembler program example in Figure 43 on page 97 shows this socket option using the EZASMI macro:

```
*********************************************************************
*                                                                   *
*        Issue SETSOCKOPT - MCAST_JOIN_GROUP                        *
*                                                                   *
*********************************************************************

         EZASMI TYPE=SETSOCKOPT,  ISSUE SETSOCKOPT                   X
               S=S,               SOCKET DESCRIPTOR                  X
               OPTLEN=OPTL136,    OPTION LENGTH                      X
               OPTNAME='MCAST_JOIN_GROUP', OPTION NAME               X
               OPTVAL=GROUP_REQ1, OPTION VALUE                       X
               ERRNO=ERRNO,       (SPECIFY ERRNO FIELD)              X
               RETCODE=RETCODE,   (SPECIFY RETCODE FIELD)            X
               ERROR=ERROR        ABEND IF MACRO ERROR
         BAL   R14,RCCHECK         --> CHECK IT
*
* Here your program will perform normal processing such as sending or
* receiving message.
*

*********************************************************************
*                                                                   *
*        Issue SETSOCKOPT - MCAST_LEAVE_GROUP                       *
*                                                                   *
*********************************************************************

         EZASMI TYPE=SETSOCKOPT,  ISSUE SETSOCKOPT                   X
               S=S,               SOCKET DESCRIPTOR                  X
               OPTLEN=OPTL136,    OPTION LENGTH                      X
               OPTNAME='MCAST_LEAVE_GROUP', OPTION NAME              X
               OPTVAL=GROUP_REQ1, OPTION VALUE                       X
               ERRNO=ERRNO,       (SPECIFY ERRNO FIELD)              X
               RETCODE=RETCODE,   (SPECIFY RETCODE FIELD)            X
               ERROR=ERROR        ABEND IF MACRO ERROR
         BAL   R14,RCCHECK         --> CHECK IT


*
* GETSOCKOPT and SETSOCKOPT parms
*
OPTLEN1  DC    F'1'
OPTLEN4  DC    F'4'
OPTLEN8  DC    F'8'
OPTL136  DC    F'136'
OPTL264  DC    F'264'
*-------------------------------------------------------*
* Group_Req Structure
*-------------------------------------------------------*
GROUP_REQ1   DS  0CL136
GR_INTF1     DC  XL4'00010005'         Interface Index
             DS  CL4                   Padding
GR_GROUP1    DS  0CL128                Group Address
             DC  XL16'10020000E01111110000000000000000'
             DC  XL112'00'
*-------------------------------------------------------*
* Group_Source_Req Structure
*-------------------------------------------------------*
GSR_REQ1     DS  0CL264
GSR_INTF1    DC  XL4'00010005'         Interface Index
             DS  CL4                   Padding
GSR_GROUP1   DS  0CL128                Group Address
             DC  XL16'10020000E01111110000000000000000'
             DC  XL112'00'
GSR_SRCAD1   DS  0CL128                Source Address
             DC  XL16'10020000424242420000000000000000'
             DC  XL112'00'
```

Figure 43. MCAST_JOIN_GROUP and MCAST_LEAVE_GROUP

To remove the host from the multicast host group you must issue a SETSOCKOPT call with the MCAST_LEAVE_GROUP option. Using this call is similar to using the MCAST_JOIN_GROUP option because it also uses the GROUP_REQ structure to declare the multicast address and the local interface index. You can also use MCAST_LEAVE_GROUP option to remove all sources for a given multicast group.

While the application is a member of the multicast host group, datagrams can be sent or received as required. To see the multicast groups that are joined on an interface, use the Netstat DEvlinks/-d command. To see the multicast groups that are joined on a socket, use the Netstat ALL/-A command.

MCAST_JOIN_SOURCE_GROUP and MCAST_LEAVE_SOURCE_GROUP

Use the MCAST_JOIN_SOURCE_GROUP option to set the IPv4 or IPv6 multicast address, source address, and the local interface index. Use the SETSOCKOPT API and specify the address of the GROUP_SOURCE_REQ structure that contains these addresses and the interface index. The application can join multiple source multicast groups on a single socket and can also join the same group on multiple interfaces on the same socket. However, there is a maximum limit of 20 groups per single UDP socket and there is a maximum limit of 256 groups per single RAW socket. The stack chooses a default multicast interface if the interface index 0 is passed. The format of the GROUP_SOURCE_REQ structure is in the BPXYSOCK macro. The assembler program example in Figure 44 on page 99 shows this socket option using the EZASMI macro:

```
*********************************************************************
*                                                                   *
*        Issue SETSOCKOPT - MCAST_JOIN_SOURCE_GROUP                 *
*                                                                   *
*********************************************************************

         EZASMI TYPE=SETSOCKOPT,  ISSUE SETSOCKOPT                   X
               S=S,               SOCKET DESCRIPTOR                  X
               OPTLEN=OPTL264,    OPTION LENGTH                      X
               OPTNAME='MCAST_JOIN_SOURCE_GROUP', OPTION NAME        X
               OPTVAL=GSR_REQ1,   OPTION VALUE                       X
               ERRNO=ERRNO,       (SPECIFY ERRNO FIELD)              X
               RETCODE=RETCODE,   (SPECIFY RETCODE FIELD)            X
               ERROR=ERROR        ABEND IF MACRO ERROR
         BAL   R14,RCCHECK         --> CHECK IT
*
* Here your program will perform normal processing such as sending or
* receiving message.
*

*********************************************************************
*                                                                   *
*        Issue SETSOCKOPT - MCAST_LEAVE_SOURCE_GROUP                *
*                                                                   *
*********************************************************************

         EZASMI TYPE=SETSOCKOPT,  ISSUE SETSOCKOPT                   X
               S=S,               SOCKET DESCRIPTOR                  X
               OPTLEN=OPTL264,    OPTION LENGTH                      X
               OPTNAME='MCAST_LEAVE_SOURCE_GROUP', OPTION NAME       X
               OPTVAL=GSR_REQ1,   OPTION VALUE                       X
               ERRNO=ERRNO,       (SPECIFY ERRNO FIELD)              X
               RETCODE=RETCODE,   (SPECIFY RETCODE FIELD)            X
               ERROR=ERROR        ABEND IF MACRO ERROR
         BAL   R14,RCCHECK         --> CHECK IT
```

Figure 44. MCAST_JOIN_SOURCE_GROUP and MCAST_LEAVE_SOURCE_GROUP

To remove the host from the source multicast host group you must issue a SETSOCKOPT call with the MCAST_LEAVE_SOURCE_GROUP option. This call is similar to the MCAST_JOIN_SOURCE_GROUP option because it also uses the GROUP_SOURCE_REQ structure to declare the IPv4 or IPv6 multicast address, source address, and the local interface index (see Figure 44). You can also use the MCAST_LEAVE_GROUP option to remove all sources for a given multicast group.

While the application is a member of the source multicast host group, datagrams can be sent or received as required. To see the multicast groups that are joined on an interface, use the Netstat DEvlinks/-d command. To see the multicast groups that are joined on a socket, use the Netstat ALL/-A command.

MCAST_BLOCK_SOURCE and MCAST_UNBLOCK_SOURCE

The MCAST_BLOCK_SOURCE socket option enables the application to block IPv4 or IPv6 multicast packets that have a source address that matches the given source address. The specified multicast group must have been joined previously. The MCAST_UNBLOCK_SOURCE socket option enables the application to unblock a previously blocked source for a given source multicast group. Use the SETSOCKOPT API and specify the GROUP_SOURCE_REQ structure that contains the multicast address, the source address, and the local interface address. The format of the GROUP_SOURCE_REQ structure is in the BPXYSOCK macro. The assembler program example in Figure 45 on page 100 shows the socket option using the EZASMI macro:

```
*********************************************************************
*                                                                   *
*        Issue SETSOCKOPT - MCAST_BLOCK_SOURCE                      *
*                                                                   *
*********************************************************************

         EZASMI TYPE=SETSOCKOPT,  ISSUE SETSOCKOPT                  X
               S=S,               SOCKET DESCRIPTOR                 X
               OPTLEN=OPTL264,    OPTION LENGTH                     X
               OPTNAME='MCAST_BLOCK_SOURCE', OPTION NAME            X
               OPTVAL=GSR_REQ1,   OPTION VALUE                      X
               ERRNO=ERRNO,       (SPECIFY ERRNO FIELD)             X
               RETCODE=RETCODE,   (SPECIFY RETCODE FIELD)           X
               ERROR=ERROR        ABEND IF MACRO ERROR
         BAL   R14,RCCHECK         --> CHECK IT
*
* Here your program will perform normal processing such as sending or
* receiving message.
*

*********************************************************************
*                                                                   *
*        Issue SETSOCKOPT - MCAST_UNBLOCK_SOURCE                    *
*                                                                   *
*********************************************************************

         EZASMI TYPE=SETSOCKOPT,  ISSUE SETSOCKOPT                  X
               S=S,               SOCKET DESCRIPTOR                 X
               OPTLEN=OPTL264,    OPTION LENGTH                     X
               OPTNAME='MCAST_UNBLOCK_SOURCE', OPTION NAME          X
               OPTVAL=GSR_REQ1,   OPTION VALUE                      X
               ERRNO=ERRNO,       (SPECIFY ERRNO FIELD)             X
               RETCODE=RETCODE,   (SPECIFY RETCODE FIELD)           X
               ERROR=ERROR        ABEND IF MACRO ERROR
         BAL   R14,RCCHECK         --> CHECK IT
```

Figure 45. MCAST_BLOCK_SOURCE and MCAST_UNBLOCK_SOURCE

While the application is a member of the multicast host group, datagrams can be sent or received as required. To see the multicast groups that are joined on an interface, use the Netstat DEvlinks/-d command. To see the multicast groups that are joined on a socket, use the Netstat ALL/-A command.

Designing multicast programs: IOCTL multicast commands

The following IOCTL commands enable applications to support the advanced (full-state) multicast API for IPv4 and IPv6 addresses:

- SIOCGIPMSFILTER
- SIOCGMSFILTER
- SIOCSIPMSFILTER
- SIOCSMSFILTER

Use the Macro, Callable, and REXX Sockets API IOCTL call for these options.

SIOCGIPMSFILTER

An SIOCGIPMSFILTER IOCTL enables an application to retrieve a list of the IPv4 source addresses that comprise the source filter, with the current mode on a given interface and a multicast group for a socket. The source filter can include or exclude the set of source addresses, depending on the filter mode (MCAST_INCLUDE or MCAST_EXCLUDE), which is defined in the IP_MSFILTER structure of the BPXYIOCC macro.

SIOCGMSFILTER

An SIOCGMSFILTER IOCTL enables an application to retrieve a list of the IPv4 or IPv6 source addresses that comprise the source filter along with the current mode on a given interface index and a multicast group for a socket. The source filter may either include or exclude the set of source address, depending on the filter mode (MCAST_INCLUDE or MCAST_EXCLUDE), which is defined in the GROUP_FILTER structure of the BPXYIOCC macro.

SIOCSIPMSFILTER

An SIOCSIPMSFILTER IOCTL enables an application to specify or modify a list of IPv4 source addresses on a given interface and to specify or modify a multicast group for a socket. The source filter can include or exclude the set of source addresses, depending on the filter mode (MCAST_INCLUDE or MCAST_ EXCLUDE), which is defined in the IP_MSFILTER structure of the BPXYIOCC macro. The application can join multiple source multicast groups on a single socket; it also can join the same group on multiple interfaces on the same socket. However, there is a maximum limit of 20 groups per single UDP socket and there is a maximum limit of 256 groups per single RAW socket.

SIOCSMSFILTER

An SIOCSMSFILTER IOCTL enables an application to specify or modify a list of IPv4 or IPv6 source addresses on a given interface index and to specify or modify a multicast group for a socket. The source filter can include or exclude the set of source address, depending on the filter mode (MCAST_INCLUDE or MCAST_EXCLUDE), which is defined in the GROUP_FILTER structure of the BPXYIOCC macro. The application can join multiple source multicast groups on a single socket; it also can join the same group on multiple interfaces on the same socket. However, there is a maximum limit of 20 groups per single UDP socket and there is a maximum limit of 256 groups per single RAW socket.

Part 3. Application program interfaces

The following application programming interfaces (API's) are described:

- C Socket application programming interface (API)
- X/Open Transport Interface (XTI)
- Macro application programming interface (API)
- CALL instruction application programming interface (API)
- REXX socket application programming interface (API)
- Pascal application programming interface (API)

© Copyright IBM Corp. 1989, 2010

Chapter 10. C Socket application programming interface

Note: The TCP/IP C socket API is not being enhanced for IPv6. The use of the UNIX C socket library is encouraged for IPv4 application development and is required for IPv6 application development. For more information, see *z/OS XL C/C++ Run-Time Library Reference*.

This information describes the C IPv4 socket application program interface (API) provided with TCP/IP. Use the socket routines to interface with the TCP, UDP, and IP protocols. The socket routines allow you to communicate with other programs across networks. You can, for example, use socket routines when you write a client program that must communicate with a server program running on another computer.

Topics include:

- Compiler restrictions
- Compiling and linking C applications
- Compiler messages
- Program abends
- C socket implementation
- C socket header files
- C structures
- Error messages and return codes
- C socket calls
- Sample C socket programs

To use the C socket API, you must know C language programming. For more information about C language programming, see *z/OS XL C/C++ Programming Guide*.

Compiler restrictions with C applications

This topic tells you how to move your application to the z/OS Communications Server system.

- When you need to recompile, use the compiler shipped with this product.
- All applications linked to the TCP/IP C sockets library must run on the LE run-time library shipped with z/OS Communications Server.
- To access system return values, you need only use include statement errno.h supplied with the compiler. To access network return values, you must add the following include statement:

  ```
  #include <tcperrno.h>
  ```

- To print system errors only, use perror(), a procedure available from the C compiler run-time library. To print both system and network errors, use tcperror(), a procedure provided by IBM and included with z/OS Communications Server.

  Note to CICS users:

© Copyright IBM Corp. 1989, 2010

Do not use tcperror(). Add statement #include <ezacichd.h> and compile the statement as non-reentrant. For more information, see the information about C Language Programming in the *z/OS Communications Server: IP CICS Sockets Guide*.

- If your C language statements contain information, such as sequence numbers, that are not part of the input for the C/C++ compiler, you must exclude that information during compilation. The C/C++ compiler provides several ways to do this, one of which is:

  ```
  #pragma margins (1,72)
  ```

  In this example, we are presuming you have sequence numbers in columns 73 through 80.
- By default, prototype C socket functions and their parameters for the current release are defined. If you need to access the TCP/IP V3R1 definitions, specify the following during a compile:

  ```
  #define_TCP31_PROTOS
  ```
- Use of C socket functions by routines that are a part of fetched modules or DLLs might not yield the desired results. Applications that use these C language features need to be designed so that only one copy of the API code is used within the execution environment. Also note that proper cleanup of the supporting data structures relies on the termination logic defined with the atexit() function and has all of the corresponding restrictions listed for it (see *z/OS XL C/C++ Run-Time Library Reference* for details). Improper use will likely cause new copies of the associated data structures to be allocated in the application's address space each time the fetched module or DLL is loaded.

Compiling and linking C applications

There are several ways to compile, link-edit, and execute z/OS Communications Server C source program in MVS. To run a C source program under MVS batch using IBM supplied cataloged procedures, you must include data sets. This topic contains information about the data sets that you must include.

The following data set name is used as an example in the sample Job Control Language (JCL) statements.

USER.MYPROG.H
Contains user #include files.

C application compatibility considerations

Unless noted in *z/OS Communications Server: New Function Summary*, an application program compiled and link edited on a release of z/OS Communications Server IP can be used on higher level releases. That is, the API is upward compatible.

Application programs that are compiled and link edited on a release of z/OS Communications Server IP cannot be used on older releases. That is, the API is not downward compatible.

C socket API: Non-reentrant modules

You must make additions to the compile step of your cataloged procedure to compile a non-reentrant module. The following lines describe these additions. Cataloged procedures are included in the IBM-supplied samples for your MVS system.

Note: Compile all C code source using the def(MVS) preprocessor symbol.

- Add the following line as the first //SYSLIB DD statement:

```
//SYSLIB DD  DSN=SEZACMAC,DISP=SHR
```

- Add the following //USERLIB DD statement:

```
//USERLIB DD  DSN=USER.MYPROG.H,DISP=SHR
```

The following lines describe the additions that you must make to the link-edit step of your cataloged procedure to link-edit a non-reentrant module.

- To link-edit programs that use C sockets library functions, add the following statement as the first //SYSLIB DD statement:

```
//SYSLIB DD  DSN=SEZACMTX,DISP=SHR
```

Figure 46 on page 108 shows a sample JCL to be used when compiling non-reentrant modules. Modify the lines to conform to the naming conventions of your site:

```
//COMPIT   JOB ,COMPILE,MSGLEVEL=(1,1)
//*****************************************************************
//*                                                               *
//*  SAMPLE JCL THAT COMPILES A TEST PROGRAM  AS NORENT            *
//*       USING THE C/C++ COMPILER C/MVS IN NON-OE ENVIRONMENT     *
//*  INPUT  : USER71.TEST.SRC(&INFILE)                            *
//*  OUTPUT : USER71.TEST.OBJ(&OUTFILE)                           *
//*                                                               *
//*****************************************************************
//*
//CPPC PROC CREGSIZ='4M',
//   INFILE=CTEST,
//   OUTFILE=CTEST,
//   CPARM1=NORENT,
//   CPARM2='LIS,SO,EXP,OPT,DEF(MVS)',
//   DCB80='(RECFM=FB,LRECL=80,BLKSIZE=3200)',
//   DCB3200='(RECFM=FB,LRECL=3200,BLKSIZE=12800)',
//   LIBPRFX1='CEEL.OSV2R7',
//   LIBPRFX2='CEE.OSV2R7',
//   COMPRFX='CBC.OSV2R7'
//*
//*-------------------------------------------------
//*  COMPILE STEP:
//*-------------------------------------------------
//COMPILE EXEC PGM=CCNDRVR,PARM=('&CPARM1','&CPARM2'),
//   REGION=&CREGSIZ
//STEPLIB  DD  DSNAME=&LIBPRFX1..SCEERUN,DISP=SHR
//         DD  DSNAME=&COMPRFX..SCBCCMP,DISP=SHR
//SYSMSGS  DD  DUMMY,DSNAME=&COMPRFX..SCBC3MSG(EDCMSGE),DISP=SHR
//SYSIN    DD  DSNAME=USER71.TEST.SRC(&INFILE),DISP=SHR
//USERLIB  DD  DSN=USER.MYPROG.H,DISP=SHR
//SYSLIB   DD  DSN=TCP.SEZACMAC,DISP=SHR
//         DD DSN=&LIBPRFX2..SCEEH.H,DISP=SHR
//SYSLIN   DD  DSNAME=USER16.TEST.OBJ(&OUTFILE),DISP=SHR
//SYSPRINT DD  SYSOUT=*
//SYSCPRT  DD  SYSOUT=*
//SYSUT1   DD  UNIT=VIO,SPACE=(32000,(30,30)),DCB=&DCB80
//SYSUT5   DD  UNIT=VIO,SPACE=(32000,(30,30)),DCB=&DCB3200
//SYSUT6   DD  UNIT=VIO,SPACE=(32000,(30,30)),DCB=&DCB3200
//SYSUT7   DD  UNIT=VIO,SPACE=(32000,(30,30)),DCB=&DCB3200
//SYSUT8   DD  UNIT=VIO,SPACE=(32000,(30,30)),DCB=&DCB3200
//SYSUT9   DD  UNIT=VIO,SPACE=(32000,(30,30)),
//             DCB=(RECFM=VB,LRECL=137,BLKSIZE=882)
//SYSUT10  DD  SYSOUT=*
//*
//    PEND
//    EXEC PROC=CPPC
```

Figure 46. Sample JCL for compiling non-reentrant modules.

Figure 47 on page 109 shows a sample JCL to be used when linking non-reentrant modules. Modify the lines to conform to the naming conventions of your site:

```
//LINKIT   JOB ,LINK,MSGLEVEL=(1,1)
//*****************************************************************
//*                                                               *
//*  SAMPLE JCL THAT LINKS A NON_REENTRANT TEST PROGRAM           *
//*       USING THE C/C++ COMPILER C/MVS                          *
//*  INPUT  LIBRARY: USER71.TEST.OBJ(&MEM)                        *
//*  OUTPUT LIBRARY: USER71.TEST.LMOD(&MEM)                       *
//*                                                               *
//*****************************************************************
//EDCL PROC USER=USER71
//TCPIP     EXEC PGM=IEWL,
//     PARM=',MAP,RMODE(ANY),SIZE=(320K,64K)'
//SYSPRINT DD SYSOUT=*
//SYSUT1   DD UNIT=SYSDA,SPACE=(CYL,(1,1))
//SYSLMOD  DD DSN=&USER..TEST.LMOD(&MEM),DISP=SHR
//SYSLIN   DD DSN=&USER..TEST.OBJ(&MEM),DISP=SHR
//SYSLIB   DD DSN=TCP.SEZACMTX,DISP=SHR
//         DD DSN=CEE.OSV2R7.SCEELKED,DISP=SHR
//     PEND
//   EXEC EDCL,MEM=CTEST
```

Figure 47. Sample JCL for linking non-reentrant modules.

Figure 48 shows JCL to be used when running non-reentrant modules. Modify the lines to conform to the naming conventions of your site:

```
//RUNTST  JOB ,RUN,MSGLEVEL=(1,1),CLASS=A,REGION=4096K
//*****************************************************************
//*                                                               *
//*  SAMPLE JCL THAT RUNS A TEST PROGRAM, CTEST                   *
//*                                                               *
//*****************************************************************
//S1  EXEC PGM=CTEST
//STEPLIB DD DSN=CEEL.OSV2R7.SCEERUN,DISP=SHR
//        DD DSN=USER71.TEST.LMOD,DISP=SHR
//SYSPRINT DD  SYSOUT=*
```

Figure 48. Sample JCL for running non-reentrant modules.

Note: For more information about compiling and linking, see *z/OS XL C/C++ Compiler and Run-Time Migration Guide for the Application Programmer*.

C socket API: Reentrant modules

The following lines describe the additions that you must make to the compile step of your cataloged procedure to compile a reentrant module. Cataloged procedures are included in the IBM-supplied samples for your MVS system.

Note: Compile all C source code using the def(MVS) preprocessor symbol.

Be sure to use the RENT compiler option if your code is reentrant.

- Add the following line as the first //SYSLIB DD statement:

  ```
  //SYSLIB DD  DSN=SEZACMAC,DISP=SHR
  ```

- Add the following //USERLIB DD statement:

  ```
  //USERLIB DD  DSN=USER.MYPROG.H,DISP=SHR
  ```

The following lines describe the additions that you must make to the prelink-edit and link-edit steps of your cataloged procedure to create a reentrant module.

To prelink programs that use the C sockets library function, put the following statement first in the SYSLIB concatenation:

```
//SYSLIB DD DSN=SEZARNT1,DISP=SHR
```

Guideline: The system administrator should have followed the instructions for program reentrancy in the *z/OS XL C/C++ Programming Guide* topic that contains information related to restrictions for using MVS TCP/IP API with z/OS UNIX.

To link-edit programs that have the C sockets library function, the following statement must be first in the SYSLIB concatenation:

```
//SYSLIB DD DSN=SEZACMTX,DISP=SHR
```

Notes:

1. If Language Environment libraries are concatenated ahead of SEZACMTX, socket errors can occur because the link-edit uses the Language Environment z/OS UNIX socket library, not the TCP/IP library.
2. For more information about compiling and linking, see *z/OS XL C/C++ Compiler and Run-Time Migration Guide for the Application Programmer*.

Figure 49 on page 111 shows sample JCL to be used when compiling a test program with reentrancy. Modify the lines to conform to the naming conventions of your site:

```
//*****************************************************************
//*                                                               *
//*  SAMPLE JCL THAT COMPILES A TEST PROGRAM, CTEST, AS 'RENT',   *
//*       USING THE C/C++ COMPILER C/MVS                          *
//*                                                               *
//*****************************************************************
//*
//CPPC PROC CREGSIZ='4M',
//   INFILE=CTEST,
//   CPARM1=RENT,
//   CPARM2='LIS,SO,EXP,OPT,DEF(MVS),SHOWINC',
//   DCB80='(RECFM=FB,LRECL=80,BLKSIZE=3200)',
//   DCB3200='(RECFM=FB,LRECL=3200,BLKSIZE=12800)',
//   LIBPRFX1='CEEL.OSV2R7',
//   LIBPRFX2='CEE.OSV2R7',
//   COMPRFX='CBC.OSV2R7'
//*
//*--------------------------------------------------
//*  COMPILE STEP:
//*--------------------------------------------------
//COMPILE EXEC PGM=CCNDRVR,PARM=(,
//   '&CPARM1','&CPARM2'),REGION=&CREGSIZ
//STEPLIB  DD  DSNAME=&LIBPRFX1..SCEERUN,DISP=SHR
//         DD  DSNAME=&COMPRFX..SCBCCMP,DISP=SHR
//SYSMSGS  DD  DUMMY,DSNAME=&COMPRFX..SCBC3MSG(EDCMSGE),DISP=SHR
//SYSIN    DD  DSNAME=USER71.TEST.SRC(&INFILE),DISP=SHR
//USERLIB  DD  DSN=USER.MYPROG.H,DISP=SHR
//SYSLIB   DD  DSN=TCP.SEZACMAC,DISP=SHR
//         DD DSN=&LIBPRFX2..SCEEH.H,DISP=SHR
//SYSLIN   DD  DSNAME=USER71.TEST.RENTDS,DISP=SHR
//SYSPRINT DD  SYSOUT=*
//SYSCPRT  DD  SYSOUT=*
//SYSUT1   DD  UNIT=VIO,SPACE=(32000,(30,30)),DCB=&DCB80
//SYSUT5   DD  UNIT=VIO,SPACE=(32000,(30,30)),DCB=&DCB3200
//SYSUT6   DD  UNIT=VIO,SPACE=(32000,(30,30)),DCB=&DCB3200
//SYSUT7   DD  UNIT=VIO,SPACE=(32000,(30,30)),DCB=&DCB3200
//SYSUT8   DD  UNIT=VIO,SPACE=(32000,(30,30)),DCB=&DCB3200
//SYSUT9   DD  UNIT=VIO,SPACE=(32000,(30,30)),
//             DCB=(RECFM=VB,LRECL=137,BLKSIZE=882)
//SYSUT10  DD  SYSOUT=*
//*
//    PEND
//    EXEC PROC=CPPC
```

Figure 49. Sample JCL for compiling reentrant modules

Figure 50 on page 112 shows sample JCL to be used when prelinking and linking a reentrant program using the C socket library. Modify the lines to conform to the naming conventions of your site:

```
//*******************************************************************
//*
//*   PRE-LINK AND LINK FOR REENTRANCY WITH C/C++ COMPILER,
//*        z/OS RUNTIME LIBRARY.
//*   NOTES:
//*    - SPECIFY 'RENT' ON LINK STEP
//*    - RENTDS WAS PREVIOUSLY COMPILED WITH 'RENT'
//*    - THE MEMBER @@DC370$ CAN BE USED TO BRING IN ALL C SOCKET
//*      MEMBERS. THIS IS EASIER THAN SPECIFYING ALL THE INDIVIDUAL
//*      MEMBER INCLUDES.
//*    - TCP.SEZARNT1 IS THE REENTRANT C SOCKET LIBRARY.
//*      IT IS USED ON THE PRE-LINK STEP.
//*    - TCP.SEZACMTX IS THE GENERIC SOCKET LIBRARY.
//*      IT IS USED ON THE LINK STEP TO RESOLVE OTHER C SOCKET
//*      MODULES THAT DO NOT EXIST IN TCP.SEZARNT1.
//*    - THE PRE-LINK REQUIRES THE 'UPCASE' PARM SO THAT THE
//*      OTHER MODULES FROM SEZACMTX (WHICH ARE KNOWN BY
//*      THEIR UPPERCASE NAMES) CAN BE FOUND.
//*******************************************************************
//*
//*-------------------------------------------------------
//*     MODIFY THE FOLLOWING LINES TO CONFORM TO THE
//*     NAMING CONVENTIONS AT YOUR SITE.
//*-------------------------------------------------------
//RENTTEST PROC MYHLQ='USER71.TEST',
//   LIBPRFX1='CEE',
//   LIBPRFX2='CEE'
//*-------------------------------------------------------------
//* PRE-LINKEDIT STEP:
//*-------------------------------------------------------------
//PLKED   EXEC PGM=EDCPRLK,
//    REGION=2048K,PARM='UPCASE'
//STEPLIB  DD  DSNAME=&LIBPRFX1..SCEERUN,DISP=SHR
//SYSMSGS  DD  DSNAME=&LIBPRFX2..SCEEMSGP(EDCPMSGE),DISP=SHR
//SYSLIB   DD  DSN=TCP.SEZARNT1,DISP=SHR
//SYSMOD   DD  DSNAME=&&PLKSET,UNIT=SYSDA,DISP=(MOD,PASS),
//             SPACE=(32000,(30,30)),
//             DCB=(RECFM=FB,LRECL=80,BLKSIZE=3200)
//OBJLIB   DD  DSN=&MYHLQ..OBJ,DISP=SHR
//MYRENT   DD  DSN=&MYHLQ..RENTDS,DISP=SHR
//SYSOUT   DD  SYSOUT=*
//SYSPRINT DD  SYSOUT=*
//*
//*-------------------------------------------------------------------
//* LINKEDIT STEP:
//*-------------------------------------------------------------------
//LKED   EXEC PGM=IEWL,COND=(4,LT,PLKED),
//    REGION=2048K,PARM='RENT,AMODE=31,MAP'
//SYSLIB   DD  DSN=TCP.SEZACMTX,DISP=SHR
//         DD  DSNAME=&LIBPRFX2..SCEELKED,DISP=SHR
//SYSPRINT DD  SYSOUT=*
//SYSLIN   DD  DSNAME=*.PLKED.SYSMOD,DISP=(OLD,DELETE)
//SYSLMOD  DD  DSNAME=&MYHLQ..LMOD(CTESTRNT),DISP=SHR
//SYSUT1   DD  UNIT=SYSDA,SPACE=(32000,(30,30))
//   PEND
//S1  EXEC PROC=RENTTEST
//PLKED.SYSIN DD *
  INCLUDE MYRENT
  INCLUDE SYSLIB(@@DC370$)
/*
```

Figure 50. Sample JCL for prelinking and linking reentrant modules

Figure 51 on page 113 shows sample JCL to be used when running the reentrant program prelinked and linked in the previous JCL sample. Modify the lines to

conform to the naming conventions of your site:

```
//RUNTST  JOB ,RUN,MSGLEVEL=(1,1),CLASS=A,REGION=4096K
//*******************************************************************
//*                                                                 *
//*  SAMPLE JCL THAT RUNS A TEST PROGRAM, CTESTRNT                  *
//*                                                                 *
//*******************************************************************
//S1  EXEC PGM=CTESTRNT
//STEPLIB DD DSN=CEEL.OSV2R7.SCEERUN,DISP=SHR
//        DD DSN=USER71.TEST.LMOD,DISP=SHR
//SYSPRINT DD  SYSOUT=*
```

Figure 51. Sample JCL for running the reentrant program

C program compiler messages

z/OS Communications Server uses the C/C++/390 compiler. For C programs, migrating from AD/Cycle® to the C/C++/390 compiler can pose a few minor problems. See *z/OS XL C/C++ Messages* or *z/OS XL C/C++ Compiler and Run-Time Migration Guide for the Application Programmer* for more information.

C program abends

A C program might compile and link correctly, but at run-time it might abend or behave peculiarly. The following lists some reasons for unexpected behavior, and suggests some fixes.

Errno values

Code depends on specific errno values. This might be a problem, as errno values can change from release to release. Do the following:

1. Check for any error conditions.
2. Make sure your logic has a default section that can be used if the specific errno has changed or is no longer available.

Printing errno values: The tcpserror() function converts errno values to strings, which you can then print using printf() or a similar command. This procedure is provided by IBM and included with z/OS Communications Server, and is similar to the strerror() function in the standard C library.

Return values

Code depends on a specific return value. Some RTL functions, such as remove(), specify that the return code be nonzero on failure. In earlier releases, checking for -1 was sufficient; with release V1R4, the correct check is for nonzero.

Unfortunately, there is no checklist of functions that might generate this problem. If you get an abend, work backwards from the failure and examine prior RTL function return-code checking.

Built-in RTL functions

If RTL functions were built-in during your compile, ensure that they perform the same way as the non-built-in functions from the RTL.

Functions that might have this problem include abs, cds, cs, decabs, decchk, decfix, fabs, fortrc, memchr, memcpy, memcmp, memset, strcat, strchr, strcmp, strcpy, strlen, strncat, strncmp, strncpy, strrchr, and tsched.

SCEERUN missing
Ensure that SCEERUN is the first library in STEPLIB encountered by your compile procedure.

Uninitialized storage
Check for uninitialized storage. Storage for automatic variables is guaranteed to be garbage.

C socket implementation

The IBM socket implementation differs from the Berkeley socket implementation. The following list summarizes the differences in the two methods:

- The IBM implementation does not support AF_INET6 sockets.
- Under IBM implementation, you must make reference to the additional header file, TCPERRNO.H, if you want to refer to the networking errors other than those described in the compiler-supplied ERRNO.H file.
- Under IBM implementation, you must use the tcperror() routine to print the networking errno messages. tcperror() should be used only after socket calls, and perror() should be used only after C library calls.
- Under IBM implementation, you must include MANIFEST.H to remap the socket function long names to eight-character names.
- The IBM ioctl() call implementation might differ from the current Berkeley ioctl() call implementation. See “ioctl()” on page 170 for a description of the functions supported by the IBM implementation.
- The IBM getsockopt() and setsockopt() calls support only a subset of the options available. See “getsockopt()” on page 154 and “setsockopt()” on page 206 for details about the supported options.
- The IBM fcntl() call supports only a subset of the options available. See “fcntl()” on page 131 for details about the supported commands.
- The IBM implementation supports an increased maximum number (2000) of simultaneous sockets through the use of the maxdesc() call. (Only 1997 simultaneous sockets can be used, however.) The default maximum number of sockets is 47, any or all of which can be AF_INET sockets.

Keep the following in mind while creating your C socket application:

- Compile all C source using the def(MVS) preprocessor symbol.
- During debugging, set sock_do_teststor (1) to *on* to validate all storage addresses. After debugging, use sock_do_teststor (0) set to *off*.

C socket header files

To use the socket routines described in this topic, you must have the following header files available to your compiler. They can be found in the SEZACMAC data set.

- bsdtime.h
- bsdtocms.h
- bsdtypes.h
- fcntl.h
- if.h
- in.h
- inet.h
- ioctl.h
- manifest.h
- netdb.h

- rtrouteh.h
- socket.h
- tcperrno.h
- types.h
- uio.h

Note: The C socket header files have been enhanced to allow the user to specify the coded character set to be used. When including the header files in an application, the bsdtypes.h file must precede the socket.h file.

Manifest.h

Under IBM implementation, MANIFEST.H is used to remap socket function long names to eight-character names. To refer to the names, you must include the following statement as the first #include at the beginning of each program:

```
#include <manifest.h>
```

Prototyping

Under TCP/IP z/OS Communications Server, the prototyping of C socket functions and their parameters is the default. If you are migrating your applications, you can bypass the new prototyping by specifying `#define_TCP31_PROTOS` during a C compile.

C structures

The parameter lists for some C language socket calls include a pointer to a data structure defined by a C structure. Table 6 shows the C structures used, and the corresponding assembler language syntax.

Table 6. C structures in assembler language format

C structure	Assembler language equivalent

`struct sockaddr_in`
`{`
`  short  sin_family;`
`  ushort  sin_port;`
`  struct  in_addr sin_addr;`
`  char  sin_zero[8];`
`};`
	`FAMILY  DS  H`
	`PORT  DS  H`
	`ADDR  DS  F`
	`ZERO  DC  XL8'00'`

`struct timeval`
`{`
`  long  tv_sec;`
`  long  tv_usec;`
`};`
	`TVSEC  DS  F`
	`TVUSEC  DS  F`

`struct  linger {`
`  int  l_onoff;`
`  int  l_linger;`
`};`
	`ONOFF  DS  F`
	`LINGER  DS  F`

Table 6. C structures in assembler language format (continued)

C structure	Assembler language equivalent

struct ifreq {
#define IFNAMSIZ 16
char ifr_name[IFNAMSIZ];
union {
struct sockaddr ifru_addr;
struct sockaddr ifru_dstaddr;
struct sockaddr ifru_broadaddr;
short ifru_flags;
int ifru_metric;
caddr_t ifru_data;
} ifr_ifru;
};
	NAME DS 0CL16
	ADDR.FAMILY DS H
	ADDR.PORT DS H
	ADDR.ADDR DS F
	ADDR.ZERO DC XL8'00'
	ORG ADDR.FAMILY
	DST.FAMILY DS H
	DST.PORT DS H
	DST.ADDR DS F
	DST.ZERO DC XL8'00'
	ORG ADDR.FAMILY
	BRD.FAMILY DS H
	BRD.PORT DS H
	BRD.ADDR DS F
	BRD.ZERO DC XL8'00'
	ORG ADDR.FAMILY
	FLAGS DS H
	ORG ADDR.FAMILY
	METRIC DS F

struct ifconf {
int ifc_len;
union {
caddr_t ifcu_buf;
struct ifreq *ifcu_req;
} ifc_ifcu;
};
	IFCLEN DS F
	IGNORED DS F

struct clientid {
int domain;
char name[8];
char subtaskname[8];
char reserved[20];
};
	DOMAIN DS F
	NAME DS CL8
	SUBTASK DS CL8
	RESERVED DC XL20'00'

C socket API error messages and return codes

For information about error messages, see *z/OS Communications Server: IP Messages Volume 1 (EZA)*.

The most common return codes (ERRNOs) returned by TCP/IP are listed following each socket call.

For information about all return codes see Appendix B, "Socket call error return codes," on page 885.

C socket calls

This topic lists the syntax, parameters, and other information appropriate to each C socket call supported by TCP/IP.

accept()

The accept() call is used by a server to accept a connection request from a client. The call accepts the first connection on its queue of pending connections. The accept() call creates a new socket descriptor with the same properties as *s* and returns it to the caller. If the queue has no pending connection requests, accept() blocks the caller unless *s* is in nonblocking mode. If no connection requests are queued and *s* is in nonblocking mode, accept() returns -1 and sets errno to EWOULDBLOCK. The new socket descriptor cannot be used to accept new connections. The original socket, *s*, remains available to accept additional connection requests.

```
#include <manifest.h>
#include <bsdtypes.h>
#include <socket.h>
#include <in.h>
int accept(int s, struct sockaddr *addr, int *addrlen)
```

Parameter	Description
s	The socket descriptor.
addr	The socket address of the connecting client that is filled by accept() before it returns. The format of *addr* is determined by the domain in which the client resides. *addr* is only filled in by accept() when both *addr* and *addrlen* are nonzero values.
addrlen	Must initially point to an integer that contains the size in bytes of the storage pointed to by *addr*. If *addr* is NULL, then *addrlen* is ignored and can be NULL.

The *s* parameter is a stream socket descriptor created using the socket() call. It is usually bound to an address using the bind() call. The listen() call marks the socket as one that accepts connections and allocates a queue to hold pending connection requests. The listen() call allows the caller to place an upper boundary on the size of the queue.

The *addr* parameter points to a buffer into which the connection requester address is placed. The *addr* parameter is optional and can be set to NULL. If *addr* or *addrlen* is null or 0, *addr* is not filled in. The exact format of *addr* depends on the addressing domain from which the communication request originated. For example, if the connection request originated in the AF_INET domain, *addr* points to a *sockaddr_in* structure as defined in the header file IN.H. The *addrlen* parameter is used only when *name* is not NULL. Before calling accept(), you must set the integer pointed to by *addrlen* to the size of the buffer, in bytes, pointed to by *addr*. If the buffer is not large enough to hold the address, only the *addrlen* number of bytes of the requester address is copied.

Note: This call is used only with SOCK_STREAM sockets. There is no way to screen requesters without calling accept(). The application cannot determine which system from which requesters connections will be accepted. However, the caller can choose to close a connection immediately after discovering the identity of the requester.

A socket can be checked for incoming connection requests using the select() call.

Return values

A nonnegative socket descriptor indicates success; the value -1 indicates an error. Errno identifies the specific error.

Errno	Description
EBADF	The *s* parameter is not a valid socket descriptor.
ENOBUFS	Indicates insufficient buffer space available to create the new socket.
EINVAL	The *s* parameter is not of type SOCK_STREAM.
EFAULT	Using *addr* and *addrlen* would result in an attempt to copy the address into a portion of the caller address space to which information cannot be written.
EWOULDBLOCK	The socket descriptor *s* is in nonblocking mode, and no connections are in the queue.

Example

Following are two examples of the accept() call. In the first, the caller wishes to have the requester's address returned. In the second, the caller does not want the requester address returned's.

```
int clientsocket;
int s;
struct sockaddr clientaddress;
int addrlen;
int accept(int s, struct sockaddr *addr, int *addrlen);
/* socket(), bind(), and listen() have been called */
/* EXAMPLE 1: I want the address now */
addrlen = sizeof(clientaddress);
clientsocket = accept(s, &clientaddress, &addrlen)
/* EXAMPLE 2: I can get the address later using getpeername() */
addrlen = 0;
clientsocket = accept(s, (struct sockaddr *) 0, (int *) 0);
```

Related calls

bind(), connect(), getpeername(), listen(), socket()

bind()

The bind() call binds a unique local name to the socket using descriptors. After calling socket(), the descriptor does not have a name associated with it. However, it does belong to a particular addressing family, as specified when socket() is called. The exact format of a name depends on the addressing family. The bind() call also allows servers to specify the network interfaces from which they want to receive UDP packets and TCP connection requests.

```
#include <manifest.h>
#include <bsdtypes.h>
#include <socket.h>
#include <in.h>
int bind(int s, struct sockaddr *name, int namelen)
```

Parameter	Description
s	Socket descriptor returned by a previous socket() call
name	Points to a *sockaddr* structure containing the name to be bound to *s*
namelen	Size of *name* in bytes

The *s* parameter is a socket descriptor of any type created by calling socket().

The *name* parameter points to a buffer containing the name to be bound to *s*. The *namelen* parameter is the size, in bytes, of the buffer pointed to by *name*.

Related information

Socket descriptor created in the AF_INET domain

If the socket descriptor *s* was created in the AF_INET domain, then the format of the name buffer is expected to be *sockaddr_in*, as defined in the header file IN.H.

```
struct in_addr
{
        u_long s_addr;
};
struct sockaddr_in
{
        short   sin_family;
        u_short sin_port;
        struct  in_addr sin_addr;
        char    sin_zero[8];
};
```

The *sin_family* field must be set to AF_INET.

The *sin_port* field identifies the port to which the application must bind. It must be specified in network byte order. If *sin_port* is set to 0, the caller expects the system to assign an available port. The application can call getsockname() to discover the port number assigned.

The in_addr *sin_addr* field is set to the internet address and must be specified in network byte order. On hosts with more than one network interface (called multihomed hosts), a caller can select the interface to which it should bind. Subsequently, only UDP packets and TCP connection requests from this interface (the one value matching the bound name) are routed to the application. If this field is set to the constant INADDR_ANY, as defined in IN.H, the caller is requesting that the socket be bound to all network interfaces on the host. Subsequently, UDP

packets and TCP connections from all interfaces matching the bound name are routed to the application. This becomes important when a server offers a service to multiple networks. By leaving the address unspecified, the server can accept all UDP packets and TCP connection requests made of its port, regardless of the network interface on which the requests arrived.

The *sin_zero* field is not used and should be set to all zeros.

Socket descriptor created in the AF_IUCV domain

If the socket descriptor *s* is created in the AF_IUCV domain, the format of the name buffer is expected to be *sockaddr_iucv*, as defined in the header file SAIUCV.H.

```
struct sockaddr_iucv
{
    short           siucv_family;    /* addressing family */
    unsigned short  siucv_port;      /* port number */
    unsigned long   siucv_addr;      /* address */
    unsigned char   siucv_nodeid[8]; /* nodeid to connect to */
    unsigned char   siucv_userid[8]; /* userid to connect to */
    unsigned char   siucv_name[8];   /* iucvname for connect */
};
```

- The *siucv_family* field must be set to AF_IUCV.
- The *siucv_port*, *siucv_addr*, and *siucv_nodeid* fields are reserved for future use.
- The *siucv_port* and *siucv_addr* fields must be set to zero.
- The *siucv_nodeid* field must be set to exactly eight blank characters.
- The *siucv_userid* field is set to the MVS user ID of the application making the bind call. This field must be eight characters long, padded with blanks to the right. It cannot contain the NULL character.
- The *siucv_name* field is set to the application name by which the socket is to be known. It must be unique, because only one socket can be bound to a given name. The preferred form of the name contains eight characters, padded with blanks to the right. The eight characters for a connect() call executed by a client must exactly match the eight characters passed in the bind() call executed by the server.

Note: Internally, dynamic names are built using hexadecimal character strings representing the internal storage address of the socket. You should choose names that contain at least one non-hexadecimal character to prevent potential conflict. Hexadecimal characters include 0–9, and a–f. Uppercase A–F are considered non-hexadecimal and can be used by the user to build dynamic names.

Return values

The value 0 indicates success; the value -1 indicates an error. Errno identifies the specific error.

Errno Description

EBADF
The *s* parameter is not a valid socket descriptor.

EADDRNOTAVAIL
The address specified is not valid on this host. For example, the internet address does not specify a valid network interface.

EFAULT
The name or namelen parameter specified an address outside of the caller address space.

EAFNOSUPPORT
The address family is not supported (it is not AF_INET).

EADDRINUSE
The address is already in use. See the SO_REUSEADDR option described under "getsockopt()" on page 154 and the SO_REUSEADDR option described under the "setsockopt()" on page 206 for more information. This Errno might also be returned if the port is configured as RESERVED on a port reservation statement in the TCP/IP profile. For details, see TCP/IP profile (PROFILE.TCPIP) and configuration statement information in the *z/OS Communications Server: IP Configuration Reference*.

EINVAL
The socket is already bound to an address. For example, an attempt to bind a name to a socket that is in the connected state.

Example

Following are examples of the bind() call. The internet address and port must be in network byte order. To put the port into network byte order, the htons() utility routine is called to convert a short integer from host byte order to network byte order. The *address* field is set using another utility routine, inet_addr(), which takes a character string representing the dotted decimal address of an interface and returns the binary internet address representation in network byte order. Finally, it is a good idea to clear the structure before using it to ensure that the name requested does not set any reserved fields. See "connect()" on page 124 for examples how a client might connect to servers.

This example illustrates the bind() call binding to interfaces in the AF_INET domain.

```
int rc;
int s;
struct sockaddr_in myname;
struct sockaddr_iucv mymvsname;
int bind(int s, struct sockaddr *name, int namelen);
/* Bind to a specific interface in the internet domain */
/* make sure the sin_zero field is cleared */
memset(&myname, 0, sizeof(myname));
myname.sin_family = AF_INET;
myname.sin_addr = inet_addr("129.5.24.1"); /* specific interface */
myname.sin_port = htons(1024);
.
.
.
rc = bind(s, (struct sockaddr *) &myname, sizeof(myname));
/* Bind to all network interfaces in the internet domain */
/* make sure the sin_zero field is cleared */
memset(&myname, 0, sizeof(myname));
myname.sin_family = AF_INET;
myname.sin_addr.s_addr = INADDR_ANY; /* specific interface */
myname.sin_port = htons(1024);
.
.
.
rc = bind(s, (struct sockaddr *) &myname, sizeof(myname));
/* Bind to a specific interface in the internet domain.
   Let the system choose a port                        */
/* make sure the sin_zero field is cleared */
memset(&myname, 0, sizeof(myname));
myname.sin_family = AF_INET;
myname.sin_addr = inet_addr("129.5.24.1"); /* specific interface */
myname.sin_port = 0;
```

```
:
rc = bind(s, (struct sockaddr *) &myname, sizeof(myname));
```

This example illustrates the bind() call binding to interfaces in the AF_IUCV domain.

```
/* Bind to a name in the IUCV domain */
/* make sure the siucv_addr, siucv_port fields are zeroed and the
   siucv_nodeid fields is set to blanks */
memset(&mymvsname, 0, sizeof(mymvsname));
strncpy(mymvsname.siucv_nodeid, "        ", 8);
strncpy(mymvsname.siucv_userid, "        ", 8);
strncpy(mymvsname.siucv_name,   "        ", 8);
mymvsname.siucv_family = AF_IUCV;
strncpy(mymvsname.siucv_userid, "MVSUSER1", 8);
strncpy(mymvsname.siucv_name, "APPL", 4);
:
rc = bind(s, (struct sockaddr *) &myname, sizeof(myname));
```

The binding of a stream socket is not complete until a successful call to bind(), listen(), or connect() is made. Applications using stream sockets should check the return values of bind(), listen(), and connect() before using any function that requires a bound stream socket.

Related calls

gethostbyname(), getsockname(), htons(), inet_addr(), listen(), socket()

close()

The close() call shuts down the socket associated with the socket descriptor *s* and frees resources allocated to the socket. If *s* refers to an open TCP connection, the connection is closed. If a stream socket is closed when there is input data queued, the TCP connection is reset, not cleanly closed.

If you specify 0 on SO_LINGER on the setsockopt() call, the data is canceled and the CLOSE is immediately returned. If you do not specify a value for SO_LINGER on the setsockopt() call, the CLOSE returns and TCP/IP tries to immediately resend the data.

Note: Issue a shutdown() call before issuing a close() call for any socket.

```
#include <manifest.h>
#include <socket.h>
int close(int s)
```

Parameter	Description
s	Descriptor of the socket to be closed

Return values

The value 0 indicates success; the value -1 indicates an error. Errno identifies the specific error.

Errno	Description
EBADF	The *s* parameter is not a valid socket descriptor.

Related calls

accept(), getsockopt(), setsockopt(), socket()

connect()

For stream sockets, the connect() call attempts to establish a connection between two sockets. For UDP sockets, the connect() call specifies the peer for a socket. The *s* parameter is the socket used to originate the connection request. The connect() call performs two tasks when called for a stream socket. First, it completes the binding necessary for a stream socket [in case it has not been previously bound using the bind() call]. Second, it attempts to connect to another socket.

The connect() call on a stream socket is used by the client application to connect to a server. The server must have a passive open pending. If the server is using sockets, this means the server must successfully call bind() and listen() before a connection can be accepted by the server using accept(). Otherwise, connect() returns -1 and errno is set to ECONNREFUSED.

If *s* is in blocking mode, the connect() call blocks the caller until the connection is set up, or until an error is received. If the socket is in nonblocking mode, then connect() returns -1 with errno set to EINPROGRESS if the connection can be initiated (no other errors occurred). The caller can test completion of the connection setup by calling select() and testing ability to write to the socket.

When called for a datagram or raw socket, connect() specifies the peer with which this socket is associated. This gives the application the ability to use data transfer calls reserved for sockets that are in the connected state. In this case, read(), write(), readv(), writev(), send(), and recv() calls are available in addition to sendto(), recvfrom(), sendmsg(), and recvmsg() calls. Stream sockets can call connect() only once, but datagram sockets can call connect() multiple times to change their association. Datagram sockets can dissolve their association by connecting to an incorrect address, such as a null address (all fields cleared).

```
#include <manifest.h>
#include <bsdtypes.h>
#include <socket.h>
#include <in.h>
int connect(int s, struct sockaddr *name, int namelen)
```

Parameter	Description
s	Socket descriptor
name	Points to a *socket address* structure containing the address of the socket to which connection will be attempted
namelen	Size of the *socket address*, in bytes, pointed to by *name*

The *name* parameter points to a buffer containing the name of the peer to which the application needs to connect. The *namelen* parameter is the size, in bytes, of the buffer pointed to by *name*.

Related information

Servers in the AF_INET domain

If the server is in the AF_INET domain, the format of the name buffer is expected to be *sockaddr_in* as defined in the header file IN.H.

```
struct in_addr
{
        u_long s_addr;
```

```
};
struct sockaddr_in
{
        short   sin_family;
        u_short sin_port;
        struct  in_addr sin_addr;
        char    sin_zero[8];
};
```

The *sin_family* field must be set to AF_INET. The *sin_port* field identifies the port to which the server is bound; it must be specified in network byte order. The *sin_addr* field specifies a 32–bit Internet address. The *sin_zero* field is not used, and must be set to all zeros.

Servers in the AF_IUCV domain

If the server is in the AF_IUCV domain, the format of the name buffer is expected to be *sockaddr_iucv* as defined in the header file SAIUCV.H.

```
struct sockaddr_iucv
{
    short          siucv_family;    /* addressing family */
    unsigned short siucv_port;      /* port number */
    unsigned long  siucv_addr;      /* address */
    unsigned char  siucv_nodeid[8]; /* nodeid to connect to */
    unsigned char  siucv_userid[8]; /* userid to connect to */
    unsigned char  siucv_name[8];   /* iucvname for connect */
};
```

The *siucv_family* field must be set to AF_IUCV.

Note: The *siucv_port*, *siucv_addr*, and *siucv_nodeid* fields are reserved for future use. The *siucv_port* and *siucv_addr* fields must be set to 0. Set the *siucv_nodeid* field to exactly eight blank characters. The *siucv_userid* field is set to the MVS user ID of the application to which the application is requesting a connection. This field must be eight characters long, padded with blanks to the right. It cannot contain the null character. The *siucv_name* field is set to the application name by which the server socket is known. The name should exactly match the eight characters passed in the bind() call executed by the server.

Return values

The value 0 indicates success; the value -1 indicates an error. Errno identifies the specific error.

Errno **Description**

EADDRNOTAVAIL
Calling host cannot reach the specified destination.

EAFNOSUPPORT
Address family is not supported.

EALREADY Socket descriptor *s* is marked nonblocking, and a previous connection attempt is incomplete.

EBADF The *s* parameter is not a valid socket descriptor.

ECONNREFUSED
The connection request was rejected by the destination host.

EFAULT The *name* or *namelen* parameter specified an address outside of the caller address space.

EINPROGRESS
The socket descriptor *s* is marked nonblocking, and the connection cannot be completed immediately. The EINPROGRESS value does not indicate an error.

EISCONN Socket descriptor *s* is already connected.

ENETUNREACH
Network cannot be reached from this host.

ETIMEDOUT Connection attempt timed out before the connection was made.

Example

Following is a connect() call example. The internet address and port must be in network byte order. To put the port into network byte order, the htons() utility is called to convert a short integer from host byte order to network byte order. The *address* field is set using another utility, inet_addr(), which takes a character string representing the dotted decimal address of an interface and returns the binary internet address in network byte order. Set the structure to 0 before using it to ensure that the name requested does not set any reserved fields.

These examples could be used to connect to the servers shown in the examples listed with the call "bind()" on page 119.

```
int s;
struct sockaddr_in servername;
struct sockaddr_iucv mvsservername;
int rc;
int connect(int s, struct sockaddr *name, int namelen);
/* Connect to server bound to a specific interface in the internet domain */
/* make sure the sin_zero field is cleared */
memset(&servername, 0, sizeof(servername));
servername.sin_family = AF_INET;
servername.sin_addr = inet_addr("129.5.24.1"); /* specific interface */
servername.sin_port = htons(1024);
.
.
.
rc = connect(s, (struct sockaddr *) &servername, sizeof(servername));
/* Connect to a server bound to a name in the IUCV domain */
/* make sure the siucv_addr, siucv_port, siucv_nodeid fields are cleared
*/
memset(&mvsservername, 0, sizeof(mvsservername));
mvsservername.siucv_family = AF_IUCV;
strncpy(mvsservername.siucv_nodeid, "        ",8);
/* The field is 8 positions padded to the right with blanks */
strncpy(mvsservername.siucv_userid, "MVSUSER1 ", 8);
strncpy(mvsservername.siucv_name, "APPL    ", 8);
.
.
.
rc = connect(s, (struct sockaddr *) &mvsservername, sizeof(mvsservername));
```

Related calls

bind(), htons(), inet_addr(), listen(), select(), selectex(), socket()

endhostent()

When indicated by sethostent(), the endhostent() call frees the cached information for the local host tables . The endhostent() call is available only where RESOLVE_VIA_LOOKUP is defined before MANIFEST.H is included. See *z/OS Communications Server: IP Configuration Guide* for information about using local host tables.

```
#include <manifest.h>
#include <socket.h>
void endhostent()
```

Parameters

None

Related calls

gethostbyname(), gethostent(), sethostent()

endnetent()

When indicated by setnetent(), the endnetent() call frees the cached information for the local host tables. The endnetent() call is available only where RESOLVE_VIA_LOOKUP is defined before MANIFEST.H is included. See *z/OS Communications Server: IP Configuration Guide* for information about using local host tables.

```
#include <manifest.h>
#include <socket.h>
void endnetent()
```

Parameters

None

Related calls

getnetbyname(), getnetent(), setnetent()

endprotoent()

The endprotoent() call closes the *hlq*.ETC.PROTO data set.

The *hlq*.ETC.PROTO data set contains information about networking protocols IP, ICMP, TCP, and UDP.

```
#include <manifest.h>
#include <socket.h>
 void endprotoent()
```

Parameters

None

Related calls

getprotoent(), setprotoent()

endservent()

The endservent() call closes the *hlq*.ETC.SERVICES data set.

The *hlq*.ETC.SERVICES data set contains information about the networking services running on the host. Example services are domain name server, FTP, and Telnet.

```
#include <manifest.h>
#include <socket.h>
void endservent()
```

Parameters

None

Related calls

getservbyport(), getservent(), setservent()

fcntl()

The operating characteristics of sockets can be controlled with the fcntl() call.

Note: COMMAND values that are supported by the UNIX Systems Services fcntl() callable service are also supported.

```
#include <manifest.h>
#include <socket.h>
#include <bsdtypes.h>
#include <fcntl.h>
int fcntl(int s, int cmd, int arg)
```

Parameter	Description
s	Socket descriptor
cmd	Command to perform
arg	Data associated with *cmd*

The operations to be controlled are determined by *cmd*. The *arg* parameter is a variable, the meaning of which depends on the value of the *cmd* parameter. The following are valid fcntl() commands:

Command	Description
F_SETFL	Sets the status flags of socket descriptor *s*. (One flag, FNDELAY, can be set.)
F_GETFL	Returns the status flags of socket descriptor *s*. (One flag, FNDELAY, can be queried.) The FNDELAY flag marks *s* as being in nonblocking mode. If data is not present on calls that can block [read(), readv(), and recv()] the call returns with -1, and errno is set to EWOULDBLOCK.

Note: This function does not reject other values that might be rejected downstream.

Return values

For the **F_GETFL** command, the return value is the flags, set as a bit mask. For the **F_SETFL** command, the value 0 indicates success; the value -1 indicates an error. Errno identifies the specific error.

Errno	Description
EBADF	The *s* parameter is not a valid socket descriptor.
EINVAL	The *arg* parameter is not a valid flag, or the command is not a valid command.

Example

```
int s;
int rc;
int flags;
:
/* Place the socket into nonblocking mode */
rc = fcntl(s, F_SETFL, FNDELAY);
/* See if asynchronous notification is set */
flags = fcntl(s, F_GETFL, 0);
if (flags & FNDELAY)
   /* it is set */
else
   /* it is not */
```

Related calls

ioctl(), getsockopt(), setsockopt(), socket()

getclientid()

The getclientid() call returns the identifier by which the calling application is known to the TCP/IP address space. The *clientid* is used in givesocket() and takesocket() calls.

```
#include <manifest.h>
#include <socket.h>
#include <bsdtypes.h>
int  getclientid(int domain, struct clientid *clientid)
```

Parameter	Description
domain	The value in *domain* must be AF_INET.
clientid	Points to a *clientid* structure to be provided.

Return values

The value 0 indicates success. The value -1 indicates an error. Errno identifies the specific error.

Errno Description

EFAULT
The *clientid* parameter as specified would result in an attempt to access storage outside the caller address space, or storage that cannot be modified by the caller.

EAFNOSUPPORT
The domain is not AF_INET.

Related calls

takesocket()

getdtablesize()

The TCPIP address space reserves a fixed-size table for each address space using sockets. The size of this table equals the number of sockets an address space can allocate simultaneously. The getdtablesize() call returns the maximum number of sockets that can fit in the table.

To increase the table size, use maxdesc(). After calling maxdesc(), always use getdtablesize() to verify the change.

```
#include <manifest.h>
#include <socket.h>
int getdtablesize()
```

Parameters

None

Related calls

maxdesc()

gethostbyaddr()

The gethostbyaddr() call tries to resolve the IP address to a host name. The resolution attempted depends on how the resolver is configured and if any local host tables exist. If the symbol RESOLVE_VIA_LOOKUP is defined before including MANIFEST.H, gethostbyaddr() only uses local host tables and name servers are not used. See *z/OS Communications Server: IP Configuration Guide* for information about configuring the resolver and using local host tables.

```
#include <manifest.h>
#include <netdb.h>
struct hostent *gethostbyaddr(char *addr, int addrlen, int domain)
```

Parameter	Description
addr	Points to an unsigned long value containing the address of the host
addrlen	Size of *addr* in bytes
domain	Address domain supported (AF_INET)

The gethostbyaddr() call points to *hostent* structure for the host address specified on the call.

The NETDB.H header file defines the *hostent* structure, and contains the following elements:

Element	Description
h_name	The address of the official name of the host
h_aliases	A pointer to a zero-terminated list of addresses pointing to alternate names for the host
h_addrtype	The type of host address returned; currently, always set to AF_INET
h_length	The length of the host address, in bytes
h_addr	A pointer to a zero-terminated list of addresses pointing to the internet host addresses returned by the call

Return values

The return value points to static data that is overwritten by subsequent calls. A pointer to a *hostent* structure indicates success. A NULL pointer indicates an error or end-of-file. When a NULL pointer or 0 is returned, the value of errno is indeterminate: the output from a tcperror() call cannot be validated. The global variable h_errno identifies the specific error.

h_errno	Description
HOST_NOT_FOUND	The name specified is unknown, the address domain specified is not supported, or the address length specified is not valid.
TRY_AGAIN	Temporary error; information not currently accessible.
NO_RECOVERY	Fatal error occurred.

Related calls

gethostent(), sethostent(), endhostent()

gethostbyname()

The gethostbyname() call tries to resolve the host address to an IP address. The resolution attempted depends on how the resolver is configured and if any local host tables exist. If the symbol RESOLVE_VIA_LOOKUP is defined before including MANIFEST.H, gethostbyname() only uses local host tables and name servers are not used. See *z/OS Communications Server: IP Configuration Guide* for information about configuring the resolver and using local host tables.

```
#include <manifest.h>
#include <netdb.h>
struct hostent *gethostbyname(char *name)
```

Parameter	Description
name	The name of the host being queried. Any trailing blanks will be removed from the specified name prior to trying to resolve it to an IP address. The maximum host name length is 255 characters.

The gethostbyname() call returns a pointer to a *hostent* structure for the host name specified on the call.

The NETDB.H header file defines the *hostent* structure and contains the following elements:

Element	Description
h_name	The address of the official name of the host
h_aliases	A pointer to a zero-terminated list of addresses pointing to alternate names for the host
h_addrtype	The type of host address returned; currently, set to AF_INET
h_length	The length of the host address in bytes
h_addr	A pointer to the network address of the host

Return values

The return value points to static data that is overwritten by subsequent calls. A pointer to a *hostent* structure indicates success. A NULL pointer indicates an error or EOF. When a NULL pointer or 0 is returned, the value of errno is indeterminate, and, therefore, the output from a tcperror() call is also not valid. Global variable h_errno identifies the specific error.

h_errno Value	Description
HOST_NOT_FOUND	The name specified is unknown.
TRY_AGAIN	Temporary error; information not currently accessible.
NO_RECOVERY	Fatal error occurred.

Related calls

gethostent(), sethostent(), endhostent()

gethostent()

The gethostent() call returns the next line in the local host table for a host name and points to the next host entry in the local host table. The gethostent() call also returns any aliases. The gethostent() call is available only when RESOLVE_VIA_LOOKUP is defined before MANIFEST.H is included. See *z/OS Communications Server: IP Configuration Guide* for information about using local host tables.

```
#include <manifest.h>
#include <netdb.h>
struct hostent *gethostent()
```

The NETDB.H header file defines the *hostent* structure and contains the following elements:

Element	Description
h_name	The address of the official name of the host
h_aliases	A pointer to a zero-terminated list of addresses pointing to alternate names for the host
h_addrtype	The type of host address returned; currently set to AF_INET
h_length	The length of the host address, in bytes
h_addr	A pointer to the network address of the host

Return values

The return value points to static data that is overwritten by subsequent calls. A pointer to a *hostent* structure indicates success. A NULL pointer indicates an error or EOF. When a NULL pointer or 0 is returned, the value of errno is indeterminate, and, therefore, the output from a tcperror() call is also not valid.

Related calls

gethostbyname(), sethostent()

gethostid()

The gethostid() call returns the 32-bit identifier unique to the current host. This value is the default home internet address.

This call can be used only in the AF_INET domain.

```
#include <manifest.h>
#include <socket.h>
unsigned long gethostid()
```

Return values

The gethostid() call returns the 32-bit identifier of the current host, which should be unique across all hosts. When a NULL pointer or 0 is returned, the value of errno is indeterminate, and, therefore, the output from a tcperror() call is also not valid.

Related calls

gethostname()

gethostname()

The gethostname() call returns the name of the host processor on which the program is running. Characters to the limit of *namelen* are copied into the name array. The value returned for host name is limited to 24 characters. The returned name is NULL-terminated unless truncated to the size of the name array.

Note: The host name returned is the host name the TCPIP stack learned at startup from the TCPIP.DATA file that was found.

This call can be used only in the AF_INET domain.

Errno EINVAL is returned when *namelen* is 0, or greater than 255 characters.

```
#include <manifest.h>
#include <socket.h>
int gethostname(char *name, int namelen)
```

Parameter	Description
name	Character array to be filled with the host name
namelen	Length of *name*; restricted to 255 characters

Return values

The value 0 indicates success; the value -1 indicates an error. Errno identifies the specific error.

Errno	Description
EFAULT	The *name* parameter specified an address outside the caller address space.

Related calls

gethostbyname(), gethostid()

getibmopt()

The getibmopt() call returns the number of TCP/IP images installed on a given MVS system, and their status, version, and name.

Note: Images from pre-V3R2 releases of TCP/IP for MVS are excluded. The getibmopt() call is not meaningful to pre-V3R2 releases.

Using this information, the caller can dynamically choose the TCP/IP image with which to connect through the setibmopt() call. The getibmopt() call is optional. If it is not used, determine the connecting TCP/IP image as follows:

- Connect to the TCP/IP specified TCPIPJOBNAME in the active TCPIP.DATA file.
- Locate TCPIP.DATA using the search order described in the *z/OS Communications Server: IP Configuration Reference*.

```
#include <manifest.h>
#include <socket.h>
int getibmopt(int cmd, struct ibm_gettcpinfo *buf)
struct ibm_tcpimage {
    unsigned short status;
    unsigned short version;
    char name[8];
}
struct ibm_gettcpinfo {
    int tcpcnt;
    struct ibm_tcpimage image[8];
}
```

Parameter	Description
cmd	The command to perform. For TCP/IP V3R2 for MVS, IBMTCP_IMAGE is supported.
buf	Points to the structure filled in by the call.

The *buf* parameter is a pointer to the (*struct ibm_gettcpinfo*) buffer into which the TCP/IP image status, version, and name are placed.

On successful return, the *struct ibm_tcpimage* buffer contains the status, version, and name of up to eight active TCP/IP images.

The status field can contain the following information:

Status Field	Meaning
X'8xxx'	Active
X'4xxx'	Terminating
X'2xxx'	Down
X'1xxx'	Stopped or stopping

Note: In the above status fields, *xxx* is reserved for IBM use and can contain any value.

When this field returns with a combination of Down and Stopped, TCP/IP was abended. Value stopped, when returned alone, indicates that TCP/IP has been stopped only.

The version field for z/OS V1R7 is X'0617'.

The TCP/IP character name field is the PROC name, left-justified, and padded with blanks.

The *tcpcnt* field of *struct ibm_gettcpinfo* is a count field into which the TCP/IP image count is placed. The caller uses this value to determine how many entries in the *ibm_tcpimage* structure of *buf* have been filled. If the *tcpcnt* returned is 0, there are no TCP/IP images present.

Return values

Zero indicates success; the value -1 indicates an error. Errno identifies the specific error.

Errno	Description
EOPNOTSUPP	This is returned for command that is not valid.
EFAULT	The *name* parameter specified an address outside of the caller address space.

getibmsockopt()

Like getsockopt() call, the getibmsockopt() call gets the options associated with a socket in the AF_INET domain. This call is for options specific to the IBM implementation of sockets. Currently, only the SOL_SOCKET level is supported.

This call can be used only in the AF_INET domain.

```
#include <manifest.h>
#include <socket.h>
int getibmsockopt(int s, int level, int optname, char *optval, int *optlen)
```

Parameter	Description
s	The socket descriptor
level	The level for which the option is set
optname	The name of a specified socket option
optval	Points to option data
optlen	Points to the length of the option data

Return values

The value 0 indicates success; the value -1 indicates an error. Errno identifies the specific error.

Errno	Description
EBADF	The *s* parameter is not a valid socket descriptor.
EFAULT	Using optval and optlen parameters would result in an attempt to access storage outside the caller address space.
EINVAL	This is returned when optlen points to a length of 0.

Example

```
#include <manifest.h>
#include <socket.h>
#include <tcperror.h>
 { struct ibm_bulkmode_struct bulkstr;
   int optlen, rc;
   optlen = sizeof(bulkstr);
   rc = getibmsockopt(s, SOL_SOCKET, (char *), &bulkstr, &optlen);
   if (rc < 0)
     { tcperror("on getibmsockopt()");
       exit(1);
     }
   fprintf(stream,"%d byte buffer available for outbound queue.\n",
           bulkstr.b_max_send_queue_size_avail);
 }
```

Related calls

ibmsflush(), setibmsockopt(), getockopt()

getnetbyaddr()

The getnetbyaddr() call searches the local host tables for the specified network address. This call can be used only in the AF_INET domain. See *z/OS Communications Server: IP Configuration Guide* for information about using local host tables.

```
#include <manifest.h>
#include <bsdtypes.h>
#include <netdb.h>
struct netent *getnetbyaddr(unsigned long net, int type)
```

Parameter	Description
net	The network address
type	The address domain supported (AF_INET)

The *netent* structure is defined in the NETDB.H header file and contains the following elements:

Element	Description
n_name	The official name of the network.
n_aliases	An array, terminated with a NULL pointer, of alternative names for the network.
n_addrtype	The type of network address returned. The call always sets this value to AF_INET.
n_net	The network number, returned in host byte order.

Return values

The return value points to static data that is overwritten by subsequent calls. A pointer to a *netent* structure indicates success. A NULL pointer indicates an error or end-of-file. When a NULL pointer or 0 is returned, the value of errno is indeterminate, and therefore, the output from a tcperror() call cannot be validated.

Related calls

endnetent(), getnetbyname(), getnetent(), setnetent(), endhostent()

getnetbyname()

The getnetbyname() call searches the local host tables for the specified network name. This call can be used only in the AF_INET domain. See *z/OS Communications Server: IP Configuration Guide* for information about using local host tables.

```
#include <manifest.h>
#include <netdb.h>
struct netent *getnetbyname(char *name)
```

Parameter	Description
name	Points to a network name.

The getnetbyname() call returns a pointer to a *netent* structure for the network name specified on the call.

The *netent* structure is defined in the NETDB.H header file and contains the following elements:

Element	Description
n_name	The official name of the network.
n_aliases	An array, terminated with a NULL pointer, of alternative names for the network.
n_addrtype	The type of network address returned. The call always sets this value to AF_INET.
n_net	The network number, returned in host byte order.

Return values

The return value points to static data that is overwritten by subsequent calls. A pointer to a *netent* structure indicates success. A NULL pointer indicates an error or end-of-file. When a NULL pointer or 0 is returned, the value of errno is indeterminate, and therefore, the output from a tcperror() call cannot be validated.

Related calls

endnetent(), getnetbyaddr(), getnetent(), setnetent(), endhostent()

getnetent()

The getnetent() call returns the next line in the local host table for a network name and points to the next network entry in the local host table. The getnetent() call also returns any aliases. The getnetent() call is available only when RESOLVE_VIA_LOOKUP is defined before MANIFEST.H is included. See *z/OS Communications Server: IP Configuration Guide* for information about using local host tables.

```
#include <manifest.h>
#include <netdb.h>
struct netent *getnetent()
```

The *netent* structure is defined in the NETDB.H header file and contains the following elements:

Element	Description
n_name	The official name of the network.
n_aliases	An array, terminated with a NULL pointer, of alternative names for the network.
n_addrtype	The type of network address returned. The call always sets this value to AF_INET.
n_net	The network number, returned in host byte order.

Return values

The return value points to static data that is overwritten by subsequent calls. A pointer to a *netent* structure indicates success. A NULL pointer indicates an error or end-of-file.

Related calls

endnetent(), getnetbyaddr(), getnetbyname(), setnetent(), endhostent()

getpeername()

The getpeername() call returns the name of the peer connected to socket descriptor *s*. For AF_IUCV, *namelen* must be initialized to reflect the size of the space pointed to by *name*; it is set to the number of bytes copied into the space before the call returns. For AF_INET, the input value in the contents of *namelen* are ignored, but are set before the call returns. The size of the peer name is returned in bytes. If the buffer of the local host is too small to receive the entire peer name, the name is truncated.

```
#include <manifest.h>
#include <bsdtypes.h>
#include <socket.h>
int getpeername(int s, struct sockaddr *name, int *namelen)
```

Parameter	Description
s	The socket descriptor.
name	Points to a structure containing the internet address of the connected socket that is filled in by getpeername() before it returns. The exact format of *name* is determined by the domain in which communication occurs.
namelen	Points to a fullword containing the size of the address structure pointed to by *name* in bytes.

Return values

The value 0 indicates success; the value -1 indicates an error. Errno identifies the specific error.

Errno	Description
EBADF	The *s* parameter is not a valid socket descriptor.
EFAULT	Using the *name* and *namelen* parameters as specified would result in an attempt to access storage outside of the caller address space.
ENOTCONN	The socket is not in the connected state.

Related calls

accept(), connect(), getsockname(), socket()

getprotobyname()

The getprotobyname() call searches the *hlq*.ETC.PROTO data set for the specified protocol name.

The getprotobyname() call returns a pointer to a *protoent* structure for the network protocol specified on the call.

```
#include <manifest.h>
#include <netdb.h>
struct protoent *getprotobyname(char *name)
```

Parameter	Description
name	Points to the specified protocol.

The *protoent* structure is defined in the NETDB.H header file and contains the following elements:

Element	Description
p_name	The official name of the protocol
p_aliases	An array, terminated with a NULL pointer, of alternative names for the protocol
p_proto	The protocol number

Return values

The return value points to static data that is overwritten by subsequent calls. A pointer to a *protoent* structure indicates success. A NULL pointer indicates an error or end-of-file. When a NULL pointer or 0 is returned, the value of errno is indeterminate, and therefore, the output from a tcperror() call cannot be validated.

Related calls

endprotoent(), getprotobynumber(), getprotoent(), setprotoent()

getprotobynumber()

The getprotobynumber() call searches the *hlq*.ETC.PROTO data set for the specified protocol number.

The getprotobynumber() call returns a pointer to a *protoent* structure for the network protocol specified on the call.

```
#include <manifest.h>
#include <netdb.h>
struct protoent *getprotobynumber(int proto)
```

Parameter	Description
proto	Protocol number

The *protoent* structure is defined in the NETDB.H header file and contains the following elements:

Element	Description
p_name	The official name of the protocol
p_aliases	An array, terminated with a NULL pointer, of alternative names for the protocol
p_proto	The protocol number

Return values

The return value points to static data that is overwritten by subsequent calls. A pointer to a *protoent* structure indicates success. A NULL pointer indicates an error or end-of-file. When a NULL pointer or 0 is returned, the value of errno is indeterminate, and therefore, the output from a tcperror() call cannot be validated.

Related calls

endprotoent(), getprotobyname(), getprotoent(), setprotoent()

getprotoent()

The getprotoent() call reads the *hlq*.ETC.PROTO data set, and the getprotoent() call returns a pointer to the next entry in the *hlq*.ETC.PROTO data set.

```
#include <manifest.h>
#include <netdb.h>
struct protoent *getprotoent()
```

The *protoent* structure is defined in the NETDB.H header file and contains the following elements:

Element	Description
p_name	The official name of the protocol
p_aliases	An array, terminated with a NULL pointer, of alternative names for the protocol
p_proto	The protocol number

Return values

The return value points to static data that is overwritten by subsequent calls. A pointer to a *protoent* structure indicates success. A NULL pointer indicates an error or end-of-file. When a NULL pointer or 0 is returned, the value of errno is indeterminate, and therefore, the output from a tcperror() call cannot be validated.

Related calls

endprotoent(), getprotobyname(), getprotobynumber(), setprotoent()

getservbyname()

The getservbyname() call searches the *hlq*.ETC.SERVICES data set for the specified service name. Service name searches must match the protocol, if a protocol is stated.

The getservbyname() call returns a pointer to a *servent* structure for the network service specified on the call.

```
#include <manifest.h>
#include <netdb.h>
struct servent *getservbyname(char *name, char *proto)
```

Parameter	Description
name	Points to the specified service name
proto	Points to the specified protocol

The *servent* structure is defined in the NETDB.H header file and contains the following elements:

Element	Description
s_name	The official name of the service
s_aliases	An array, terminated with a NULL pointer, of alternative names for the service
s_port	The port number of the service
s_proto	The protocol required to contact the service

Return values

The return value points to static data that is overwritten by subsequent calls. Points to a *servent* structure indicates success. A NULL pointer indicates an error or end-of-file. When a NULL pointer or 0 is returned, the value of errno is indeterminate, and therefore, the output from a tcperror() call cannot be validated.

Related calls

endservant(), getservbyport(), getservent(), setservent()

getservbyport()

The getservbyport() call searches the *hlq*.ETC.SERVICES data set for the specified port number. Searches for a port number must match the protocol, if a protocol is stated.

The getservbyport() call returns a pointer to a *servent* structure for the port number specified on the call.

```
#include <manifest.h>
#include <netdb.h>
struct servent *getservbyport(int port, char *proto)
```

Parameter	Description
port	Port number
proto	Points to the specified protocol

The *servent* structure is defined in the NETDB.H header file and contains the following elements:

Element	Description
s_name	The official name of the service
s_aliases	An array, terminated with a NULL pointer, of alternative names for the service
s_port	The port number of the service
s_proto	The protocol required to contact the service

Return values

The return value points to static data that is overwritten by subsequent calls. Points to a *servent* structure indicates success. A NULL pointer indicates an error or end-of-file. When a NULL pointer or 0 is returned, the value of errno is indeterminate, and therefore, the output from a tcperror() call cannot be validated.

Related calls

endservant(), getservbyname(), getservent(), setservent()

getservent()

The getservent() call reads the next line of the *hlq*.ETC.SERVICES data set and returns a pointer to the next entry in the *hlq*.ETC.SERVICES data set.

```
#include <manifest.h>
#include <netdb.h>
struct servent *getservent()
```

The *servent* structure is defined in the NETDB.H header file and contains the following elements:

Element	Description
s_name	The official name of the service
s_aliases	An array, terminated with a NULL pointer, of alternative names for the service
s_port	The port number of the service
s_proto	The required protocol to contact the service

Return values

The return value points to static data that is overwritten by subsequent calls. Points to a *servent* structure indicate success. A NULL pointer indicates an error or end-of-file. When a NULL pointer or 0 is returned, the value of errno is indeterminate, and therefore, the output from a tcperror() call cannot be validated.

Related calls

endservant(), getservbyname(), getservbyport(), setservent()

getsockname()

The getsockname() call stores the current name for the socket specified by the *s* parameter into the structure pointed to by the *name* parameter. It returns the address to the socket that has been bound. If the socket is not bound to an address, the call returns with the family set and sets the rest of the structure to 0. For example, an inbound socket in the internet domain would cause the name to point to a *sockaddr_in* structure with the *sin_family* field set to AF_INET, and all other fields cleared.

Stream sockets are not assigned a name until a call is successful: bind(), connect(), or accept().

The getsockname() call is often used to discover the port assigned to a socket after the socket has been implicitly bound to a port. For example, an application can call connect() without previously calling bind(). In this case, the connect() call completes the binding necessary by assigning a port to the socket. This assignment can be detected using a call to getsockname().

For AF_IUCV, *namelen* must be initialized to indicate the size of the space pointed to by *name*, and is set to the number of bytes copied into the space before the call returns. For AF_INET, the input value in the contents of *namelen* is ignored, but set before the call returns.

```
#include <manifest.h>
#include <bsdtypes.h>
#include <socket.h>
int getsockname(int s, struct sockaddr *name, int *namelen)
```

Parameter	Description
s	The socket descriptor.
name	The address of the buffer into which getsockname() copies the name of *s*.
namelen	Points to a fullword containing the size of the address structure pointed to by *name* in bytes.

Return values

A value of 0 indicates success; the value -1 indicates an error. Errno identifies the specific error.

Errno Value	Description
EBADF	The *s* parameter is not a valid socket descriptor.
EFAULT	Using the *name* and *namelen* parameters as specified would result in an attempt to access storage outside of the caller address space.

Related calls

accept(), bind(), connect(), getpeername(), socket()

getsockopt()

The getsockopt() call gets options associated with a socket. It can be called only for sockets in the AF_INET domain. This call is not supported in the AF_IUCV domain. While options can exist at multiple protocol levels, they are always present at the highest socket level.

When manipulating socket options, you must specify the level at which the option resides and the name of that option. To manipulate options at the socket level, the *level* parameter must be set to SOL_SOCKET as defined in SOCKET.H. To manipulate options at the TCP level, the level parameter must be set to IPPROTO_TCP as defined in SOCKET.H. To manipulate options at any other level, such as the IP level, supply the appropriate protocol number for the protocol controlling the option. Currently, the SOL_SOCKET, IPPROTO_TCP, and IPPROTO_IP levels are supported. The getprotobyname() call can be used to return the protocol number for a named protocol.

```
#include <manifest.h>
#include <bsdtypes.h>
#include <socket.h>

int getsockopt(int s, int level, int optname, char *optval, int *optlen
```

Parameter	Description
s	The socket descriptor.
level	The level to which the option is set.
optname	The name of a specified socket option. See Appendix D, "GETSOCKOPT/SETSOCKOPT command values" for the numeric values of *optname*.
optval	Points to option data.
optlen	Points to the length of the option data.

The *optval* and *optlen* parameters are used to return data used by the particular get command. The *optval* parameter points to a buffer that is to receive the data requested by the get command. The *optlen* parameter points to the size of the buffer pointed to by the *optval* parameter. Initially, this size must be set to the size of that buffer before calling getsockopt(). On return it is set to the size of the data actually returned.

All of the socket level options except SO_LINGER expect *optval* to point to an integer and *optlen* to be set to the size of an integer. When the integer is nonzero, the option is enabled. When it is 0, the option is disabled. The SO_LINGER option expects *optval* to point to a *linger* structure as defined in SOCKET.H. This structure is defined in the following example:

```
#include <manifest.h>
struct  linger
{
       int     l_onoff;                /* option on/off */
       int     l_linger;               /* linger time */
};
```

The *l_onoff* field is set to 0 if the SO_LINGER option is being disabled. A nonzero value enables the option. The *l_linger* field specifies the amount of time to linger on close.

The following option is recognized at the TCP level (IPPROTO_TCP):

Option **Description**

TCP_NODELAY
Returns the status of Nagle algorithm (RFC 896). This option is not supported for AF_IUCV sockets.

When *optval* is 0, Nagle algorithm is enabled and TCP will wait to send small packets of data until the acknowledgment for the previous data is received.

When *optval* is nonzero, Nagle algorithm is disabled and TCP will send small packets of data even before the acknowledgment for previous data sent is received.

The following options are recognized at the socket level (SOL_SOCKET):

Option **Description**

SO_ACCEPTCONN
Indicates whether listen() was called for a stream socket.

SO_BROADCAST
Toggles the ability to broadcast messages. The default is *disabled*. When this option is enabled, it allows the application to send broadcast messages over *s* when the interface specified in the destination supports the broadcasting of packets. This option has no meaning for stream sockets.

SO_CLUSTERCONNTYPE
Returns a bit mapped 32–bit value. One or more than one of the following will be returned:

- No Conn means that the socket is not connected.
- None means that the socket is active, but the partner is not in the same cluster. If this indicator is set, the other 3 indicators are 0.
- Same cluster means that the connection partners are in the same cluster.
- Same image means that the connection partners are in the same MVS image. SO_CLUSTERCONNTYPE_SAME_CLUSTER will also be set. If the connection partner is a distributed DVIPA, the same image bit will not be on since the exact hosting stack is not known.
- Internal means that communication from this node to the stack hosting the partner application is not sent on links/interfaces exposed outside the cluster (sysplex). To determine if both ends of the connection flow over internal links/interfaces, the partner application must also issue this getsockopt() and both ends exchange their results from this socket call (through an application-dependent method).

  Note: If the destination IP address for a connection (partner's IP address) is a dynamic VIPA or distributed dynamic VIPA residing in the cluster, the internal indicator will not be on because traffic for these connections can be forwarded to the target TCP/IP stacks over links or interfaces that are external to the cluster.

An internal indicator means that for this side of the connection, the link/interface type is one of the following:

- CTC
- HiperSockets™ (iQDIO)
- MPCPTP (including XCF and IUTSAMEH connections)
- OSA-Express QDIO with CHPID type OSX or OSM
- Loopback
- Or both partners are owned by the same multi-homed stack

On return, one or more of the following bits are set:

```
00000000  00000000 00000000 00000001'-SO_CLUSTERCONNTYPE_NONE
00000000  00000000 00000000 00000010'-SO_CLUSTERCONNTYPE_SAME_CLUSTER
00000000  00000000 00000000 00000100'-SO_CLUSTERCONNTYPE_SAME_IMAGE
00000000  00000000 00000000 00001000'-SO_CLUSTERCONNTYPE_INTERNAL
00000000  00000000 00000000 00000000'-SO_CLUSTERCONNTYPE_NOCONN
```

Note: A value of all zeros means that there is no active connection on the socket. This is usually the case for a listening socket. This is also true for a client socket before the client issues connect(). The caller should first check for a returned value of SO_CLUSTERCONNTYPE_NOCONN before checking for any of the other returned indicators.

If getsockopt() (SO_CLUSTERCONNTYPE) is issued before the connection has been established, it results in a return value of 0.

If the application issues getsockopt() (SO_CLUSTERCONNTYPE) on a connected socket, and has received an indication of SO_CLUSTERCONNTYPE_INTERNAL, any subsequent rerouting decisions due to current route failure will either select an alternate route, which is also SO_CLUSTERCONNTYPE_INTERNAL, or fail the connection with no route available indications. This means that when an application has received an indication of SO_CLUSTERCONNTYPE_INTERNAL on a connection, any subsequent rerouting preserves that indication on the new route, or will fail the connection. This ensures that a connection that an application relies on as being internal does not transparently become non-internal due to a routing change.

If the application never issues the new getsockopt() or if the connection was previously reported as not SO_CLUSTERCONNTYPE_INTERNAL, rerouting decisions are made as at present, and the rerouting is transparent to the application as long as any alternate route exists.

SO_DEBUG The sock_debug() call provides the socket library tracing facility. The *onoff* parameter can have a value of 0 or nonzero. When *onoff*=0 (the default), no socket library tracing is done; when *onoff*=nonzero, the system traces for socket library calls and interrupts.

SO_ERROR Returns any error pending on the socket and clears the error status. It can be used to check for asynchronous errors on connected datagram sockets and for other asynchronous errors (errors returned explicitly by one of the socket calls).

SO_KEEPALIVE
Toggles the TCP keep alive mechanism for a stream socket. The default is *disabled*. When activated, the keep alive mechanism

periodically sends a packet along an otherwise idle connection. If the remote TCP does not respond to the packet or to retransmissions of the packet, the connection is terminated with the error ETIMEDOUT.

SO_LINGER Lingers on close if data is present. The default is *disabled*. When this option is enabled and there is unsent data present when close() is called, the calling application is blocked during the close() call until the data is transmitted, or the connection has timed out. If this option is disabled, the close() call returns without blocking the caller and the TCP/IP address space still waits before trying to send the data. Although the data transfer is usually successful, it cannot be guaranteed, because the TCP/IP address space waits only a finite amount of time while trying to send the data. This option has meaning only for stream sockets.

SO_OOBINLINE
Toggles reception of out-of-band data. The default is *disabled*. When this option is enabled, it causes out-of-band data to be placed in the normal data input queue as it is received, making it available to recv(), recvfrom(), and recvmsg() without specifying the MSG_OOB flag in those calls. When this option is disabled, it causes out-of-band data to be placed in the priority data input queue as it is received, making it available to recv(), recvfrom(), and recvmsg() only by specifying the MSG_OOB flag in those calls. This option has meaning only for stream sockets.

SO_RCVBUF Returns the size of the data portion of the TCP/IP send buffer in *optval*. The size of the data portion of the receive buffer is protocol-specific.

SO_REUSEADDR
Toggles local address reuse. The default is disabled. This alters the normal algorithm used in the bind() call.

The normal bind() call algorithm allows each internet address and port combination to be bound only once. If the address and port have been bound already, a subsequent bind() will fail and return error EADDRINUSE.

After the SO_REUSEADDR option is active, the following situations are supported:

- A server can bind() the same port multiple times as long as every invocation uses a different local IP address, and the wildcard address INADDR_ANY is used only one time per port.
- A server with active client connections can be restarted and can bind to its port without having to close all of the client connections.
- For datagram sockets, multicasting is supported so multiple bind() calls can be made to the same class D address and port number.

SO_SNDBUF Returns the size of the data portion of the TCP/IP send buffer in *optval*. The size of the data portion of the send buffer is protocol-specific.

SO_TYPE Returns the type of the socket. On return, the integer pointed to by *optval* is set to SOCK_STREAM, SOCK_DGRAM, or SOCK_RAW.

The following options are recognized at the IP level (IPPROTO_IP):

Option	Description
IP_MULTICAST_TTL	Gets the IP time to live of outgoing multicast datagrams. The default value is 1 (multicast is available only to the local subnet).
IP_MULTICAST_LOOP	Used to determine whether outgoing multicast datagrams are looped back.
IP_MULTICAST_IF	Gets the interface for sending outbound multicast datagrams from the socket application. **Note:** Multicast datagrams can be transmitted only on one interface at a time.

Return values

The value 0 indicates success; the value -1 indicates an error. Errno identifies the specific error.

Errno	Description
EBADF	The *s* parameter is not a valid socket descriptor.
EFAULT	Using *optval* and *optlen* parameters would result in an attempt to access storage outside the caller address space.
EINVAL	The *optname* parameter is unrecognized, or the *level* parameter is not SOL_SOCKET.

Example

The following are examples of the getsockopt() call. See "setsockopt()" on page 206 to see how the setsockopt() call options are set.

Example 1

```
#include <manifest.h>

int rc;
int s;
int optval;
int optlen;
struct linger l;
int getsockopt(int s, int level, int optname, char *optval, int *optlen);

.
.
.
/* Is out of band data in the normal input queue? */
optlen = sizeof(int);
rc = getsockopt(
        s, SOL_SOCKET, SO_OOBINLINE, (char *) &optval, &optlen);
if (rc == 0)
{
    if (optlen == sizeof(int))
    {
         if (optval)
            /* yes it is in the normalqueue */
         else
            /* no it is not                  */
    }
}
```

⋮

Example 2

```
/* Do I linger on close? */
optlen = sizeof(l);
rc = getsockopt(
        s, SOL_SOCKET, SO_LINGER, (char *) &l, &optlen);
if (rc == 0)
{
    if (optlen == sizeof(l))
    {
         if (l.l_onoff)
            /* yes I linger */
         else
            /* no I do not  */
    }
}
```

Related calls

bind(), close(), getprotobyname(), setsockopt(), socket()

givesocket()

The givesocket() call tells TCP/IP to make the specified socket available to a takesocket() call issued by another program. Any connected stream socket can be given. Typically, givesocket() is used by a master program that obtains sockets by means of accept() and gives them to slave programs that handle one socket at a time.

This call can be used only in the AF_INET domain.

```
#include <manifest.h>
#include <bsdtypes.h>
#include <socket.h>

int  givesocket(int d, struct clientid *clientid)
```

Parameter	Description
d	The descriptor of a socket to be given to another application.
clientid	Points to a client ID structure specifying the target program to which the socket is to be given.

To pass a socket, the master program first calls givesocket() with the client ID structure filled in as follows:

Field	Description
domain	This call is supported only in the AF_INET domain.
name	The slave program address space name, left-justified and padded with blanks. The slave program can run in the same address space as the master program, in which case this field is set to the master program address space. If this field is set to blanks, any MVS address space can take the socket.
subtaskname	Specifies blanks.
reserved	Specifies binary zeros.

The master program then calls getclientid() to obtain its client ID, and passes its client ID, along with the descriptor of the socket to be given, to the slave program. One way to pass a socket is by passing the slave program startup parameter list.

The slave program calls takesocket(), specifying the master program client ID and socket descriptor.

Waiting for the slave program to take the socket, the master program uses select() to test the given socket for an exception condition. When select() reports that an exception condition is pending, the master program calls close() to free the given socket.

If your program closes the socket before a pending exception condition is indicated, the TCP connection is immediately reset, and the target program call to takesocket() call is unsuccessful. Calls other than the close() call issued on a given socket return a value of -1, with errno set to EBADF.

Sockets that have been given and not taken for a period of four days will be closed and become unavailable. If a *select* for the socket is outstanding, it is posted.

Return values

The value 0 indicates success. The value -1 indicates an error. Errno identifies a specific error.

Errno	Description
EBADF	The *d* parameter is not a valid socket descriptor. The socket has already been given. The socket domain is not AF_INET.
EBUSY	Listen() has been called for the socket.
EFAULT	Using the *clientid* parameter as specified would result in an attempt to access storage outside the caller address space.
EINVAL	The *clientid* parameter does not specify a valid client identifier.
ENOTCONN	The socket is not connected.
EOPNOTSUPP	The socket type is not SOCK_STREAM.

Related calls

accept(), close(), getclientid(), listen(), select(), takesocket()

htonl()

The htonl() call translates a long integer from host byte order to network byte order.

```
#include <manifest.h>
#include <bsdtypes.h>
#include <in.h>

unsigned long htonl(unsigned long a)
```

Parameter	Description
a	The unsigned long integer to be put into network byte order.

Return values

Returns the translated long integer.

Related calls

htons(), ntohs(), ntohl()

htons()

The htons() call translates a short integer from host byte order to network byte order.

```
#include <manifest.h>
#include <bsdtypes.h>
#include <in.h>

unsigned short htons(unsigned short a)
```

Parameter	Description
a	The unsigned short integer to be put into network byte order.

Return values

Returns the translated short integer.

Related calls

ntohs(), htonl(), ntohl()

inet_addr()

The inet_addr() call interprets character strings representing host addresses expressed in standard dotted decimal notation and returns host addresses suitable for use as internet addresses.

```
#include <manifest.h>
#include <bsdtypes.h>
#include <socket.h>
#include <in.h>
#include <inet.h>

unsigned long inet_addr(char *cp)
```

Parameter	Description
cp	A character string in standard dotted decimal (.) notation

Values specified in standard dotted decimal notation take one of the following forms:

```
a.b.c.d
a.b.c
a.b
a
```

When a four-part address is specified, each part is interpreted as a byte of data and assigned, from left to right, to one of the four bytes of an internet address.

When a three-part address is specified, the last part is interpreted as a 16-bit quantity and placed in the two rightmost bytes of the network address. This makes the three-part address a good format for specifying Class B network addresses as 128.net.host.

When a two-part address is specified, the last part is interpreted as a 24-bit quantity and placed in the three rightmost bytes of the network address. This makes the two-part address a good format for specifying Class A network addresses as net.host.

When a one-part address is specified, the value is stored directly in the network address space without any rearrangement of its bytes.

Numbers supplied as address parts in standard dotted decimal notation can be decimal, hexadecimal, or octal. Numbers are interpreted using C language syntax. A leading *0x* implies hexadecimal; a leading 0 implies octal. A number without a leading 0 implies decimal.

Return values

The internet address is returned in network byte order.

A value of -1 is returned as an error.

Related calls

inet_lnaof(), inet_makeaddr(), inet_netof(), inet_network(), inet_ntoa()

inet_lnaof()

The inet_lnaof() call breaks apart the existing internet host address, and returns the local network address portion.

```
#include <manifest.h>
#include <bsdtypes.h>
#include <socket.h>
#include <in.h>
#include <inet.h>

unsigned long inet_lnaof(struct in_addr in)
```

Parameter	Description
in	The host internet address

Return values

The local network address is returned in host byte order.

Related calls

inet_addr(), inet_makeaddr(), inet_netof(), inet_network(), inet_ntoa()

inet_makeaddr()

The inet_makeaddr() call combines an existing network number and a local network address to construct an internet address.

```
#include <manifest.h>
#include <bsdtypes.h>
#include <socket.h>
#include <in.h>
#include <inet.h>

struct in_addr
inet_makeaddr(unsigned long net, unsigned long lna)
```

Parameter	Description
net	The network number
lna	The local network address

Return values

The internet address is returned in network byte order.

Related calls

inet_addr(), inet_lnaof(), inet_netof(), inet_network(), inet_ntoa()

inet_netof()

The inet_netof() call breaks apart the existing internet host address and returns the network number portion.

```
#include <manifest.h>
#include <bsdtypes.h>
#include <socket.h>
#include <in.h>
#include <inet.h>

unsigned long inet_netof(struct in_addr in)
```

Parameter	Description
in	The internet address in network byte order

Return values

The network number is returned in host byte order.

Related calls

inet_addr(), inet_lnaof(), inet_makeaddr(), inet_ntoa()

inet_network()

The inet_network() call interprets character strings representing addresses expressed in standard dotted decimal notation and returns numbers suitable for use as a network number.

```
#include <manifest.h>
#include <bsdtypes.h>
#include <socket.h>
#include <in.h>
#include <inet.h>

unsigned long inet_network(char *cp)
```

Parameter	Description
cp	A character string in standard, dotted decimal (.) notation

Return values

The network number is returned in host byte order.

Related calls

inet_addr(), inet_lnaof(), inet_makeaddr(), inet_ntoa()

inet_ntoa()

The inet_ntoa() call returns a pointer to a string expressed in dotted decimal notation. The inet_ntoa() call accepts an internet address expressed as a 32-bit quantity in network byte order and returns a string expressed in dotted decimal notation.

```
#include <manifest.h>
#include <bsdtypes.h>
#include <socket.h>
#include <in.h>
#include <inet.h>

char *inet_ntoa(struct in_addr in)
```

Parameter	Description
in	The host internet address

Return values

Returns a pointer to the internet address expressed in dotted decimal notation

Related calls

inet_addr(), inet_lnaof(), inet_makeaddr(), inet_network(), inet_ntoa()

ioctl()

The operating characteristics of sockets can be controlled using the ioctl() call.

Rules:

- This call can be used only in the AF_INET domain.
- Only the ioctl() commands that are documented in this topic are supported by this API.

```
#include <manifest.h>
#include <socket.h>
#include <bsdtypes.h>
#include <ioctl.h>
#include <rtrouteh.h>
#include <if.h>
#include <ezbcmonc.h>
int ioctl(int s, unsigned long cmd, char *arg)
```

Parameter	Description
s	The socket descriptor.
cmd	The command to perform.
arg	Points to the data associated with *cmd*.

The operations to be controlled are determined by *cmd*. The *arg* parameter points to data associated with the particular command, and its format depends on the command being requested. The following are valid ioctl() keywords:

Keyword	Description
FIONBIO	Sets or clears nonblocking I/O for a socket. The variable *arg* points to an integer. If the integer is 0, nonblocking I/O on the socket is cleared; otherwise, the socket is set for nonblocking I/O.
FIONREAD	Gets for the socket the number of immediately readable bytes. The variable *arg* points to an integer.
SIOCADDRT	Adds a routing table entry. The variable *arg* points to a *rtentry* structure, as defined in RTROUTE.H. The routing table entry, passed as an argument, is added to the routing tables.
SIOCATMARK	Queries whether the current location in the data input is pointing to out-of-band data. The variable *arg* points to an integer of 1 when the socket points to a mark in the data stream for out-of-band data; otherwise, it points to 0.
SIOCDELRT	Deletes a routing table entry. The variable *arg* points to a *rtentry* structure, as defined in RTROUTE.H. If the structure exists, the routing table entry passed as an argument is deleted from the routing tables.
SIOCGIFADDR	Gets the network interface address. The variable *arg* points to an *ifreq* structure, as defined in IF.H. The interface address is returned in the argument.
SIOCGIFBRDADDR	Gets the network interface broadcast address. The variable *arg* points to an *ifreq* structure, as defined in IF.H. The interface broadcast address is returned in the argument.

SIOCGIFCONF
Gets the network interface configuration. The variable *arg* points to an *ifconf* structure, as defined in IF.H. The interface configuration is returned in the argument.

SIOCGIFDSTADDR
Gets the network interface destination address. The variable *arg* points to an *ifreq* structure, as defined in IF.H. The interface destination (point-to-point) address is returned in the argument.

SIOCGIFFLAGS
Gets the network interface flags. The variable *arg* points to an *ifreq* structure, as defined in IF.H. The interface flags are returned in the argument.

SIOCGIFMETRIC
Gets the network interface routing metric. The variable *arg* points to an *ifreq* structure, as defined in IF.H. The interface routing metric is returned in the argument.

SIOCGIFNETMASK
Gets the network interface network mask. The variable *arg* points to an *ifreq* structure, as defined in IF.H. The interface network mask is returned in the argument.

SIOCSIFMETRIC
Sets the network interface routing metric. The variable *arg* points to an *ifreq* structure, as defined in IF.H. The interface routing metric is set to the value passed in the argument.

SIOCGMONDATA
Returns TCP/IP stack statistical counters. The variable *arg* points to a MonDataIn structure. The counters are returned in a MonDataOut structure. Both of these structures are defined in EZBZMONC in SEZANMAC.

Note: The ARP counter data provided differs depending on the type of device. See *z/OS Communications Server: IP Configuration Guide* for information about devices that support ARP Offload and what is supported for each device.

Return values

The value 0 indicates success; the value -1 indicates an error. Errno identifies the specific error.

Errno	Description
EBADF	The *s* parameter is not a valid socket descriptor.
EINVAL	The request is not valid, or not supported.
EFAULT	The arg is a bad pointer.

Example

```
int s;
int dontblock;
int rc;
.
.
/* Place the socket into nonblocking mode */
dontblock = 1;
rc = ioctl(s, FIONBIO, (char *) &dontblock);
.
.
```

listen()

The listen() call applies only to stream sockets. It performs two tasks: it completes the binding necessary for a socket *s*, if bind() has not been called for *s*, and it creates a connection request queue of length *backlog* to queue incoming connection requests. When the queue is full, additional connection requests are ignored.

The listen() call indicates a readiness to accept client connection requests. It transforms an active socket into a passive socket. Once called, *s* can never again be used as an active socket to initiate connection requests. Calling listen() is the third of four steps that a server performs when it accepts a connection. It is called after allocating a stream socket using socket(), and after binding a name to *s* using bind(). It must be called before calling accept().

```
#include <manifest.h>
#include <socket.h>
int listen(int s, int backlog)
```

Parameter	Description
s	Socket descriptor
backlog	Maximum queue length for pending connections

If the backlog is less than 0, *backlog* is set to 0. If the backlog is greater than SOMAXCONN, as defined in the TCPIP.PROFILE file, *backlog* is set to SOMAXCONN. There is a SOMAXCONN variable in the SOCKET.H file that is hardcoded at 10. If your C socket programs use this variable to determine the maximum listen() *backlog* queue length, remember to change the header file to reflect the value you specified for TCP/IP in TCPIP.PROFILE.

Return values

The value 0 indicates success; the value -1 indicates an error. Errno identifies the specific error.

Errno	Description
EBADF	The *s* parameter is not a valid socket descriptor.
EOPNOTSUPP	The *s* parameter is not a socket descriptor that supports the listen() call.

Related calls

accept(), bind(), connect(), socket()

maxdesc()

The maxdesc() call reserves additional space in the TCP/IP address space to allow socket numbers to extend beyond the default range of 0 through 49. Socket numbers 0, 1, and 2 are never assigned, so the default maximum number of sockets is 47.

```
#include <manifest.h>
#include <bsdtypes.h>
#include <socket.h>
#include <in.h>

int maxdesc(int *totdesc, int *inetdesc)
```

Parameter	Description
totdesc	Points to an integer containing a value one greater than the largest socket number desired. The maximum allowed value is 2000. **Note:** If a totdesc value greater than 2000 is specified, the internal value is set to 2000. In all cases, use getdtablesize() to verify the value set by maxdesc().
inetdesc	Points to an integer containing a value one greater than the largest socket number desired. The maximum value, usable for AF_INET sockets, allowed is 2000.

Set the integer pointed to by *totdesc* to one more than the maximum socket number desired. If your program does not use AF_INET sockets, set the integer pointed to by *inetdesc* to 0 . If your program uses AF_INET sockets, set the integer pointed to by *inetdesc* to the same value as *totdesc*; maxdesc() must be called before your program creates its first socket. Your program should use getdtablesize() to verify that the number of sockets has been changed.

Note: Increasing the size of the bit sets for the select() call must be done at compile time. To increase the size of the bit sets, before including BSDTYPES.H, define FD_SETSIZE to be the largest value of any socket. The default size of FD_SETSIZE is 255 sockets.

Return values

The value 0 indicates success. (Your application should check the integer pointed to by *inetdesc*. It might contain less than the original value, if there was insufficient storage available in the TCP/IP address space. In this case, the desired number of AF_INET sockets are not available.) The value -1 indicates an error. Errno identifies the specific error.

Errno	Description
EFAULT	Using the *totdesc* or *inetdesc* parameters as specified results in an attempt to access storage outside of the caller address space, or storage not able to be modified by the caller.
EALREADY	Your program called maxdesc() after creating a socket, or after a previous call to maxdesc().
EINVAL	Indicates that **totdesc* is less than **inetdesc*; **totdesc* is less than or equal to 0; or **inetdesc* is less than 0.
ENOMEM	Your address space lacks sufficient storage.

Example

```
int totdesc, inetdesc;
totdesc = 100;
inetdesc = 0;
rc = maxdesc(&totdesc, &inetdesc)
```

If successful, your application can create 97 sockets, all of type AF_IUCV. Socket numbers run from 3–99.

```
int totdesc, inetdesc;
totdesc = 100;
inetdesc = 100;
rc = maxdesc(&totdesc, &inetdesc)
```

If successful, your application can create 97 sockets, each of which can be of type AF_INET or AF_IUCV. The socket numbers run from 3–99.

Related calls

select(), socket(), getdtablesize()

ntohl()

The ntohl() call translates a long integer from network byte order to host byte order.

```
#include <manifest.h>
#include <bsdtypes.h>
#include <in.h>

unsigned long ntohl(unsigned long a)
```

Parameter	Description
a	The unsigned long integer to be put into host byte order

Return values

Returns the translated long integer

Related calls

htonl(), htons(), ntohs()

ntohs()

The ntohs() call translates a short integer from network byte order to host byte order.

```
#include <manifest.h>
#include <bsdtypes.h>
#include <in.h>

unsigned short ntohs(unsigned short a)
```

Parameter	Description
a	The unsigned short integer to be put into host byte order

Return values

Returns the translated short integer

Related calls

ntohl(), htons(), htonl()

read()

The read() call reads data on a socket with descriptor *s* and stores it in a buffer. The read() call applies only to connected sockets. This call returns as many as *len* bytes of data. If fewer than the number of bytes requested is available, the call returns the number currently available. If data is not available for the socket *s*, and *s* is in blocking mode, the read() call blocks the caller until data arrives. If data is not available, and *s* is in nonblocking mode, read() returns a -1 and sets errno to EWOULDBLOCK. See "ioctl()" on page 170, or "fcntl()" on page 131 for a description of how to set nonblocking mode.

If a datagram packet is too long to fit in the supplied buffer, datagram sockets discard extra bytes. Stream sockets act like streams of information with no boundaries separating data. For example, if applications A and B are connected with a stream socket and Application A sends 1000 bytes, each call to this function can return 1 byte, or 10 bytes, or the entire 1000 bytes. Therefore, applications using stream sockets should place this call in a loop, calling this function until all data has been received.

```
#include <manifest.h>
#include <socket.h>
int read(int s, char *buf, int len)
```

Parameter	Description
s	Socket descriptor.
buf	Points to the buffer that receives the data.
len	Length in bytes of the buffer pointed to by *buf*.

Return values

If successful, the number of bytes copied into the buffer is returned. The value 0 indicates that the connection is closed. The value -1 indicates an error. Errno identifies the specific error.

Errno	Description
EBADF	Indicates that *s* is not a valid socket descriptor.
EFAULT	Using the *buf* and *len* parameters would result in an attempt to access storage outside the caller address space.
EWOULDBLOCK	Indicates an unconnected socket (RAW). **Note:** ENOTCONN is returned for TCP, and EINVAL is returned for UDP.
EMSGSIZE	For non-TCP sockets, this indicates that the length exceeds the maximum data size. This is determined by getsockopt() using SO_SNDBUF for the socket type (TCP, UDP, or RAW).

Related calls

connect(), fcntl(), getsockopt(), ioctl(), readv(), recv(), recvmsg(), recvfrom(), select(), selectex(), send(), sendmsg(), sendto(), setsockopt(), socket(), write(), writev()

readv()

The readv() call reads data on a socket with descriptor *s* and stores it in a set of buffers. The readv() call applies to connected sockets only.

```
#include <manifest.h>
#include <socket.h>
#include <bsdtypes.h>
#include <uio.h>

int readv(int s, struc iovec *iov, int iovcnt)
```

Parameter	Description
s	The socket descriptor.
iov	Points to an iovec structure.
iovcnt	The number of buffers pointed to by the *iov* parameter.

The data is scattered into the buffers specified by iov[0]...iov[iovcnt–1]. The *iovec* structure is defined in UIO.H and contains the following variables:

Variable	Description
iov_base	Points to the buffer.
iov_len	The length of the buffer.

The readv() call applies only to connected sockets.

This call returns up to *len* bytes of data. If less than the number of bytes requested is available, the call returns the number currently available. If data is not available for the socket *s*, and *s* is in blocking mode, the readv() call blocks the caller until data arrives. If data is not available and *s* is in nonblocking mode, readv() returns a -1 and sets errno to EWOULDBLOCK. See “fcntl()” on page 131 or “ioctl()” on page 170 for a description of how to set nonblocking mode. When a datagram packet is too long to fit in the supplied buffer, datagram sockets discard extra bytes. Stream sockets act like streams of information with no boundaries separating data. For example, if applications A and B are connected with a stream socket and Application A sends 1000 bytes, each call to this function can return 1 byte, or 10 bytes, or the entire 1000 bytes. Therefore, applications using stream sockets should place this call in a loop and call this function until all data has been received.

Return values

If successful, the number of bytes read into the buffers is returned. The value 0 indicates that the connection is closed. The value -1 indicates an error. Errno identifies the specific error.

Errno	Description
EBADF	Indicates that *s* is not a valid socket descriptor.
EFAULT	Using *iov* and *iovcnt* would result in an attempt to access storage outside the caller address space.
EINVAL	*Iovcnt* was not valid, or one of the fields in the *iov* array was not valid. Also returned for a NULL *iov* pointer.
EWOULDBLOCK	Indicates that *s* is in nonblocking mode and data is not available to read.

Related calls

connect(), fcntl(), getsockopt(), ioctl(), read(), recv(), recvmsg(), recvfrom(), select(), selectex(), send(), sendmsg(), sendto(), setsockopt(), socket(), write(), writev()

recv()

The recv() call receives data on a socket with descriptor *s* and stores it in a buffer. The recv() call applies only to connected sockets.

This call returns the length of the incoming message or data. If data is not available for socket *s*, and *s* is in blocking mode, the recv() call blocks the caller until data arrives. If data is not available and *s* is in nonblocking mode, recv() returns a -1 and sets errno to EWOULDBLOCK. See "fcntl()" on page 131 or "ioctl()" on page 170 for a description of how to set nonblocking mode.

If a datagram packet is too long to fit in the supplied buffer, datagram sockets discard extra bytes. Stream sockets act like streams of information with no boundaries separating data. For example, if applications A and B are connected with a stream socket and Application A sends 1000 bytes, each call to this function can return 1 byte, or 10 bytes, or the entire 1000 bytes. Therefore, applications using stream sockets should place this call in a loop and call this function until all data has been received.

```
#include <manifest.h>
#include <bsdtypes.h>
#include <socket.h>

int recv(int s, char *buf, int len, int flags)
```

Parameter	Description
s	Socket descriptor.
buf	Points to the buffer that receives the data.
len	Length in bytes of the buffer pointed to by *buf*.
flags	Set the *flags* parameter by specifying one or more of the following flags. If more than one flag is specified, the logical OR operator (|) must be used to separate them. Setting this parameter is supported only for sockets in the AF_INET domain. Setting these flags is not supported for sockets in the AF_IUCV domain. **MSG_OOB** Reads any out-of-band data on the socket. This is valid for stream (TCP) sockets only. **MSG_PEEK** Peeks at the data present on the socket; the data is returned but not consumed, so that a subsequent receive operation sees the same data.

Return values

If successful, the byte length of the message or datagram is returned. The value -1 indicates an error. The value 0 indicates connection closed. Errno identifies the specific error.

Errno	Description
EBADF	Indicates that *s* is not a valid socket descriptor.
EFAULT	Using the *buf* and *len* parameters would result in an attempt to access storage outside the caller address space.

EWOULDBLOCK
Indicates that *s* is in nonblocking mode and data is not available to read.

ENOTCONN Indicates an unconnected TCP socket.

EMSGSIZE For non-TCP sockets, this indicates that length exceeds the maximum data size as determined by getsockopt() using SO_SNDBUF for the socket type, either TCP, UDP, or RAW.

Related calls

connect(), fcntl(), getsockopt(), ioctl(), read(), readv(), recvfrom(), recvmsg(), select(), selectex(), send(), sendmsg(), sendto(), setsockopt(), socket(), write(), writev()

recvfrom()

The recvfrom() call receives data on a socket by name with descriptor *s* and stores it in a buffer. The recvfrom() call applies to any datagram socket, whether connected or unconnected. For a datagram socket, when *name* is nonzero, the source address of the message is filled. Parameter *namelen* must first be initialized to the size of the buffer associated with *name*; then it is modified on return to indicate the actual size of the address stored there.

This call returns the length of the incoming message or data. If a datagram packet is too long to fit in the supplied buffer, datagram sockets discard extra bytes. If data is not available for the socket *s*, and *s* is in blocking mode, the recvfrom() call blocks the caller until data arrives. If data is not available, and *s* is in nonblocking mode, recvfrom() returns a -1 and sets errno to EWOULDBLOCK. See "fcntl()" on page 131 or "ioctl()" on page 170 to set nonblocking mode.

For datagram sockets, this call returns the entire datagram sent, providing the datagram can fit into the specified buffer. Stream sockets act like streams of information with no boundaries separating data. For example, if applications A and B are connected with a stream socket, and Application A sends 1000 bytes, each call to this function can return 1 byte, or 10 bytes, or the entire 1000 bytes. Therefore, applications using stream sockets should place this call in a loop, calling this function until all data has been received.

For datagram protocols, recvfrom() returns the source address associated with each incoming datagram. For connection-oriented protocols like TCP, getpeername() returns the address associated with the remote end of the connection.

```
#include <manifest.h>
#include <bsdtypes.h>
#include <socket.h>

int recvfrom(int s, char *buf, int len, int flags,
struct sockaddr *name, int *namelen)
```

Parameter	Description
s	Socket descriptor.
buf	Pointer to the buffer to receive the data.
len	Length in bytes of the buffer pointed to by *buf*.
flags	A parameter that can be set to 0 or MSG_PEEK, or MSG_OOB. Setting this parameter is supported only for sockets in the AF_INET domain. Setting these flags is not supported for sockets in the AF_IUCV domain. **MSG_OOB** Reads any out-of-band data on the socket. This is valid for stream (TCP) sockets only. **MSG_PEEK** Peeks at the data present on the socket; the data is returned but not consumed, so that a subsequent receive operation sees the same data.

name Points to a *socket address* structure from which data is received. If *name* is a nonzero value, the source address is returned (datagram sockets).

namelen Points to the size of *name* in bytes.

Return values

If successful, the length of the message or datagram is returned in bytes. The value 0 indicates that the connection is closed. The value -1 indicates an error. Errno identifies the specific error.

Errno	Description
EBADF	Indicates that *s* is not a valid socket descriptor.
EFAULT	Using the *buf* and *len* parameters would result in an attempt to access storage outside the caller address space.
EWOULDBLOCK	Indicates that *s* is in nonblocking mode and data is not available to read.
ENOTCONN	Indicates an unconnected TCP socket.
EMSGSIZE	For non-TCP sockets, this indicates that length exceeds the maximum data size as determined by getsockopt() using SO_SNDBUF for the socket type, either TCP, UDP, or RAW.
EINVAL	Parameter *namelen* is not valid.

Related calls

fcntl(), getsockopt(), ioctl(), read(), readv(), recv(), recvmsg(), select(), selectex(), send(), sendmsg(), sendto(), setsockopt(), socket(), write(), writev()

recvmsg()

The recvmsg() call receives messages on the socket with descriptor *s* and stores the messages in an array of message headers.

For datagram protocols, recvmsg() returns the source address associated with each incoming datagram. For connection-oriented protocols like TCP, getpeername() returns the address associated with the remote end of the connection.

```
#include <manifest.h>
#include <bsdtypes.h>
#include <socket.h>

int recvmsg(int s, struct msghdr *msg, int flags)
```

Parameter	Description
s	Socket descriptor.
msg	Points to an msghdr structure.
flags	Set the *flags* parameter by specifying one or more of the following flags. If more than one flag is specified, the logical OR operator (|) must be used to separate them. Setting this parameter is supported only for sockets in the AF_INET domain. Setting these flags is not supported for sockets in the AF_IUCV domain. **MSG_OOB** Reads any out-of-band data on the socket. This is valid for stream (TCP) sockets only. **MSG_PEEK** Peeks at the data present on the socket; the data is returned but not consumed, so that a subsequent receive operation will see the same data.

A message header is defined by structure msghdr. The definition of this structure can be found in the SOCKET.H header file and contains the following elements:

Variable	Description
msg_name	An optional pointer to a buffer where the sender address is stored for datagram sockets.
msg_namelen	The size of the address buffer.
msg_iov	An array of iovec buffers into which the message is placed. An iovec buffer contains the following variables: *iov_base* Points to the buffer. *iov_len* The length of the buffer.
msg_iovlen	The number of elements in the msg_iov array.
msg_accrights	The access rights received. This field is ignored.
msg_accrightslen	The length of access rights received. This field is ignored.

The recvmsg() call applies to sockets, regardless of whether they are in the connected state, except for TCP sockets, which must be connected.

This call returns the length of the data received. If data is not available for socket *s*, and *s* is in blocking mode, the recvmsg() call blocks the caller until data arrives. If data is not available, and *s* is in nonblocking mode, recvmsg() returns a -1 and sets errno to EWOULDBLOCK. See "fcntl()" on page 131 or "ioctl()" on page 170 to see how to set nonblocking mode.

If a datagram packet is too long to fit in the supplied buffer, datagram sockets discard extra bytes. Stream sockets act like streams of information with no boundaries separating data. For example, if applications A and B are connected with a stream socket, and Application A sends 1000 bytes, each call to this function can return 1 byte, or 10 bytes, or the entire 1000 bytes. Therefore, applications using stream sockets should place this call in a loop, and call this function until all data has been received.

Return values

If successful, the length of the message in bytes is returned. The value 0 indicates that the connection is closed. The value -1 indicates an error. Errno identifies the specific error.

Errno	Description
EBADF	Indicates that *s* is not a valid socket descriptor.
EFAULT	Using *msg* would result in an attempt to access storage outside the caller address space. Also returned when *msg_namelen* is not valid.
EWOULDBLOCK	Indicates that *s* is in nonblocking mode and data is not available to read.
ENOTCONN	Returned for an unconnected TCP socket.
EMSGSIZE	For non-TCP sockets, this indicates that length exceeds the maximum data size determined by getsockopt() using SO_SNDBUF for the socket type (TCP, UDP, or RAW).

Related calls

connect(), fcntl(), getsockopt(), ioctl(), read(), readv(), recv(), recvfrom(), select(), selectex(), send(), sendmsg(), sendto(), setsockopt(), socket(), write(), writev()

select()

The select() call monitors activity on a set of sockets looking for sockets ready for reading, writing, or with an exception condition pending.

```
#include <manifest.h>
#include <socket.h>
#include <bsdtypes.h>
#include <bsdtime.h>

int select(int nfds, fd_set *readfds, fd_set *writefds, fd_set *exceptfds,
struct timeval *timeout)
```

Parameter	Description
nfds	The number of socket descriptors to be checked. This value should be one greater than the greatest number of sockets to be checked. You can use the select() call to pass a bit set containing the socket descriptors for the sockets you want checked. The bit set is fixed in size using one bit for every possible socket. Use the *nfds* parameter to force select() to check only a subset of the allocated socket bit set. If your application allocates sockets 3, 4, 5, 6, and 7, and you want to check all of your allocations, *nfds* should be set to 8, the highest socket descriptor you specified, plus 1. If your application checks sockets 3 and 4, *nfds* should be set to 5. Socket numbers are assigned starting with number 3 because numbers 0, 1, and 2 are used by the C socket interface.
readfds	Points to a bit set of descriptors to check for reading.
writefds	Points to a bit set of descriptors to check for writing.
exceptfds	Points to a bit set of descriptors to check for exception conditions pending.
timeout	Points to the time to wait for select() to complete.

If *timeout* is not a NULL pointer, it specifies a maximum time to wait for the selection to complete. If *timeout* is a NULL pointer, the select() call blocks until a socket becomes ready. To poll the sockets and return immediately, *timeout* should be a non-NULL pointer to a *timeval* structure with a value of 0.

If you are using both AF_INET and AF_IUCV sockets in the socket descriptor sets, the timer value is ignored and processed as if *timeout* were a non-NULL pointer to a *timeval* structure with a value of 0.

To use select() as a timer in your program, do either of the following:

- Set the read, write, and except arrays to 0.
- Set nfds to be a NULL pointer.

To completely understand the implementation of the select() call, you must understand the difference between a socket and a port. TCP/IP defines ports to represent a certain process on a certain machine. A port represents the location of one process; it does not represent a connection between processes. In the MVS programming interface for TCP/IP, a socket describes an endpoint of

communication. Therefore, a socket describes both a port and a machine. Like file descriptors, a socket is a small integer representing an index into a table of communication endpoints in a TCP/IP address space.

To test more than one socket at a time, place the sockets to be tested into a bit set of type FD_SET. A bit set is a string of bits that when X is an element of the set, the bit representing X is set to 1. If X is not an element of the set, the bit representing X is set to 0. For example, if Socket 33 is an element of a bit set, then bit 33 is set to 1. If Socket 33 is not an element of a bit set, then bit 33 is set to 0.

Because the bit sets contain a bit for every socket that a process can allocate, the size of the bit sets is constant. The function getdtablesize() returns the number of sockets that your program can allocate. If your program needs to allocate a large number of sockets, use getdtablesize() and maxdesc() to increase the number of sockets that can be allocated. Increasing the size of the bit sets must be done when you compile the program. To increase the size of the bit sets, define FD_SETSIZE before including BSDTYPES.H. The largest value of any socket is FD_SETSIZE, defined to be 255 in BSDTYPES.H.

The following macros can manipulate bit sets.

Macro **Description**

FD_ZERO(&*fdset*)
Sets all bits in bit set *fdset* to 0. After this operation, the bit set does not contain sockets as elements. This macro should be called to initialize the bit set before calling FD_SET() to set a socket as a member.

FD_SET(*sock*, &*fdset*)
Sets the bit for the socket *sock* to 1, making *sock* a member of bit set *fdset*.

FD_CLR(*sock*, &*fdset*)
Clears the bit for the socket *sock* in bit set *fdset*. This operation sets the appropriate bit to 0.

FD_ISSET(*sock*, &*fdset*)
Returns nonzero if *sock* is a member of the bit set *fdset*. Returns 0 if *sock* is not a member of *fdset*. (This operation returns the bit representing *sock*.)

A socket is ready to be read when incoming data is buffered for it, or when a connection request is pending. A call to accept(), read(), recv(), or recvfrom() does not block. To test whether any sockets are ready to be read, use FD_ZERO() to initialize the *readfds* bit set and invoke FD_SET() for each socket to be tested.

A socket is ready to be written if there is buffer space for outgoing data. A socket is ready for reading if there is data on the socket to be received. For a nonblocking stream socket in the process of connecting the connect() will return with a -1. The program needs to check the errno. If the errno is EINPROGRESS] the socket is selected for write when the connect() completes. In the situation where the errno is not EINPROGRESS, the socket will still be selected for write which indicates that there is a pending error on the socket. A call to write(), send(), or sendto() does not block providing that the amount of data is less than the amount of buffer space. If a socket is selected for write, the amount of available buffer space is guaranteed to be at least as large as the size returned from using SO_SNDBUF with getsockopt().

To test whether any sockets are ready for writing, initialize *writefds* using FD_ZERO(), and use FD_SET() for each socket to be tested.

The select() call checks for a pending exception condition on the given socket to indicate that the target program has successfully called takesocket(). When select() indicates a pending exception condition, your program calls close() to close the given socket. A socket has exception conditions pending if it has received out-of-band data. A stream socket that was given using givesocket() is selected for exception when another application successfully takes the socket using takesocket().

The programmer can pass NULL for any bit sets without sockets to test. For example, if a program need only check a socket for reading, it can pass NULL for both *writefds* and *exceptfds*.

Because the sets of sockets passed to select() are bit sets, the select() call must test each bit in each bit set before polling the socket for status. For efficiency, the *nfsd* parameter specifies the largest socket passed in any of the bit sets. The select() call then tests only sockets in the range 0 to *nfsd*-1. Variable *nfsd* can be the result of getdtablesize(), but if the application has only two sockets and *nfsd* is the result of getdtablesize(), select() tests every bit in each bit set.

Return values

The total number of ready sockets in all bit sets is returned. The value -1 indicates an error; check errno. The value 0 indicates an expired time limit. If the return value is greater than 0, the sockets that are ready in each bit set are set to 1. Sockets in each bit set that are not ready are set to 0. Use macro FD_ISSET() with each socket to test its status.

Errno	Description
EBADF	One of the bit sets specified an incorrect socket. [FD_ZERO() was probably not called before the sockets were set.]
EFAULT	One of the bit sets pointed to a value outside the caller address space.
EINVAL	One of the fields in the timeval structure is not valid.

Note: If the number of ready sockets is greater than 65 535, only 65 535 is reported.

Example

In the following example, select() is used to poll sockets for reading (socket r), writing (socket w), and exception (socket e) conditions.

```
/* sock_stats(r, w, e) - Print the status of sockets r, w, and e. */
int sock_stats(r, w, e)
int r, w, e;
{
   fd_set reading, writing, except;
   struct timeval timeout;
   int rc, max_sock;

   /* initialize the bit sets */
   FD_ZERO( &reading );
   FD_ZERO( &writing );
   FD_ZERO( &except );

   /* add r, w, and e to the appropriate bit set */
   FD_SET( r, &reading );
```

```
   FD_SET( w, &writing );
   FD_SET( e, &except );

   /* for efficiency, what's the maximum socket number? */
   max_sock = MAX( r, w );
   max_sock = MAX( max_sock, e );
   max_sock ++;

   /* make select poll by sending a 0 timeval */
   memset( &timeout, 0, sizeof(timeout) );

   /* poll */
   rc = select( max_sock, &reading, &writing, &except, &timeout );

   if ( rc < 0 ) {
        /* an error occurred during the select() */
        tcperror( "select" );
   }
   else if ( rc == 0 ) {
        /* none of the sockets were ready in our little poll */
        printf( "nobody is home.\n" );
   } else {
        /* at least one of the sockets is ready */
        printf("r is %s\n", FD_ISSET(r,&reading) ? "READY" : "NOT READY");
        printf("w is %s\n", FD_ISSET(w,&writing) ? "READY" : "NOT READY");
        printf("e is %s\n", FD_ISSET(e,&except)  ? "READY" : "NOT READY");
   }
}
```

Related calls

getdtablesize(), maxdesc(), selectex()

selectex()

The selectex() call provides an extension to the select() call by allowing you to use an ECB or ECB list that defines an event not described by *readfs, writefds, or exceptfds*.

The selectex() call monitors activity on a set of different sockets until a timeout expires to see whether any sockets are ready for reading or writing, or if any exception conditions are pending. See "select()" on page 186 for more information about selectex().

```
#include <manifest.h>
#include <socket.h>
#include <bsdtypes.h>
#include <bsdtime.h>

int selectex(int nfds, fd_set *readfds, fd_set *writefds, fd_set *exceptfds,
struct timeval *timeout, int *ecbptr)
```

Parameter	Description
nfds	The number of socket descriptors to be checked.
readfds	Points to a bit set of descriptors to be checked for reading.
writefds	Points to a bit set of descriptors to be checked for writing.
exceptfds	Points to a bit set of descriptors to be checked for exception pending conditions.
timeout	Points to the time to wait for selectex() to complete.
ecbptr	Points to the event control block (ECB) or ECB list. For an ECB list, the high-order bit must be turned on in *ecbptr.* The last entry in the ECB list must also have its high-order bit set to 1, signifying list end. The maximum ECBs allowed is 63. **Note:** ECB list is only supported for AF_INET sockets.

Return values

The total number of ready sockets (in all bit sets) is returned. The returned value -1 indicates an error. The returned value of 0 indicates either an expired time limit or that the caller ECB has been posted. To determine which of these two conditions occurred, check the ECB value. If the value of the ECB is nonzero, then the ECB has been POSTed; otherwise, the time limit has expired. The caller must initialize the ECB value to 0 before issuing selectex(). If the caller's ECB has been POSTed, the caller descriptor sets are also set to 0. If the return value is greater than 0, the socket descriptors in each bit set that are ready are set to 1. All others are set to 0.

Errno	Description
EBADF	One of the descriptor sets specified an incorrect descriptor.
EFAULT	One of the parameters pointed to a value outside the caller address space.
EINVAL	One of the fields in the *timeval* structure is not valid.

Note: If the number of ready sockets is greater than 65 535, only 65 535 is reported.

Related calls

accept(), connect(), getdtablesize(), recv(), send(), select()

send()

The send() call sends datagrams on the socket with descriptor *s*. The send() call applies to all connected sockets.

If buffer space is not available to hold the socket data to be transmitted, and the socket is in blocking mode, send() blocks the caller until more buffer space becomes available. If the socket is in nonblocking mode, send() returns a -1 and sets errno to EWOULDBLOCK. See "fcntl()" on page 131 or "ioctl()" on page 170 to set nonblocking mode. See "select()" on page 186 for additional information.

For datagram sockets, this call sends the entire datagram, providing the datagram can fit into the TCP/IP buffers. Stream sockets act like streams of information with no boundaries separating data. For example, if an application wishes to send 1000 bytes, each call to this function can send 1 byte, or 10 bytes, or the entire 1000 bytes. Therefore, applications using stream sockets should place this call in a loop and call this function until all data has been sent.

```
#include <manifest.h>
#include <bsdtypes.h>
#include <socket.h>

int send(int s, char *msg, int len, int flags)
```

Parameter	Description
s	Socket descriptor.
msg	Points to the buffer containing the message to transmit.
len	Length of the message pointed to by *msg*.
flags	Set the *flags* parameter by specifying one or more of the following flags. If more than one flag is specified, the logical OR operator (|) must be used to separate them. Setting this parameter is supported only for sockets in the AF_INET domain. Setting these flags is not supported in the AF_IUCV domain. **MSG_OOB** Sends out-of-band data on sockets that support this function. Only SOCK_STREAM sockets created in the AF_INET address family support out-of-band data. **MSG_DONTROUTE** The MSG_DONTROUTE option is turned on for the duration of the operation. This is usually used only by diagnostic or routing programs.

Return values

No indication of failure to deliver is implicit in a send() routine. The value -1 indicates locally detected errors. Errno identifies the specific error.

Errno	Description
EBADF	Indicates that *s* is not a valid socket descriptor.
EFAULT	Using the *msg* and *len* parameters would result in an attempt to access storage outside the caller address space.
ENOBUFS	Buffer space is not available to send the message.

EWOULDBLOCK

Indicates that *s* is in nonblocking mode and there is not enough space in TCP/IP to accept the data.

Related calls

connect(), fcntl(), getsockopt(), ioctl(), read(), readv(), recv(), recvfrom(), recvmsg(), select(), selectex(), sendmsg(), sendto(), socket(), write(), writev()

sendmsg()

The sendmsg() call sends messages on a socket with descriptor *s* passed in an array of message headers.

```
#include <manifest.h>
#include <bsdtypes.h>
#include <socket.h>

int sendmsg(int s, struct msghdr *msg, int flags)
```

Parameter	Description
s	Socket descriptor.
msg	Points to an msghdr structure.
flags	Set the *flags* parameter by specifying one or more of the following flags. If more than one flag is specified, the logical OR operator (|) must be used to separate them. Setting this parameter is supported only for sockets in the AF_INET domain. Setting these flags is not supported in the AF_IUCV domain. **MSG_OOB** Sends out-of-band data on the socket. **MSG_DONTROUTE** The SO_DONTROUTE option is turned on for the duration of the operation; it is usually used by diagnostic or routing programs only.

A message header is defined by a msghdr. The definition of this structure can be found in the SOCKET.H header file and contains the following parameters.

Parameter	Description
msg_name	The pointer to the buffer containing the recipient address. This is required for datagram sockets where an explicit connect() has not been done.
msg_namelen	The size of the address buffer. This is required for datagram sockets where an explicit connect() has not been done.
msg_iov	An array of iovec buffers containing the message. The iovec buffer contains the following: **iov_base** Points to the buffer. **iov_len** The length of the buffer.
msg_iovlen	The number of elements in the msg_iov array.
msg_accrights	The access rights sent. This field is ignored.
msg_accrightslen	The length of the access rights sent. This field is ignored.

The sendmsg() call applies to sockets regardless of whether they are in the connected state and returns the length of the data sent.

If there is not enough buffer space available to hold the socket data to be transmitted, and the socket is in blocking mode, sendmsg() blocks the caller until more buffer space becomes available. If the socket is in nonblocking mode, sendmsg() returns a -1 and sets errno to EWOULDBLOCK. See “fcntl()” on page 131 or “ioctl()” on page 170 to set nonblocking mode.

For datagram sockets, this call sends the entire datagram, providing the datagram can fit into the TCP/IP buffers. Stream sockets act like streams of information with no boundaries separating data. For example, if an application wishes to send 1000 bytes, each call to this function can send 1 byte, or 10 bytes, or the entire 1000 bytes. Therefore, applications using stream sockets should place this call in a loop, and call this function until all data has been sent.

Return values

If successful, the length of the message in bytes is returned. The value -1 indicates an error. Errno identifies the specific error.

Errno	Description
EBADF	Indicates that *s* is not a valid socket descriptor.
EFAULT	Using *msg* would result in an attempt to access storage outside the caller address space.
EINVAL	Indicates that *msg_namelen* is not the size of a valid address for the specified address family.
EMSGSIZE	The message was too big to be sent as a single datagram.
ENOBUFS	Buffer space is not available to send the message.
EWOULDBLOCK	Indicates that *s* is in nonblocking mode and there is not enough space in TCP/IP to accept the data.

Related calls

connect(), fcntl(), getsockopt(), ioctl(), read(), readv(), recv(), recvfrom(), recvmsg(), select(), selectex(), send(), sendto(), setsockopt(), socket(), write(), writev()

sendto()

The sendto() call sends datagrams on the socket with descriptor *s*. The sendto() call applies to any datagram socket, whether connected or unconnected.

If there is not enough available buffer space to hold the socket data to be transmitted, and the socket is in blocking mode, sendto() blocks the caller until more buffer space becomes available. If the socket is in nonblocking mode, sendto() returns a -1 and sets errno to EWOULDBLOCK. See "fcntl()" on page 131 or "ioctl()" on page 170 to set nonblocking mode.

For datagram sockets, this call sends the entire datagram, providing the datagram can fit into the TCP/IP buffers. Stream sockets act like streams of information with no boundaries separating data. For example, if an application wishes to send 1000 bytes, each call to this function can send 1 byte, or 10 bytes, or the entire 1000 bytes. Therefore, applications using stream sockets should place this call in a loop, and call this function until all data has been sent.

```
#include <manifest.h>
#include <bsdtypes.h>
#include <socket.h>

int sendto(int s, char *msg, int len, int flags, struct sockaddr *to,
    int tolen)
```

Parameter	Description
s	Socket descriptor.
msg	Points to the buffer containing the message to be transmitted.
len	Length of the message in the buffer pointed to by *msg*.
flags	A parameter that can be set to 0 or MSG_DONTROUTE. Setting this parameter is supported only for sockets in the AF_INET domain. Setting these flags is not supported in the AF_IUCV domain. **MSG_DONTROUTE** The SO_DONTROUTE option is turned on for the duration of the operation. This is usually used by diagnostic or routing programs only.
to	Address of the target.
tolen	Size of the structure pointed to by *to*.

Return values

If successful, the number of characters sent is returned. The value -1 indicates an error. Errno identifies the specific error.

No indication of failure to deliver is implied in the return value of this call when used with datagram sockets.

Errno Description

EBADF
Indicates that *s* is not a valid socket descriptor.

EFAULT
Using the *msg* and *len* parameters would result in an attempt to access storage outside the caller address space.

EINVAL
Tolen is not the size of a valid address for the specified address family.

EMSGSIZE
The message was too big to be sent as a single datagram. The default is large-envelope-size.

ENOBUFS
Buffer space is not available to send the message.

EWOULDBLOCK
Indicates that *s* is in nonblocking mode and there is not enough space in TCP/IP to accept the data.

Related calls

read(), readv(), recv(), recvfrom(), recvmsg(), send(), select(), selectex(), sendmsg(), socket() write(), writev()

sethostent()

The sethostent() call opens and caches the local host table contents for gethostent() calls. The sethostent() call is available only when RESOLVE_VIA_LOOKUP is defined before MANIFEST.H is included. See *z/OS Communications Server: IP Configuration Guide* for information about using local host tables.

```
#include <manifest.h>
#include <socket.h>

int sethostent(int stayopen)
```

Parameter	Description
stayopen	A nonzero flag value prevents the cached local host table contents from being freed after an endhostent().

Return values

The value 0 indicates success. The value -1 indicates an error. Errno identifies the specific error, returning the errno value of the fopen() call.

Related calls

endhostent(), endnetent(), gethostbyaddr(), gethostbyname(), gethostent()

setibmopt()

The setibmopt() call chooses the TCP/IP image with which to connect. It is used in conjunction with getibmopt(), which returns the number of TCP/IP images installed on a given MVS system and their names, versions, and states. With this information, the caller can dynamically choose the TCP/IP image with which to connect through the setibmopt() call.

Note: Images from pre-V3R2 releases of TCP/IP for MVS are excluded. The setibmopt() call is not meaningful for pre-V3R2 releases.

The setibmopt() call is optional. If setibmopt is not used, the standard method for determining the connecting TCP/IP image is followed. If setibmopt is used, it must be issued before any other socket calls that establish the connection to TCP/IP.

```
#include <manifest.h>
#include <socket.h>

int setibmopt(int cmd, struct ibm_tcpimage *buf)

struct ibm_tcpimage {
    unsigned short status;
    unsigned short version;
    char name[8];
}
```

Parameter	Description
cmd	The command to perform. For TCP/IP V3R2 for MVS, IBMTCP_IMAGE is supported.
buf	The address of the buffer to be used.

Parameter *buf* is the address of the struct ibm_tcpimage buffer containing the name and version of the TCP/IP image to which the caller wishes to connect. The name must be left-justified and padded with blanks. The TCP/IP name is always the PROC name, left-justified and padded with blanks. The TCP/IP version and status are ignored. The caller is responsible to fill in *name* before issuing the call. If setibmopt is not one of the active TCP/IP supported images on the system, subsequent socket calls will fail. This call checks the validity of the contents of the *name* field in the structure pointed to by *buf*. It checks the validity by verifying that the TCP/IP name is in the list generated by a getibmopt () call. It does not check the *status* or *version* fields. This call sets the image of the connection to be created on another call.

Typically, the caller issues getibmopt() to verify the choice for the TCP/IP image. On successful return, the caller's choice will be honored when attempting the connection to TCP/IP.

Return values

A 0 indicates success; the value -1 indicates an error. Errno identifies the specific error.

Errno	Description
EOPNOTSUPP	This is not supported in this release of TCP/IP.
EALREADY	Your program is already connected to a TCP/IP image.

EFAULT Using *buf* would result in an attempt to copy the address into a portion of the caller address space into which information cannot be written.

setibmsockopt()

Like setsockopt() call, the setibmsockopt() call sets the options associated with a socket in the AF_INET domain. This call is for options specific to the IBM implementation of sockets.

```
#include <manifest.h>
#include <socket.h>

int setibmsockopt(int s, int level, int optname, char *optval, int optlen)
```

Parameter	Description
s	Socket descriptor.
level	Level for which the option is being set. Only SOL_SOCKET is supported.
optname	The name of a specified socket option.
optval	Points to option data.
optlen	The length of the option data.

SO_IGNOREINCOMINGPUSH is another option to consider. This option is meaningful only for stream sockets. This option is effective only for connections established through an offload box. If optval points to 1, the option is set. If optval points to 0, the option is off.

The SO_IGNOREINCOMINGPUSH option causes a receive call to return when one of the following occurs:
- The requested length is reached.
- The internal TCP/IP length is reached.
- The peer application closes the connection.

The amount of data returned for each call is maximized and the amount of CPU time consumed by your program and TCP/IP is reduced.

This option is not appropriate to your operation if your program depends on receiving data before the connection is closed. For example, this option is appropriate for an FTP data connection, but not for a Telnet connection.

Return values

The value 0 indicates success; the value -1 indicates an error. Errno identifies the specific error.

Errno	Description
EBADF	The *s* parameter is not a valid socket descriptor.
EFAULT	Using *optval* and *optlen* parameters would result in an attempt to access storage outside the caller address space.
ENOPROTOOPT	The optname parameter is unrecognized, or the level parameter is not SOL_SOCKET.

Example

```
#include <manifest.h>
#include <socket.h>
#include <tcperror.h>
```

```
{ struct ibm_bulkmode_struct bulkstr;
  int optlen, rc;

  optlen = sizeof(bulkstr);
  rc = getibmsockopt(s, SOL_SOCKET, , (char *), &bulkstr, &optlen);
  if (rc < 0) {
      tcperror("on getibmsockopt()");
      exit(1);
  }
  fprintf(stream,"%d byte buffer available for outbound queue.\n",
          bulkstr.b_max_send_queue_size_avail);

  bulkstr.b_max_send_queue_size=bulkstr.b_max_send_queue_size_avail;
  bulkstr.b_onoff = 1;
  bulkstr.b_teststor = 0;
  bulkstr.b_move_data = 1;
  bulkstr.b_max_receive_queue_size = 65536;
  rc = setibmsockopt(s, SOL_SOCKET, , (char *), &bulkstr, optlen);
  if (rc < 0) {
      tcperror("on setibmsockopt()");
      exit(1);
  }
}
```

Related calls

getibmsockopt(), getsockopt(), ibmsflush(), setsockopt()

setnetent()

The setnetent() call opens and caches the local host table contents for getnetent() call. The setnetent() call is available only when RESOLVE_VIA_LOOKUP is defined before MANIFEST.H is included. See *z/OS Communications Server: IP Configuration Guide* for information about using local host tables.

```
#include <manifest.h>
#include <socket.h>

int setnetent(int stayopen)
```

Parameter	Description
stayopen	A nonzero flag value prevents the cached local host table contents from being freed after an endnetent().

Return values

The value 0 indicates success; the value -1 indicates an error. Errno identifies the specific error, returning the errno value of the fopen() call.

Related calls

endnetent(), endhostent(), getnetbyaddr(), getnetbyname(), getnetent()

setprotoent()

The setprotoent() call opens the *hlq*.ETC.PROTO data set and sets it to the data set starting point. If the *stayopen* flag is nonzero, the *hlq*.ETC.PROTO data set remains open after every call.

Note: The *hlq*.ETC.PROTO data set is described in the *z/OS Communications Server: IP Configuration Reference*.

```
#include <manifest.h>
#include <socket.h>

int setprotoent(int stayopen)
```

Parameter	Description
stayopen	A flag that can be set to prevent data set *hlq*.ETC.PROTO closing after every call to setprotoent().

Return values

The value 0 indicates success; the value -1 indicates an error. Errno identifies the specific error, returning the errno value of the fopen() call.

Related calls

endprotoent(), getprotobyname(), getprotobynumber(), getprotoent()

setservent()

The setservent() call opens the *hlq*.ETC.SERVICES data set and resets it to its starting point. If the *stayopen* flag is nonzero, the *hlq*.ETC.SERVICES data set remains open after every call.

Note: The *hlq*.ETC.SERVICES data set is described in the *z/OS Communications Server: IP Configuration Reference*.

```
#include <manifest.h>
#include <socket.h>

int setservent(int stayopen)
```

Parameter	Description
stayopen	A flag that can be set to prevent data set *hlq*.ETC.SERVICES closing after each call to setservent().

Return values

The value 0 indicates success; the value -1 indicates an error. Errno identifies the specific error, returning the errno value of the fopen() call.

Related calls

endservent(), getservbyname(), getservent()

setsockopt()

The setsockopt() call sets options associated with a socket. It can be called only for sockets in the AF_INET domain. Options can exist at multiple protocol levels; they are always present at the highest socket level.

When manipulating socket options, you must specify the level at which the option resides and the name of the option. To manipulate options at the socket level, the *level* parameter must be set to SOL_SOCKET, as defined in SOCKET.H. To manipulate options at the TCP level, the *level* parameter must be set to IPPROTO_TCP, as defined in SOCKET.H. To manipulate options at any other level, such as the IP level, supply the appropriate protocol number for the protocol controlling the option. Currently, the SOL_SOCKET, IPPROTO_TCP, and IPPROTO_IP levels are supported. The getprotobyname() call can be used to return the protocol number for a named protocol.

```
#include <manifest.h>
#include <bsdtypes.h>
#include <socket.h>

int setsockopt(int s, int level, int optname, char *optval, int optlen)
```

Parameter	Description
s	The socket descriptor
level	The level for which the option is being set
optname	The name of a specified socket option. See Appendix D, "GETSOCKOPT/SETSOCKOPT command values" for the numeric values of *optname*.
optval	The pointer to option data
optlen	The length of the option data

The *optval* and *optlen* parameters are used to pass data used by the particular set command. The *optval* parameter points to a buffer containing the data needed by the set command. The *optlen* parameter must be set to the size of the data pointed to by *optval*.

All of the socket level options except SO_LINGER expect *optval* to point to an integer and *optlen* to be set to the size of an integer. When the integer is nonzero, the option is enabled. For toggle type options, if the integer is nonzero, the option is enabled. If it is 0, the option is disabled. The SO_LINGER option expects *optval* to point to a *linger* structure, as defined in SOCKET.H. This structure is defined in the following example:

```
struct  linger
{
        int     l_onoff;                /* option on/off */
        int     l_linger;               /* linger time */
};
```

The *l_onoff* field is set to 0 if the SO_LINGER option is begin disabled. A nonzero value enables the option. The *l_linger* field specifies the amount of time to wait on close. The units of *l_linger* are seconds.

The following option is recognized at the TCP level:

Option	Description
TCP_NODELAY	Toggles the use of Nagle algorithm (RFC 896) for all data sent over the socket. This option is not supported for AF_IUCV sockets. Under most circumstances, TCP sends data when it is presented from the application. However, when outstanding data has not yet been acknowledged, TCP will defer the transmission of any new data from the application until all of the outstanding data has been acknowledged. The Nagle algorithm enforces this deferral, even in cases where the receiver's window is sufficiently open to accept the new data. For interactive applications, such as ones that send a stream of mouse events which receive no replies, this deferral of transmission might result in significant delays. For these types of applications, disabling Nagle algorithm would improve response time. **Notes:** 1. When Nagle algorithm is enabled, TCP will wait to send small amounts of data until the acknowledgment for the previous data is received. 2. When Nagle algorithm is disabled, TCP will send small amounts of data even before the acknowledgment for previous data sent is received.

The following keywords are recognized at the socket level:

Keyword	Description
SO_RCVBUF	Sets the size of the data portion of the TCP/IP receive buffer in OPTVAL. The size of the data portion of the receive buffer is protocol-specific. If the requested size exceeds the allowed size, the following occurs: • If the protocol is TCP, a return value of -1 and errno of ENOBUFS is set. The receive buffer size is unchanged. For maximum values for the TCP protocol, see the TCPCONFIG TCPRCVBUFRSIZE and TCPMAXRCVBUFSIZE parameters in the *z/OS Communications Server: IP Configuration Reference*. • If the protocol is UDP or RAW, a return value of 0 is returned and the buffer size is set to 65 535.
SO_SNDBUF	Sets the size of the data portion of the TCP/IP send buffer in OPTVAL. The size of the data portion of the send buffer is protocol-specific. If the requested size exceeds the allowed size, the following occurs: • If the protocol is TCP, a return value of -1 and errno of ENOBUFS is set. The send buffer size is unchanged. For maximum values for the TCP protocol, see the TCPCONFIG TCPSENDBUFRSIZE parameters in the *z/OS Communications Server: IP Configuration Reference*. • If the protocol is UDP or RAW, a return value of 0 is returned and the buffer size is set to 65535.
SO_BROADCAST	Toggles the ability to broadcast messages. The default is *disabled*. If

this option is enabled, it allows the application to send broadcast messages over *s* when the interface specified in the destination supports broadcasting of packets. This option has no meaning for stream sockets.

SO_KEEPALIVE
Toggles the TCP keep alive mechanism for a stream socket. The default is *disabled*. When activated, the keep alive mechanism periodically sends a packet on an otherwise idle connection. If the remote TCP does not respond to the packet, or to retransmissions of the packet, the connection is ended with the error ETIMEDOUT.

SO_LINGER Lingers on close if data is present. The default is *disabled*. When this option is enabled and there is unsent data present when close() is called, the calling application is blocked during the close() call until the data is transmitted, or the connection has timed out. If this option is disabled, the close() call returns without blocking the caller, and the TCP/IP address space still waits to try to send the data. Although the data transfer is usually successful, it cannot be guaranteed, because the TCP/IP address space waits a finite amount of time while trying to send the data. This option has meaning for stream sockets only.

SO_OOBINLINE
Toggles the reception of out-of-band data. The default is *disabled*. When this option is enabled, it causes out-of-band data to be placed in the normal data input queue as it is received, making it available to recv(), recvfrom(), and recvmsg() without having to specify the MSG_OOB flag in those calls. When this option is disabled, it causes out-of-band data to be placed in the priority data input queue as it is received, making it available to recv(), recvfrom(), and recvmsg() only by specifying the MSG_OOB flag in those calls. This option has meaning for stream sockets only.

SO_REUSEADDR
Toggles local address reuse. The default is disabled. This alters the normal algorithm used in the bind() call.

The normal bind() call algorithm allows each internet address and port combination to be bound only once. If the address and port have been bound already, a subsequent bind() will fail and return error EADDRINUSE.

After the 'SO_REUSEADDR' option is active, the following situations are supported:

- A server can bind() the same port multiple times as long as every invocation uses a different local IP address and the wildcard address INADDR_ANY is used only one time per port.
- A server with active client connections can be restarted and can bind to its port without having to close all of the client connections.
- For datagram sockets, multicasting is supported so multiple bind() calls can be made to the same class D address and port number.

The following options are recognized at the IP level (IPPROTO_IP):

Option **Description**

IP_MULTICAST_TTL
Sets the IP time to live of outgoing multicast datagrams. The default value is 1 (multicast is available only to the local subnet).

IP_MULTICAST_LOOP
Enables or disables the loopback of outgoing multicast datagrams. The default value is enable.

IP_MULTICAST_IF
Sets the interface for sending outbound multicast datagrams from the socket application.

Note: Multicast datagrams can be transmitted only on one interface at a time.

IP_ADD_MEMBERSHIP
Joins a multicast group on a specific interface. An interface has to be specified with this option. Only applications that want to receive multicast datagrams need to join multicast groups.

IP_DROP_MEMBERSHIP
Exits a multicast group.

Return values

The value 0 indicates success; the value -1 indicates an error. Errno identifies the specific error.

Errno	Description
EBADF	The *s* parameter is not a valid socket descriptor.
EFAULT	Using *optval* and *optlen* parameters would result in an attempt to access storage outside the caller address space.
ENOBUFS	No buffer space is available.
ENOPROTOOPT	The *optname* parameter is unrecognized, or the *level* parameter is not SOL_SOCKET.

Example

See "getsockopt()" on page 154 to see how the getsockopt() options set is queried.

```
int rc;
int s;
int optval;
struct linger l;
int setsockopt(int s, int level, int optname,char *optval, int optlen);
.
.
.
/* I want out of band data in the normal inputqueue */
optval = 1;
rc = setsockopt(s, SOL_SOCKET, SO_OOBINLINE, (char *) &optval, sizeof(int));

.
.
.
/* I want to linger on close */
l.l_onoff  = 1;
l.l_linger = 100;
rc = setsockopt(s, SOL_SOCKET, SO_LINGER, (char *) &l, sizeof(l));
```

Related calls

fcntl(), getprotobyname(), getsockopt(), ioctl(), socket()

shutdown()

The shutdown() call shuts down all or part of a duplex connection. Parameter *how* sets the condition for shutdown to the socket *s* connection.

If you issue a shutdown() for a socket that currently has outstanding socket calls pending, see Table 3 on page 37 to determine the effects of this operation on the outstanding socket calls.

Note: Issue a shutdown() call before issuing a close() call for a socket.

```
#include <manifest.h>
#include <socket.h>

int shutdown(int s, int how)
```

Parameter	Description
s	The socket descriptor.
how	The *how* condition can have a value of 0, 1, or 2, where: • Zero ends further receive operations. • One ends further send operations. • Two ends further send and receive operations.

Return values

The value 0 indicates success; the value -1 indicates an error. Errno identifies the specific error.

Errno Description

EBADF
Indicates that *s* is not a valid socket descriptor.

EINVAL
The *how* parameter was not set to a valid value: 0, 1, or 2.

sock_debug()

The sock_debug() call provides the socket library tracing facility. The *onoff* parameter can have a value of 0 or nonzero. If *onoff*=0 (the default), no socket library tracing is done. If *onoff*=nonzero, the system traces for socket library calls and interrupts.

Note: You can include the statement SOCKDEBUG in data set TCPIP.DATA as an alternative to calling sock_debug() with *onoff* not equal to 0.

```
#include <manifest.h>
#include <socket.h>

void sock_debug(init onoff)
```

Parameter	Description
onoff	A parameter that can be set to 0 or nonzero

Related calls

accept(), close(), connect(), socket()

sock_do_teststor()

The sock_do_teststor() call is used to check for calls that attempt to access storage outside the caller address space.

```
#include <manifest.h>
#include <socket.h>

void sock_do_teststor(int onoff)
```

Parameter	Description
onoff	A parameter that can be set to 0 or nonzero

If *onoff* is not 0 for either inbound or outbound sockets, both the address of the message buffer and the message buffer itself are checked for addressability at every socket call. The error condition, EFAULT, is set if there is an addressing problem. If *onoff* is set to 0, address checking is not done by the socket library program. If an error occurs when *onoff* is 0, normal runtime error handling reports the exception condition.

The default for *onoff* is 0. Addresses are not checked for addressability for parameters of C socket calls. While you are testing your program, you might find it useful to set *onoff* to a nonzero value.

Notes:

1. You can include the statement SOCKNOTESTSTOR in data set TCPIP.DATA, as an alternative to calling sock_do_teststor() with *onoff* equal to 0.
2. You can include the statement SOCKTESTSTOR in the data set TCPIP.DATA which is in the client's catalog when the socket program is started, as an alternative to calling sock_do_teststor() with *onoff* not equal to 0.

Restrictions

None

socket()

The socket() call creates an endpoint for communication and returns a socket descriptor representing that endpoint. Different types of sockets provide different communication services.

```
#include <manifest.h>
#include <bsdtypes.h>
#include <socket.h>

int socket(int domain, int type, int protocol)
```

Parameter	Description
domain	The address domain requested. It is either AF_INET or AF_IUCV.
type	The type of socket created, either SOCK_STREAM, SOCK_DGRAM, or SOCK_RAW.
protocol	The protocol requested. Possible values are 0, IPPROTO_UDP, or IPPROTO_TCP.

The *domain* parameter specifies the communication domain within which communication is to take place. This parameter specifies the address family (format of addresses within a domain) to be used. The families supported are AF_INET, which is the internet domain, and AF_IUCV, which is the IUCV domain. These constants are defined in the SOCKET.H header file.

The *type* parameter specifies the type of socket created. The type is analogous to the communication requested. These socket type constants are defined in the SOCKET.H header file. The types supported are:

Socket Type	Description
SOCK_STREAM	Provides sequenced, two-way byte streams that are reliable and connection-oriented. They support a mechanism for out-of-band data. This type is supported in both the AF_INET and AF_IUCV domains.
SOCK_DGRAM	Provides datagrams, which are connectionless messages, of a fixed maximum length whose reliability is not guaranteed. Datagrams can be corrupted, received out of order, lost, or delivered repeatedly. This type is supported in the AF_INET domain only.
SOCK_RAW	Provides the interface to internal protocols (such as IP and ICMP). This type is supported in the AF_INET domain only. **Note:** To use raw sockets, the application must be APF-authorized.

The *protocol* parameter specifies the particular protocol to be used with the socket. In most cases, a single protocol exists to support a particular type of socket within a particular addressing family (not true with raw sockets). If the *protocol* parameter is set to 0, the system selects the default protocol number for the domain and socket type requested. Protocol numbers are found in the *hlq*.ETC.PROTO data set. Alternatively, the getprotobyname() call can be used to get the protocol number for a protocol with a known name. The *protocol* field must be set to 0 if the *domain*

parameter is set to AF_IUCV. The *protocol* defaults are TCP for stream sockets and UDP for datagram sockets. There is no default for raw sockets.

SOCK_STREAM sockets model duplex byte streams. They provide reliable, flow-controlled connections between peer applications. Stream sockets are either active or passive. Active sockets are used by clients who initiate connection requests using connect(). By default, socket() creates active sockets. Passive sockets are used by servers to accept connection requests from the connect() call. An active socket is transformed into a passive socket by binding a name to the socket using the bind() call, and by indicating a willingness to accept connections with the listen() call. Once a socket is passive, it cannot be used to initiate connection requests.

In the AF_INET domain, the bind() call applied to a stream socket lets the application specify the networks from which it will accept connection requests. The application can fully specify the network interface by setting the *internet address* field in the *address* structure to the internet address of a network interface. Alternatively, the application can use a *wildcard* to specify that it wants to receive connection requests from any network. This is done by setting the *internet address* field within the *address* structure to the constant INADDR_ANY, as defined in the SOCKET.H header file.

Once a connection has been established between stream sockets, any of the data transfer calls can be used: (read(), write(), send(), recv(), readv(), writev(), sendto(), recvfrom(), sendmsg(), and recvmsg()). Usually, the read-write or send-recv pairs are used to send data on stream sockets. If out-of-band data is to be exchanged, the send-recv pair is normally used.

SOCK_DGRAM sockets model datagrams. They provide connectionless message-exchange without guarantee of reliability. Messages sent are limited in size. Datagram sockets are not supported in the AF_IUCV domain.

There is no active or passive analogy to stream sockets with datagram sockets. Servers must still call bind() to name a socket and to specify the network interface from which it wants to receive packets. Wildcard addressing, as described for stream sockets, applies to datagram sockets also. Because datagram sockets are connectionless, the listen() call has no meaning for them and must not be used with them.

After an application has received a datagram socket, it can exchange datagrams using the sendto() and recvfrom(), or sendmsg() and recvmsg() calls. If the application goes one step further by calling connect() and fully specifying the name of the peer with which all messages are to be exchanged, then the other data transfer calls of read(), write(), readv(), writev(), send(), and recv() can be used also. See “connect()” on page 124 for more information about placing a socket into the connected state.

Datagram sockets allow messages to be broadcast to multiple recipients. Setting the destination address to a broadcast address depends on the class of address, and whether subnets are used. The constant INADDR_BROADCAST, defined in socket.h, can be used to broadcast to the primary network when the primary network configured supports broadcast.

SOCK_RAW sockets give the application an interface to lower layer protocols, such as IP and ICMP. This interface is often used to bypass the transport layer when

direct access to lower layer protocols is needed. Raw sockets are also used to test new protocols. Raw sockets are not supported in the AF_IUCV domain.

Raw sockets are connectionless and data transfer semantics are the same as those described previously for datagram sockets. The connect() call can be used similarly to specify the peer.

Outgoing packets have an IP header prefixed to them. IP options can be set and inspected using the setsockopt() and getsockopt() calls respectively. Incoming packets are received with the IP header and options intact.

Notes:

1. Sockets are deallocated using the close() call.
2. Only SOCK_STREAM sockets are supported in the AF_IUCV domain.
3. The setsockopt() and getsockopt() calls are not supported for sockets in the AF_IUCV domain.
4. The flags field in the send(), recv(), sendto(), recvfrom(), sendmsg(), and recvmsg() calls is not supported in the AF_IUCV domain.

Return values

A nonnegative socket descriptor indicates success. The value -1 indicates an error. Errno identifies the specific error.

Errno Description

EPROTONOSUPPORT
The *protocol* is not supported in this *domain* or this socket *type*.

EACCES
Access denied. The application is not an APF-authorized application.

EAFNOSUPPORT
The specified address family is not supported by this protocol family.

Example

```
int s;
struct protoent *p;
struct protoent *getprotobyname(char *name);
int socket(int domain, int type, int protocol);
.
.
.
/* Get stream socket in internetdomain with default protocol */
s = socket(AF_INET, SOCK_STREAM, 0);
.
.
.
/* Get stream socket in iucvdomain with default protocol */
s = socket(AF_IUCV, SOCK_STREAM, 0);
.
.
.
/* Get raw socket in internetdomain for ICMP protocol */
p = getprotobyname("iucv");
s = socket(AF_INET, SOCK_RAW, p->p_proto);
```

Related calls

accept(), bind(), close() connect(), fcntl(), getprotobyname(), getsockname(), getsockopt(), ioctl(), maxdesc(), read(), readv(), recv(), recvfrom(), recvmsg(), select(), selectex(), send(), sendmsg(), sendto(), shutdown(), write(), writev()

takesocket()

The takesocket() call acquires a socket from another program. Typically, the other program passes its client ID and socket descriptor to your program through your program startup parameter list.

```
#include <manifest.h>
#include <bsdtypes.h>
#include <socket.h>

int takesocket(struct clientid *clientid, int hisdesc)
```

Parameter	Description
clientid	Points to the *clientid* of the application from which you are taking a socket.
hisdesc	Describes the socket to be taken.

The takesocket() call acquires a socket from another program. Typically, the other program passes its client ID and socket descriptor to your program through your program startup parameter list.

Return values

A nonnegative socket descriptor indicates success. The value -1 indicates an error. Errno identifies a specific error.

Errno	Description
EACCES	The other application did not give the socket to your application.
EBADF	The *hisdesc* parameter does not specify a valid socket descriptor owned by the other application. The socket has already been taken.
EFAULT	Using the *clientid* parameter as specified would result in an attempt to access storage outside the caller address space.
EINVAL	The *clientid* parameter does not specify a valid client identifier.
EMFILE	The socket descriptor table is already full.
ENOBUFS	The operation cannot be performed because of a shortage of control blocks (SCB or SKCB) in the TCP/IP address space.
EPFNOSUPPORT	The domain field of the *clientid* parameter is not AF_INET.

Related calls

getclientid(), givesocket()

tcperror()

When a socket call produces an error, the call returns a negative value and the variable *errno* is set to an error value found in TCPERRNO.H. The tcperror() call prints a short error message describing the last error that occurred. If *s* is non-NULL, tcperror() prints the string *s* followed by a colon, followed by a space, followed by the error message, and terminating with a new-line character. If *s* is NULL or points to a NULL string, only the error message and the new-line character are output.

The tcperror() function is equivalent to the UNIX perror() function.

```
#include <manifest.h>
#include <socket.h>
#include <tcperrno.h>

void tcperror(char *s)
```

Parameter	Description
s	A NULL or NULL-terminated character string

Example

Example 1

```
if   ((s=socket(AF_INET, SOCK_DGRAM, 0)) < 0) {
     tcperror("socket()");
     exit(2);
}
```

If the socket() call produces error ENOMEM, socket() returns a negative value and *errno* is set to ENOMEM. When tcperror() is called, it prints the string:

```
    socket():  Not enough storage (ENOMEM)
```

Example 2

```
if ((s=socket(AF_INET, SOCK_DGRAM, 0)) < 0)
   tcperror(NULL);
```

If the socket() call produces error ENOMEM, socket() returns a negative value and *errno* is set to ENOMEM. When tcperror() is called, it prints the string:

```
     Not enough storage (ENOMEM)
```

write()

The write() call writes data from a buffer on a socket with descriptor *s*. The write() call applies only to connected sockets.

This call writes up to *len* bytes of data.

If there is not enough available buffer space to hold the socket data to be transmitted and the socket is in blocking mode, write() blocks the caller until more buffer space is available. If the socket is in nonblocking mode, write() returns a -1 and sets *errno* to EWOULDBLOCK. See "fcntl()" on page 131 or "ioctl()" on page 170 to set nonblocking mode.

For datagram sockets, this call sends the entire datagram, providing the datagram can fit into the TCP/IP buffers. Stream sockets act like streams of information with no boundaries separating data. For example, if an application wishes to send 1000 bytes, each call to this function can send 1 byte, or 10 bytes, or the entire 1000 bytes. Therefore, applications using stream sockets should place this call in a loop, and call this function until all data has been sent.

```
#include <manifest.h>
#include <socket.h>

int write(int s, char *buf, int len)
```

Parameter	Description
s	Socket descriptor.
buf	Points to the buffer holding the data to be written.
len	Length in bytes of *buf*.

Return values

If successful, the number of bytes written is returned. The value -1 indicates an error. Errno identifies the specific error.

Errno	Description
EBADF	Indicates that *s* is not a valid socket descriptor.
EFAULT	Using the *buf* and *len* parameters would result in an attempt to access storage outside the caller address space.
ENOBUFS	Buffer space is not available to send the message.
EWOULDBLOCK	Indicates that *s* is in nonblocking mode and there is not enough space in TCP/IP to accept the data.

Related calls

connect(), fcntl(), getsockopt(), ioctl(), read(), readv() recv(), recvfrom(), recvmsg(), select(), selectex(), send(), sendmsg(), sendto(), setsockopt(), socket(), writev()

writev()

The writev() call writes data from a set of buffers on a socket using descriptor *s*.

The writev() call applies only to connected sockets.

```
#include <manifest.h>
#include <socket.h>
#include <bsdtypes.h>
#include <uio.h>

int writev(int s, struct iovec *iov, int iovcnt)
```

Parameter	Description
s	Socket descriptor.
iov	Points to an array of iovec buffers.
iovcnt	Number of buffers in the array.

The data is gathered from the buffers specified by iov[0]...iov[iovcnt−1]. The *iovec* structure is defined in UIO.H and contains the following fields:

Parameter	Description
iov_base	Points to the buffer.
iov_len	The length of the buffer.

This call writes the sum of the *iov_len* bytes of data.

If buffer space is not available to hold the socket data to be transmitted and the socket is in blocking mode, writev() blocks the caller until additional buffer space becomes available. If the socket is in a nonblocking mode, writev() returns a -1 and sets *errno* to EWOULDBLOCK. For a description of how to set nonblocking mode, see “fcntl()” on page 131 or “ioctl()” on page 170.

For datagram sockets, this call sends the entire datagram, providing the datagram can fit into the TCP/IP buffers. Stream sockets act like streams of information with no boundaries separating data. For example, if an application wishes to send 1000 bytes, each call to this function can send 1 byte, or 10 bytes, or the entire 1000 bytes. Therefore, applications using stream sockets should place this call in a loop, calling this function until all data has been sent.

Return values

If successful, the number of bytes written from the buffers is returned. The value -1 indicates an error. Errno identifies the specific error.

Errno	Description
EBADF	Indicates that *s* is not a valid socket descriptor.
EFAULT	Using the *iov* and *iovcnt* parameters would result in an attempt to access storage outside the caller address space.
ENOBUFS	Buffer space is not available to send the message.
EWOULDBLOCK	Indicates that *s* is in nonblocking mode and there is not enough space in TCP/IP to accept the data.

Related calls

connect(), fcntl(), getsockopt(), ioctl(), write(), read(), readv(), recv(), recvmsg(), recvfrom(), select(), selectex(), send(), sendmsg(), sendto(), setsockopt(), socket(), write()

Sample C socket programs

This topic contains sample C socket programs. The C source code can be found in the SEZAINST data set.

Following are the sample socket programs available:

Program	Description
TCPC	C socket TCP client
TCPS	C socket TCP server
UDPC	C socket UDP client
UDPS	C socket UDP server

For samples of the multitasking C programs in the following table, see Appendix A, "Multitasking C socket sample program," on page 869.

Program	Description
MTCCLNT	C socket MTC client
MTCSRVR	C socket MTC server
MTCCSUB	C socket subtask MTCCSUB

Executing TCPS and TCPC modules

To start the TCPS server, execute TCPS 9999 on the other MVS address space (server).

To run the TCPC client, execute TCPC MVS13 9999. (MVS13 is the host name where the TCPS server is running, and 9999 is the port you have assigned.)

After executing the TCPC client, the following output is displayed on the server session:

```
Server Ended Successfully
```

Executing UDPS and UDPC modules

To start the UDPS server, execute UDPS on the other MVS address space (server). The following message is displayed:

```
Port assigned is 1028
```

To run the UDPC client, execute UDPC 9.67.60.10 1028. (Address 9.67.60.10 is the IP machine address where the UDPS server is running, and 1028 is the port assigned by the UDPS server.)

After executing the UDPC client, the following message is displayed:

```
Received Message Hello....
```

C socket TCP client

Following is an example of a C socket TCP client (TCPC) program. The source code can be found in the TCPC member of the SEZAINST data set.

```
/*** IBMCOPYR ************************************************************/
/*                                                                       */
/* Part Name: TCPC                                                       */
/*                                                                       */
/*                                                                       */
/* Copyright:    Licensed Materials - Property of IBM                    */
/*                                                                       */
/*               "Restricted Materials of IBM"                           */
/*                                                                       */
/*               5647-A01                                                */
/*                                                                       */
/*               (C) Copyright IBM Corp. 1977, 1998                      */
/*                                                                       */
/*               US Government Users Restricted Rights -                 */
/*               Use, duplication or disclosure restricted by            */
/*               GSA ADP Schedule Contract with IBM Corp.                */
/*                                                                       */
/* Status:       CSV2R6                                                  */
/*                                                                       */
/*  SMP/E Distribution Name: EZAEC01V                                    */
/*                                                                       */
/*** IBMCOPYR ************************************************************/

static char ibmcopyr[] =
   "TCPC     - Licensed Materials - Property of IBM. "
   "This module is \"Restricted Materials of IBM\" "
   "5647-A01 (C) Copyright IBM Corp. 1996. "
   "See IBM Copyright Instructions.";

/*
 * Include Files.
 */
#include <manifest.h>
#include <bsdtypes.h>
#include <in.h>
#include <socket.h>
#include <netdb.h>
#include <stdio.h>

/*
 * Client Main.
 */
main(argc, argv)
int argc;
char **argv;
{
    unsigned short port;       /* port client will connect to         */
    char buf[12];              /* data buffer for sending & receiving */
    struct hostent *hostnm;    /* server host name information        */
    struct sockaddr_in server; /* server address                      */
    int s;                     /* client socket                       */

    /*
```

Figure 52. C socket TCP client sample (Part 1 of 3)

```
 * Check Arguments Passed. Should be hostname and port.
 */
if (argc != 3)
{
    fprintf(stderr, "Usage: %s hostname port\n", argv[0]);
    exit(1);
}

/*
 * The host name is the first argument. Get the server address.
 */
hostnm = gethostbyname(argv[1]);
if (hostnm == (struct hostent *) 0)
{
    fprintf(stderr, "Gethostbyname failed\n");
    exit(2);
}

/*
 * The port is the second argument.
 */
port = (unsigned short) atoi(argv[2]);

/*
 * Put a message into the buffer.
 */
strcpy(buf, "the message");

/*
 * Put the server information into the server structure.
 * The port must be put into network byte order.
 */
server.sin_family      = AF_INET;
server.sin_port        = htons(port);
server.sin_addr.s_addr = *((unsigned long *)hostnm->h_addr);

/*
 * Get a stream socket.
 */
if ((s = socket(AF_INET, SOCK_STREAM, 0)) < 0)
{
    tcperror("Socket()");
    exit(3);
}

/*
 * Connect to the server.
 */
if (connect(s, (struct sockaddr *)&server, sizeof(server)) < 0)
{
    tcperror("Connect()");
    exit(4);
}

if (send(s, buf, sizeof(buf), 0) < 0)
```

Figure 52. C socket TCP client sample (Part 2 of 3)

```
    {
        tcperror("Send()");
        exit(5);
    }

    /*
     * The server sends back the same message. Receive it into the
     * buffer.
     */
    if (recv(s, buf, sizeof(buf), 0) < 0)
    {
        tcperror("Recv()");
        exit(6);
    }

    /*
     * Close the socket.
     */
    close(s);

    printf("Client Ended Successfully\n");
    exit(0);

}
```

Figure 52. C socket TCP client sample (Part 3 of 3)

C socket TCP server

The following is an example of a C socket TCP server (TCPS) program. The source code can be found in the TCPS member of the SEZAINST data set.

```
/*** IBMCOPYR ************************************************************/
/*                                                                       */
/* Component Name: TCPS                                                  */
/*                                                                       */
/*                                                                       */
/* Copyright:    Licensed Materials - Property of IBM                    */
/*                                                                       */
/*               "Restricted Materials of IBM"                           */
/*                                                                       */
/*               5647-A01                                                */
/*                                                                       */
/*               (C) Copyright IBM Corp. 1977, 1998                      */
/*                                                                       */
/*               US Government Users Restricted Rights -                 */
/*               Use, duplication or disclosure restricted by            */
/*               GSA ADP Schedule Contract with IBM Corp.                */
/*                                                                       */
/* Status:       CSV2R6                                                  */
/*                                                                       */
/*  SMP/E Distribution Name: EZAEC01X                                    */
/*                                                                       */
/*** IBMCOPYR ************************************************************/

static char ibmcopyr[] =
   "TCPS     - Licensed Materials - Property of IBM. "
   "This module is \"Restricted Materials of IBM\" "
   "5647-A01 (C) Copyright IBM Corp. 1996. "
   "See IBM Copyright Instructions.";

#include <manifest.h>
#include <bsdtypes.h>
#include <socket.h>
#include <in.h>
#include <netdb.h>
#include <stdio.h>


/*
 * Server Main.
 */
main(argc, argv)
int argc;
char **argv;
{
    unsigned short port;       /* port server binds to                */
    char buf[12];              /* buffer for sending & receiving data */
    struct sockaddr_in client; /* client address information          */
    struct sockaddr_in server; /* server address information          */
    int s;                     /* socket for accepting connections    */
    int ns;                    /* socket connected to client          */
    int namelen;               /* length of client name               */

    /*
```

Figure 53. C socket TCP server sample (Part 1 of 3)

```
 * Check arguments. Should be only one: the port number to bind to.
 */

if (argc != 2)
{
    fprintf(stderr, "Usage: %s port\n", argv[0]);
    exit(1);
}

/*
 * First argument should be the port.
 */
port = (unsigned short) atoi(argv[1]);

/*
 * Get a socket for accepting connections.
 */
if ((s = socket(AF_INET, SOCK_STREAM, 0)) < 0)
{
    tcperror("Socket()");
    exit(2);
}

/*
 * Bind the socket to the server address.
 */
server.sin_family = AF_INET;
server.sin_port   = htons(port);
server.sin_addr.s_addr = INADDR_ANY;

if (bind(s, (struct sockaddr *)&server, sizeof(server)) < 0)
{
    tcperror("Bind()");
    exit(3);
}

/*
 * Listen for connections. Specify the backlog as 1.
 */
if (listen(s, 1) != 0)
{
    tcperror("Listen()");
    exit(4);
}

/*
 * Accept a connection.
 */
namelen = sizeof(client);
if ((ns = accept(s, (struct sockaddr *)&client, &namelen)) == -1)
{
    tcperror("Accept()");
    exit(5);
}
```

Figure 53. C socket TCP server sample (Part 2 of 3)

```
    /*
     * Receive the message on the newly connected socket.
     */
    if (recv(ns, buf, sizeof(buf), 0) == -1)
    {
        tcperror("Recv()");
        exit(6);
    }

    /*
     * Send the message back to the client.
     */
    if (send(ns, buf, sizeof(buf), 0) < 0)
    {
        tcperror("Send()");
        exit(7);
    }

    close(ns);
    close(s);

    printf("Server ended successfully\n");
    exit(0);
}
```

Figure 53. C socket TCP server sample (Part 3 of 3)

C socket UDP server

The following is an example of a C socket UDP server (UDPS) program. The source code can be found in the UDPS member of the SEZAINST data set.

```
/*** IBMCOPYR ************************************************************/
/*                                                                       */
/* Component Name: UDPS                                                  */
/*                                                                       */
/*                                                                       */
/* Copyright:    Licensed Materials - Property of IBM                    */
/*                                                                       */
/*               "Restricted Materials of IBM"                           */
/*                                                                       */
/*               5647-A01                                                */
/*                                                                       */
/*               (C) Copyright IBM Corp. 1977, 1998                      */
/*                                                                       */
/*               US Government Users Restricted Rights -                 */
/*               Use, duplication or disclosure restricted by            */
/*               GSA ADP Schedule Contract with IBM Corp.                */
/*                                                                       */
/* Status:       CSV2R6                                                  */
/*                                                                       */
/*  SMP/E Distribution Name: EZAEC021                                    */
/*                                                                       */
/*** IBMCOPYR ************************************************************/

static char ibmcopyr[] =
   "UDPS     - Licensed Materials - Property of IBM. "
   "This module is \"Restricted Materials of IBM\" "
   "5647-A01 (C) Copyright IBM Corp. 1992, 1996. "
   "See IBM Copyright Instructions.";

#include <manifest.h>
#include <bsdtypes.h>
#include <in.h>
#include <socket.h>
#include <netdb.h>
#include <stdio.h>

main()
{
   int s, namelen, client_address_size;
   struct sockaddr_in client, server;
   char buf[32];

   /*
    * Create a datagram socket in the internet domain and use the
    * default protocol (UDP).
    */
   if ((s = socket(AF_INET, SOCK_DGRAM, 0)) < 0)
   {
       tcperror("socket()");
       exit(1);
   }

   /*
```

Figure 54. C socket UDP server sample (Part 1 of 3)

```
 * Bind my name to this socket so that clients on the network can
 * send me messages. (This allows the operating system to demultiplex
 * messages and get them to the correct server)
 *
 * Set up the server name. The internet address is specified as the
 * wildcard INADDR_ANY so that the server can get messages from any
 * of the physical internet connections on this host. (Otherwise we
 * would limit the server to messages from only one network
 * interface.)
 */
server.sin_family      = AF_INET;  /* Server is in Internet Domain */
server.sin_port        = 0;         /* Use any available port      */
server.sin_addr.s_addr = INADDR_ANY;/* Server's Internet Address   */

if (bind(s, (struct sockaddr *)&server, sizeof(server)) < 0)
{
    tcperror("bind()");
    exit(2);
}

/* Find out what port was really assigned and print it */
namelen = sizeof(server);
if (getsockname(s, (struct sockaddr *) &server, &namelen) < 0)
{
    tcperror("getsockname()");
    exit(3);
}

printf("Port assigned is %d\n", ntohs(server.sin_port));

/*
 * Receive a message on socket s in buf  of maximum size 32
 * from a client. Because the last two paramters
 * are not null, the name of the client will be placed into the
 * client data structure and the size of the client address will
 * be placed into client_address_size.
 */
client_address_size = sizeof(client);

if(recvfrom(s, buf, sizeof(buf), 0, (struct sockaddr *) &client,
         &client_address_size) <0)
{
    tcperror("recvfrom()");
    exit(4);
}
/*
 * Print the message and the name of the client.
 * The domain should be the internet domain (AF_INET).
 * The port is received in network byte order, so we translate it to
 * host byte order before printing it.
 * The internet address is received as 32 bits in network byte order
 * so we use a utility that converts it to a string printed in
 * dotted decimal format for readability.
 */
printf("Received message %s from domain %s port %d internet\
```

Figure 54. C socket UDP server sample (Part 2 of 3)

```
 address %s\n",
       buf,
       (client.sin_family == AF_INET?"AF_INET":"UNKNOWN"),
       ntohs(client.sin_port),
       inet_ntoa(client.sin_addr));

   /*
    * Deallocate the socket.
    */
   close(s);
}
```

Figure 54. C socket UDP server sample (Part 3 of 3)

C socket UDP client

The following is an example of a C socket UDP (UDPC) client program. The source code can be found in the UDPC member of the SEZAINST data set.

```
/*** IBMCOPYR ************************************************************/
/*                                                                       */
/* Component Name: UDPC                                                  */
/*                                                                       */
/*                                                                       */
/* Copyright:    Licensed Materials - Property of IBM                    */
/*                                                                       */
/*               "Restricted Materials of IBM"                           */
/*                                                                       */
/*               5647-A01                                                */
/*                                                                       */
/*               (C) Copyright IBM Corp. 1977, 1998                      */
/*                                                                       */
/*               US Government Users Restricted Rights -                 */
/*               Use, duplication or disclosure restricted by            */
/*               GSA ADP Schedule Contract with IBM Corp.                */
/*                                                                       */
/* Status:       CSV2R6                                                  */
/*                                                                       */
/*  SMP/E Distribution Name: EZAEC020                                    */
/*                                                                       */
/*** IBMCOPYR ************************************************************/

static char ibmcopyr[] =
   "UPDC     - Licensed Materials - Property of IBM. "
   "This module is \"Restricted Materials of IBM\" "
   "5647-A01 (C) Copyright IBM Corp. 1992, 1996. "
   "See IBM Copyright Instructions.";

#include <manifest.h>
#include <bsdtypes.h>
#include <in.h>
#include <socket.h>
#include <netdb.h>
#include <stdio.h>

main(argc, argv)
int argc;
char **argv;
{


   int s;
   unsigned short port;
   struct sockaddr_in server;
   char buf[32];

   /* argv[1] is internet address of server argv[2] is port of server.
    * Convert the port from ascii to integer and then from host byte
    * order to network byte order.
    */
   if(argc != 3)
   {
```

Figure 55. C socket UDP client sample (Part 1 of 2)

```
      printf("Usage: %s <host address> <port> \n",argv[0]);
      exit(1);
   }
   port = htons(atoi(argv[2]));


   /* Create a datagram socket in the internet domain and use the
    * default protocol (UDP).
    */
   if ((s = socket(AF_INET, SOCK_DGRAM, 0)) < 0)
   {
       tcperror("socket()");
       exit(1);
   }

   /* Set up the server name */
   server.sin_family      = AF_INET;            /* Internet Domain    */
   server.sin_port        = port;               /* Server Port        */
   server.sin_addr.s_addr = inet_addr(argv[1]); /* Server's Address   */

   strcpy(buf, "Hello");

   /* Send the message in buf to the server */
   if (sendto(s, buf, (strlen(buf)+1), 0,
               (struct sockaddr *)&server, sizeof(server)) < 0)
   {
       tcperror("sendto()");
       exit(2);
   }

   /* Deallocate the socket */
   close(s);
}
```

Figure 55. C socket UDP client sample (Part 2 of 2)

Chapter 11. X/Open Transport Interface

This topic describes the X/Open Transport Interface (XTI) IPv4 socket application program interface (API) and contains the following topics:

- Software requirements
- What is provided
- How XTI works in the z/OS environment
- Creating an application
- Coding XTI calls
- Compiling and linking XTI applications using cataloged procedures
- Understanding XTI sample programs

The XTI allows you to write applications in the z/OS environment to access the open transport interface.

Note: The XTI calls in this topic apply only to unconnected sessions.

For more information about the XTI protocol, see *CAE Specification: X/Open Transport Interface (XTI)*.

XTI software requirements

Application programs using the X/Open Transport Interface (XTI) require the following:

- SEZACMAC (macro library routines)
- SEZACMTX (executable modules)
- SEZALOAD (executable modules)
- SEZAINST (sample programs)
- Current z/OS Language Environment run-time library

What is provided with XTI

The XTI support provided with TCP/IP includes the following:

- The XTI library containing the XTI calls for C language programmers
- The XTI management services that allow you to include additional protocol mappers
- The RFC 1006 protocol mapping component that creates the protocol expected by the XTI interface

  For more information about RFC1006, see Appendix F, "Related protocol specifications," on page 927.

How XTI works in the z/OS environment

The XTI is a network-transparent protocol. In the z/OS environment, XTI system support is a set of application calls to create the XTI protocol, as requested by your application. The services request is communicated to the XTI transport system using the RFC 1006 protocol mapper. RFC 1006 translates messages to transport class 0 service requests before passing them to the XTI.

© Copyright IBM Corp. 1989, 2010

Figure 56 is a high-level diagram to show how the XTI interface works in an z/OS environment.

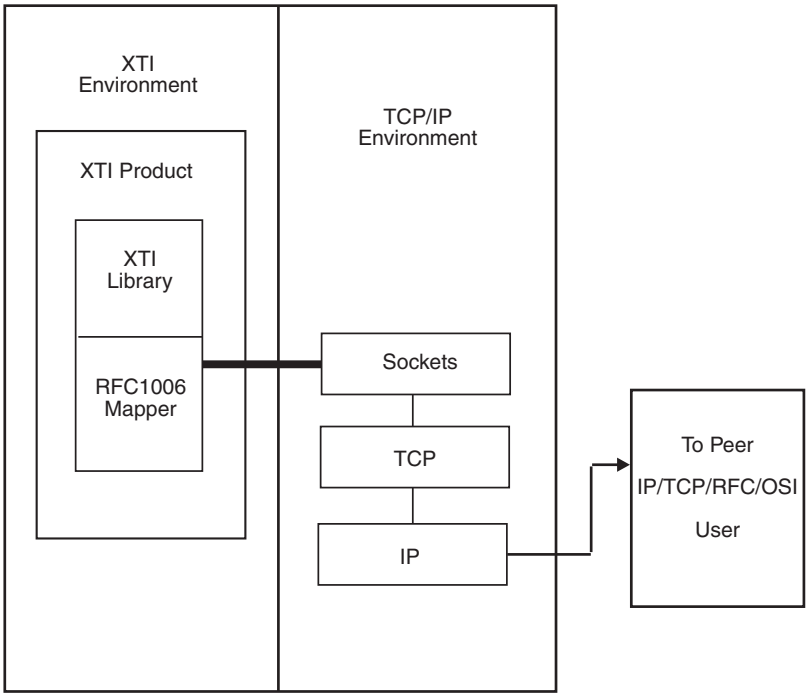


Figure 56. Using XTI with TCP/IP

In the z/OS environment, external names must be eight characters or fewer. If the XTI application program interface names exceed this limit, those names longer than eight characters are remapped to new names using the C compiler preprocessor. This name remapping is found in a file called X11GLUE.H, which is automatically included in your program when you include the header file called XLIB.H. When debugging your application, you can refer to the X11GLUE.H file to find the remapped names of the XTI programs.

Creating an application using the XTI protocol

To create an application that uses the XTI protocol, you should study the XTI application program interface in *CAE Specification: X/Open Transport Interface (XTI)*. In addition, both "XTI socket client sample program" on page 241, and "XTI socket server sample program" on page 250 illustrate programs that use the XTI interface. These programs are distributed with TCP/IP.

Coding XTI calls

The following tables list the call instructions supported by the XTI for TCP/IP. These call instructions are for unconnected sessions only, and are listed by type of service.

Coding XTI calls: Initializing a transport endpoint

Table 7 on page 235 lists the routines needed to initialize a transport endpoint. For more information, see *CAE Specification: X/Open Transport Interface (XTI)*.

Table 7. Initializing a call

Call	Description
t_bind()	Finds the endpoint for an address, and activates the endpoint.
t_open()	Creates a transport endpoint, and identifies the transport provided.

Coding XTI calls: Establishing a connection

Table 8 lists the routines needed to establish a connection. For more information, see *CAE Specification: X/Open Transport Interface (XTI)*.

Table 8. Establishing a connection

Call	Description
t_accept()	Accepts a connection after a connect indication is received.
t_connect()	Requests connection to a transport user at a known destination.
t_listen()	Listens for connect information from other transport users.
t_rcvconnect()	Checks the status of a completed connect.

Coding XTI calls: Transferring data

Table 9 lists the routines needed to transfer data. For more information, see *CAE Specification: X/Open Transport Interface (XTI)*.

Table 9. Transferring data

Routine	Description
t_rcv()	Receives normal or expedited data over a transport connection.
t_snd()	Sends normal or expedited data over a transport connection.

Coding XTI calls: Releasing a connection

Table 10 lists the routines needed to release a connection. For more information, see *CAE Specification: X/Open Transport Interface (XTI)*.

Table 10. Releasing a connection

Call	Description
t_rcvdis()	Determines the reason for an abortive release or connection reject.
t_snddis()	Sends an abortive release or a connection reject.

Coding XTI calls: Disabling a connection

Table 11 lists the routines needed to disable a connection. For more information, see *CAE Specification: X/Open Transport Interface (XTI)*.

Table 11. Disabling a connection

Call	Description
t_close()	Informs the XTI manager that you have finished with the endpoint, and frees any locally allocated resources assigned to endpoint.
t_unbind()	Resets the path to the transport endpoint. The connection is removed from the transport system, and requests for this path are denied.

Coding XTI calls: Managing events

Table 12 lists the routines needed to manage events. Each XTI call handles one event at a time. Events are processed one at a time, and you can wait on only one event at a time. For more information, see *CAE Specification: X/Open Transport Interface (XTI)*.

Table 12. Managing events

Call	Description
t_look()	Returns the events current for a transport endpoint and notifies the calling program of an asynchronous event when the calling program is in synchronous mode.

Coding XTI calls: Using utility calls

Table 13 lists utility routines that you can use to solve problems and monitor connections. For more information, see *CAE Specification: X/Open Transport Interface (XTI)*.

Table 13. Using utilities

Call	Description
t_error()	Returns the last error that occurred on a call to a transport function. You can add an identifying prefix to this call to aid in problem solving.
t_getinfo()	Returns information about the underlying transport protocol for the connection associated with file descriptor *fd*.
t_getstate()	Returns information about the state of the transport provider associated with file descriptor *fd*.

Coding XTI calls: Using system calls

Table 14 lists system routines that you can use to manage your program. For more information see *CAE Specification: X/Open Transport Interface (XTI)*.

Table 14. System function calls

Call	Description
fcntl()	Controls the operating characteristics of sockets. For more information, see "selectex()" on page 190.
select()	Checks descriptor sets to see if information is available for a read or a write. Select() also checks for pending exception conditions. For more information, see "select()" on page 186.
selectex()	Extends the select() calls by allowing you to add an ECB to define extra events. For more information, see "selectex()" on page 190.

Compiling and linking XTI applications using cataloged procedures

Several methods are available to compile, link-edit, and run your XTI program. This topic contains information about the data sets that you must include to run your XTI source program, using IBM-supplied cataloged procedures.

The following compile and link-edit sample procedures are supplied by IBM:
- XTICL is a sample compile and link-edit procedure.
- XTIC is a sample client execute procedure.

- XTIS is a sample server execute procedure.

Note: For more information about compiling and linking, see *IBM C/370 Programming Guide*.

XTICL

```
//XTICL JOB XTICLJOB
//*********************************************************************
//*                                                                   *
//*         Communications Server IP                                  *
//*                                                                   *
//*         Licensed Materials - Program Property of IBM.             *
//*         This product contains "Restricted Materials of IBM"       *
//*         5694-A01 (C) Copyright IBM Corp. 1989, 2002               *
//*         All rights reserved.                                      *
//*         US Government Users Restricted Rights -                   *
//*         Use, duplication or disclosure restricted                 *
//*         by GSA ADP Schedule Contract with IBM Corp.               *
//*         See IBM Copyright Instructions                            *
//*                                                                   *
//* SMP/E Distribution Name: EZAEB02Z                                 *
//*                                                                   *
//*********************************************************************
//*     SYMBOLIC DEFINITIONS                                          *
//*                                                                   *
//*  INSTLIB  -  TCPIP SEZAINST LIBRARY                               *
//*  SEZALOD  -  TCPIP SEZALOAD LIBRARY                               *
//*  SEZAMAC  -  TCPIP MACLIB                                         *
//*  SEZAMTX  -  TCPIP SEZACMTX LIBRARY                               *
//*  SCEERUN  -  C/C++ SCEERUN  LIBRARY                               *
//*  SCBCCMP  -  C/C++ SCBCCMP                                        *
//*  CHEADRS  -  C/C++ HEADER LIBRARY                                 *
//*  CMSGS    -  C/C++ MESSAGE LIBRARY                                *
//*  SCEELKD  -  C/C++ SCEELKED LIBRARY                               *
//*  INSTMEM  -  MEMBER TO COMPILE AND LINK                           *
//*  OBJLIB   -  LIBRARY TO PUT INSTMEM OBJ DECK                      *
//*  XTILOAD  -  LIBRARY FOR XTI LOAD MODULES                         *
//*  SOUT     -  SYSOUT PARAMETER                                     *
//*                                                                   *
//*********************************************************************
//CCOMP PROC REG='3072K',
//           CPARM='DEF(MVS),SOURCE,LIST,NOMARG,SEQ(73,80)',
//           INSTLIB=,
//           SEZALOD=,
//           SEZAMAC=,
//           SEZAMTX=,
//           SCEERUN=,
//           SCBCCMP=,
//           CHEADRS=,
//           CMSGS=,
//           SCEELKD=,
//           OBJLIB=,
//           XTILOAD=,
//           DCB80='(RECFM=FB,LRECL=80,BLKSIZE=3200)',
//           DCB3200='(RECFM=FB,LRECL=3200,BLKSIZE=12800)',
//           SOUT=*
//*                                                                   *
//*********************************************************************
//*  COMPILE STEP:
//*********************************************************************
```

Figure 57. Sample compile and link-edit job control procedure (Part 1 of 2)

```
//*                                                                   *
//COMPILE EXEC PGM=CBCDRVR,
//         PARM=('&CPARM'),
//         REGION=&REG
//STEPLIB   DD DSN=&SEZALOD,DISP=SHR
//          DD DSN=&SCEERUN,DISP=SHR
//          DD DSN=&SCBCCMP,DISP=SHR
//SYSLIB    DD DSN=&SEZAMAC,DISP=SHR
//          DD DSN=&CHEADRS,DISP=SHR
//SYSIN     DD DSN=&INSTLIB(&INSTMEM),DISP=SHR
//SYSLIN    DD DSN=&OBJLIB(&INSTMEM),DISP=SHR
//SYSMSGS   DD DUMMY,DSN=&CMSGS,DISP=SHR
//SYSPRINT  DD SYSOUT=&SOUT
//SYSCPRT   DD SYSOUT=&SOUT
//SYSTERM   DD DUMMY
//SYSUT1    DD  UNIT=VIO,SPACE=(32000,(30,30)),DCB=&DCB80
//SYSUT5    DD  UNIT=VIO,SPACE=(32000,(30,30)),DCB=&DCB3200
//SYSUT6    DD  UNIT=VIO,SPACE=(32000,(30,30)),DCB=&DCB3200
//SYSUT7    DD  UNIT=VIO,SPACE=(32000,(30,30)),DCB=&DCB3200
//SYSUT8    DD  UNIT=VIO,SPACE=(32000,(30,30)),DCB=&DCB3200
//SYSUT9    DD  UNIT=VIO,SPACE=(32000,(30,30)),
//             DCB=(RECFM=VB,LRECL=137,BLKSIZE=882)
//SYSUT10   DD  SYSOUT=*
//*
//*********************************************************************
//* LINKEDIT STEP:
//*********************************************************************
//*
//LKED    EXEC PGM=IEWL,COND=(1,LT),
//           REGION=&REG
//OBJLIB   DD DSN=&OBJLIB,DISP=SHR
//SYSLIB   DD DSN=&SEZAMTX,DISP=SHR
//         DD DSN=&SCEELKD,DISP=SHR
//SYSLMOD  DD DSN=&XTILOAD,DISP=SHR
//SYSPRINT DD SYSOUT=&SOUT
//SYSUT1   DD UNIT=SYSDA,SPACE=(CYL,(1,1))
// PEND
//*
//XTIC EXEC CCOMP,INSTMEM=XTICC
//LKED.SYSLIN DD *
       INCLUDE OBJLIB(XTICC)
       INCLUDE SYSLIB(XTI)
       MODE AMODE(31),RMODE(ANY)
       ENTRY CEESTART
       NAME XTIC(R)
//*
//XTIS EXEC CCOMP,INSTMEM=XTISC
//LKED.SYSLIN DD *
       INCLUDE OBJLIB(XTISC)
       INCLUDE SYSLIB(XTI)
       MODE AMODE(31),RMODE(ANY)
       ENTRY CEESTART
       NAME XTIS(R)
//*
```

Figure 57. Sample compile and link-edit job control procedure (Part 2 of 2)

XTIC

```
//XTICRUN JOB XTICJOB
//XTICPRC PROC P='XTIC',
//          IPADDR=XXX.XXX.XXX.XXX,
//          PORT='102',
//          REG=6M,
//          TIM=1440,
//          USERLIB='',
//          RUNLIB1='',
//          SOUT=*
//*********************************************************************
//*                                                                   *
//*         Component Name: XTIC (alias EZAEC03S)                     *
//*                                                                   *
//*         TCP/IP FOR CS z/OS                                        *
//*                                                                   *
//*         Licensed Materials - Program Property of IBM.             *
//*         This product contains "Restricted Materials of IBM"       *
//*         5694-A01 (C) Copyright IBM Corp. 1989,2005                *
//*         All rights reserved.                                      *
//*         US Government Users Restricted Rights -                   *
//*         Use, duplication or disclosure restricted                 *
//*         by GSA ADP Schedule Contract with IBM Corp.               *
//*         See IBM Copyright Instructions                            *
//*                                                                   *
//* TCP/IP for CS z/OS                                                *
//* SMP/E Distribution Name: EZAEC03S                                 *
//*                                                                   *
//*********************************************************************
//*     SYMBOLIC DEFINITIONS                                          *
//*                                                                   *
//*  P        -  PROGRAM TO EXECUTE                                   *
//*  IPADDR   -  IP ADDRESS OF HOST THAT SERVER IS EXECUTING          *
//*  PORT     -  PORT THE SERVER IS EXECUTING ON                      *
//*  REG      -  REGION SIZE                                          *
//*  TIM      -  TIME PARAMETER                                       *
//*  USERLIB  -  LIBRARY WHERE THE XTIC EXECUTEABLE MODULE IS LOCATED *
//*  RUNLIB1  -  C/C++ SCEERUN  LIBRARY                               *
//*  SOUT     -  SYSOUT PARAMETER                                     *
//*                                                                   *
//*********************************************************************
//XTIC EXEC PGM=&P,PARM='&PORT &IPADDR',
//          REGION=&REG,TIME=&TIM
//STEPLIB  DD DSN=&USERLIB,DISP=SHR
//         DD DSN=&RUNLIB1,DISP=SHR
//SYSPRINT DD SYSOUT=&SOUT
//SYSERR   DD SYSOUT=&SOUT
//SYSDEBUG DD SYSOUT=&SOUT
//LOG      DD SYSOUT=&SOUT
//SYSABEND DD SYSOUT=&SOUT
//SYSUDUMP DD SYSOUT=&SOUT
//CEEDUMP  DD SYSOUT=&SOUT
//  PEND
//    EXEC PROC=XTICPRC
```

Figure 58. Sample client execution job control procedure

XTIS

```
//XTISRUN JOB XTISJOB
//XTISPRC PROC P='XTIS',
//          REG=6M,
//          TIM=1440,
//          PORT='102',
//          USERLIB='',
//          RUNLIB1='',
//          SOUT=*
//*********************************************************************
//*                                                                   *
//*         Component Name: XTIS (alias EZAEC03T)                     *
//*                                                                   *
//*         TCP/IP FOR CS z/OS                                        *
//*                                                                   *
//*         Licensed Materials - Program Property of IBM.             *
//*         This product contains "Restricted Materials of IBM"       *
//*         5694-A01 (C) Copyright IBM Corp. 1989, 2005               *
//*         All rights reserved.                                      *
//*         US Government Users Restricted Rights -                   *
//*         Use, duplication or disclosure restricted                 *
//*         by GSA ADP Schedule Contract with IBM Corp.               *
//*         See IBM Copyright Instructions                            *
//*                                                                   *
//* TCP/IP for CS z/OS                                                *
//* SMP/E Distribution Name: EZAEC03T                                 *
//*                                                                   *
//*********************************************************************
//*     SYMBOLIC DEFINITIONS                                          *
//*                                                                   *
//*  P        -  PROGRAM TO EXECUTE                                   *
//*  REG      -  REGION SIZE                                          *
//*  TIM      -  TIME PARAMETER                                       *
//*  PORT     -  PORT NUMBER TO START SERVER ON                       *
//*  USERLIB  -  LIBRARY WHERE THE XTIS EXECUTEABLE MODULE IS LOCATED *
//*  RUNLIB1  -  C/C++ SCEERUN  LIBRARY                               *
//*  SOUT     -  SYSOUT PARAMETER                                     *
//*                                                                   *
//*********************************************************************
//XTIS EXEC PGM=&P,PARM='&PORT',
//          REGION=&REG,TIME=&TIM
//STEPLIB  DD DSN=&USERLIB,DISP=SHR
//         DD DSN=&RUNLIB1,DISP=SHR
//SYSPRINT DD SYSOUT=&SOUT
//SYSERR   DD SYSOUT=&SOUT
//SYSDEBUG DD SYSOUT=&SOUT
//LOG      DD SYSOUT=&SOUT
//SYSABEND DD SYSOUT=&SOUT
//SYSUDUMP DD SYSOUT=&SOUT
//CEEDUMP  DD SYSOUT=&SOUT
//  PEND
//    EXEC PROC=XTISPRC
```

Figure 59. Sample server execution job control procedure

Understanding XTI sample programs

This topic contains sample XTI socket programs. The XTI source code can be found in the SEZAINST data set.

Note: As with all TCP/IP applications, dynamic data set allocations are used unless explicitly overridden.

The following sample XTI socket programs are available:

Name when shipped	Alias name	Description
XTICC	EZAEC0YL	XTI socket client sample program
XTISC	EZAEC0YM	XTI socket server sample program

XTI socket client sample program

The following is an example of an XTI socket client program:

```
/*** IBMCOPYR ************************************************************/
/*                                                                       */
/* Component Name: XTICC.C (alias EZAEC0YL)                              */
/*                                                                       */
/* Copyright:    Licensed Materials - Property of IBM                    */
/*                                                                       */
/*               "Restricted Materials of IBM"                           */
/*                                                                       */
/*               5647-A01                                                */
/*                                                                       */
/*               (C) Copyright IBM Corp. 1977, 1998                      */
/*                                                                       */
/*               US Government Users Restricted Rights -                 */
/*               Use, duplication or disclosure restricted by            */
/*               GSA ADP Schedule Contract with IBM Corp.                */
/*                                                                       */
/* Status:       CSV2R6                                                  */
/*                                                                       */
/*                                                                       */
/*   SMP/E Distribution Name: EZAEC0YL                                   */
/*                                                                       */
/*                                                                       */
/*** IBMCOPYR ************************************************************/

static char ibmcopyr[] =
   "XTICC    - Licensed Materials - Property of IBM. "
   "This module is \"Restricted Materials of IBM\" "
   "5647-A01 (C) Copyright IBM Corp. 1994. "
   "See IBM Copyright Instructions.";

/*************************************************************************/
/* XTIC Sample : Client                                                  */
/*                                                                       */
/* Function:                                                             */
/*                                                                       */
/*  1. Establishes an XTI endpoint  (Asynchronous mode)                  */
/*  2. Sends a connection request to an XTI server                       */
/*  3. Receives the request                                              */
/*  4. Sends a block of data to the server                               */
/*  5. Receives a block of data from the server                          */
/*  6. Disconnects from the server                                       */
/*  7. Client stops                                                      */
/*                                                                       */
/* Command line:                                                         */
/*                                                                       */
/*  XTIC hostname                                                        */
/*                                                                       */
/*       hostname - name of the host that the server is running.         */
/*                                                                       */
/*************************************************************************/

#include "xti.h"
#include "xti1006.h"
#include "stdio.h"
```

Figure 60. Sample client code for XTI (Part 1 of 9)

```
/*
*  bind request structure for t_bind()
*/

struct t_bind req,ret;

/*
*  for client to make calls to server
*/

struct t_call scall,rcall;

/*
*  store fd returned on open()
*/

int fd;

int tot_received;

char *hostname;

/*
*  data buffer
*/

char buf[25];

int looking;

/*
*  flags returned from t_rcv()
*/

int rflags,sflags;

/*
*  transport provider for t_open()
*/

char tprov[1][8] =
     { "RFC1006" } ;

/*
*  args that are optional
*/

int args;

int pnum = 102;
char *port = "102";
char *ctsel = "client";
char *stsel = "server";
unsigned int rqlen = 0;
```

Figure 60. Sample client code for XTI (Part 2 of 9)

```
struct xti1006tsap tsap, tsapret;
void cleanup(int);
void form_addr_1006(struct xti1006tsap *,int, char *, char*, int, int);

/*
*  MAIN line program starts here !!!
*/

main(argc,argv)
int argc;
char *argv[];
{

  /*
  *  Check arguments. The host name is required.  Host name is the
  *  last parameter passed.  Port can be changed by passing it as the
  *  first parameter.
  */

  if ((argc > 3) | (argc < 2))  {
    fprintf(stderr,"Usage XTIC <port> <host>\n");
    exit(1);
  }

  if(argc==2)
    hostname = argv[1];
  else
  {
    hostname = argv[2];
    port = argv[1];
    pnum = (unsigned short) atoi(argv[1]);
  }

  /*
  *  assume normal data
  */

  sflags = 0;

  /*
  *  establish endpoint to t_listen() on
  */

  if ((fd = t_open(tprov[0],O_NONBLOCK,NULL)) < 0)
  {
    t_error("Error on t_open for FD");
    exit(t_errno);
  }

  /*
  *  compose req structure for t_bind() calls
  */

  /*
  *  length of tsap
```

Figure 60. Sample client code for XTI (Part 3 of 9)

```
*/

req.qlen = 0;
req.addr.len = sizeof(tsap);

/*
*  allocate the buffer to contain the
*  port and tsel to bind server to
*/

req.addr.buf = (char *)malloc(sizeof(tsap));

/*
*  fill address buffer with the address information
*/

form_addr_1006((struct xti1006tsap *)req.addr.buf,pnum,NULL, \
                ctsel,fd,-1);

/*
*  now that we're done composing the req,
*  do the bind of fd to addr in req
*/

if (t_bind(fd,&req,NULL) != 0)
{
  t_error("ERROR ON BIND FOR FD");
  exit(t_errno);
}

/*
*  compose call structure for t_connect() call
*/

scall.addr.len = sizeof(tsap);
scall.addr.buf = (char *)malloc(sizeof(tsap));

/*
*  fill address buffer with the address information
*/

form_addr_1006((struct xti1006tsap *)scall.addr.buf,-1,hostname, \
                stsel,fd,-1);

scall.opt.maxlen = 0;
scall.opt.len = 0;
scall.opt.buf = NULL;
scall.udata.len = 0;
scall.udata.buf = NULL;

rcall.addr.maxlen = sizeof(tsapret);
rcall.addr.buf = (char *)malloc(sizeof(tsapret));
rcall.opt.maxlen = 0;
rcall.udata.maxlen = 0;
rcall.udata.buf = NULL;
```

Figure 60. Sample client code for XTI (Part 4 of 9)

```
/*
*  issue connect request
*/

looking = t_connect(fd,&scall,&rcall);
if (looking < 0 & t_errno != TNODATA)
{
  t_error("ERROR ON CONNECT");
  cleanup(fd);
  exit(t_errno);
}

looking = 1;
while (looking)
{
  looking = t_look(fd);
  if (looking == T_CONNECT & looking > 0)
    looking = 0;
  else
    if (looking != 0)
    {
      t_error("ERROR ON LOOK");
      cleanup(fd);
      exit(t_errno);
    }
    else
      looking = 1;
}

/*
*  establish connection
*/

looking = 1;
while (looking)
  if (t_rcvconnect(fd,&rcall) == 0)
    looking = 0;
  else
    if (t_errno != TNODATA)
    {
      t_error("ERROR ON RCVCONNECT");
      cleanup(fd);
      exit(t_errno);
    }

/*
*  place message in buffer
*/

memset(buf,'B',25);

/*
*  send message to server
*/
```

Figure 60. Sample client code for XTI (Part 5 of 9)

```
looking = 1;
while (looking)
  if ((looking = t_snd(fd,buf,sizeof(buf),sflags)) < 0)
  {
    t_error("ERROR SENDING MESSAGE TO SERVER");
    cleanup(fd);
    exit(t_errno);
  }
  else
    if (looking == 0)
      looking = 1;
    else
      looking = 0;

/*
*  receive data back from the server
*/

looking = 1;
while (looking)
{
  if ((looking = t_rcv(fd,buf,sizeof(buf),&rflags)) > 0)
    looking = 0;
  else
    {
      if (looking < 0 & t_errno != TNODATA)
      {
         t_error("ERROR RECEIVING DATA FROM SERVER");
         cleanup(fd);
         exit(t_errno);
      }
      else
        looking = 1;
    }
}

/*
*  disconnect from server
*/

looking = 1;
while (looking)
  if (t_snddis(fd,NULL) == 0)
    looking = 0;
  else
  {
    t_error("ERROR DISCONNECTING FROM SERVER");
    cleanup(fd);
    exit(t_errno);
  }

/*
*  if fd is an endpoint, try to close it
*/
```

Figure 60. Sample client code for XTI (Part 6 of 9)

```
  if (t_unbind(fd) != 0)
  {
    t_error("ERROR ON BIND FOR FD");
    exit(t_errno);
  }

  cleanup(fd);

  printf("Client ended successfully\n");
  exit(0);

}

/*********************************************************************/

void form_addr_1006(addrbuf1006,portnum,hostnmstr,tselstr1006,fd1,fd2)

/*
*  formats the provided address information
*  into the buffer for RFC1006
*/

/*
*  address buffer to be filled in
*/

struct xti1006tsap *addrbuf1006;

int   portnum;

/*
*  hostnmstr represented as a string
*/

char            *hostnmstr;

/*
*  tsel represented as a string
*/

char            *tselstr1006;

/*
*  one possible endpoint to close if
*  an error occurs in forming address
*/

int   fd1;

/*
*  other possible endpoint to close
*/

int   fd2;
```

Figure 60. Sample client code for XTI (Part 7 of 9)

```
{


  /*
  *  check validity of hostname
  *  there's no way program can
  *  continue without valid addr
  */

  if (strlen(hostnmstr) > 64)
  {
     fprintf(stderr,"hostname %s too long\n",hostnmstr);
     /*
     *  don't want TADDRBUSY when you try to reuse the address
     */
     cleanup(fd1);
     cleanup(fd2);
     exit(TBADADDR);
   }

  addrbuf1006->xti1006_hostnm_len = strlen(hostnmstr);
  strcpy(addrbuf1006->xti1006_hostnm,hostnmstr);

  /*
  *  check validity of hostname
  *  there's no way program can
  *  continue without valid addr
  */

  if (strlen(tselstr1006) > 64)
  {
     fprintf(stderr,"tsel %s too long\n",tselstr1006);
     /*
     *  don't want TADDRBUSY when you try to reuse the address
     */
     cleanup(fd1);
     cleanup(fd2);
     exit(TBADADDR);
  }

  addrbuf1006->xti1006_tsel_len = strlen(tselstr1006);
  strcpy(addrbuf1006->xti1006_tsel,tselstr1006);

  if (tselstr1006 == "Nulltsap")
  {
     addrbuf1006->xti1006_tsel_len = 0;
     strcpy(addrbuf1006->xti1006_tsel,NULL);
  }
  else
  {
     addrbuf1006->xti1006_tsel_len = strlen(tselstr1006);
     strcpy(addrbuf1006->xti1006_tsel,tselstr1006);
  } /* endif */
```

Figure 60. Sample client code for XTI (Part 8 of 9)

```
  if (portnum != -1)
     addrbuf1006->xti1006_tset = portnum;

}
/*********************************************************************/

void cleanup(fd)

int fd;

{
  if (fd >= 0)
    if (t_close(fd) != 0)
    {
       fprintf(stderr,"unable to t_close() endpoint while");
       fprintf(stderr," cleaning up from error\n");
    }
}
```

Figure 60. Sample client code for XTI (Part 9 of 9)

XTI socket server sample program

As with all TCP/IP applications, dynamic dataset allocations are used unless explicitly overridden. For example, the TCPIP.DATA file can be specified using the SYSTCPD DD JCL statement. For more information, see Chapter 10, "C Socket application programming interface," on page 105.

The following is an example of an XTI socket server program.

```
/*** IBMCOPYR ************************************************************/
/*                                                                       */
/* Component Name: XTISC.C (alias EZAEC0YM)                              */
/*                                                                       */
/* Copyright:    Licensed Materials - Property of IBM                    */
/*                                                                       */
/*               "Restricted Materials of IBM"                           */
/*                                                                       */
/*               5647-A01                                                */
/*                                                                       */
/*               (C) Copyright IBM Corp. 1977, 1998                      */
/*                                                                       */
/*               US Government Users Restricted Rights -                 */
/*               Use, duplication or disclosure restricted by            */
/*               GSA ADP Schedule Contract with IBM Corp.                */
/*                                                                       */
/* Status:       CSV2R6                                                  */
/*                                                                       */
/*                                                                       */
/*   SMP/E Distribution Name: EZAEC0YM                                   */
/*                                                                       */
/*                                                                       */
/*** IBMCOPYR ************************************************************/

static char ibmcopyr[]=
   "XTISC    - Licensed Materials - Property of IBM. "
   "This module is \"Restricted Materials of IBM\" "
   "5647-A01 (C) Copyright IBM Corp. 1994. "
   "See IBM Copyright Instructions.";

/*************************************************************************/
/* XTIS Sample : Server                                                  */
/*                                                                       */
/* Function:                                                             */
/*                                                                       */
/*  1. Establishes an XTI endpoint  (Asynchronous mode)                  */
/*  2. Listens for a connection request from an XTI client               */
/*  3. Accepts the connection request                                    */
/*  4. Receives a block of data from the client                          */
/*  5. Echos the data back to the client                                 */
/*  6. Waits for the disconnect request from the XTI client              */
/*  7. Server stops                                                      */
/*                                                                       */
/* Command line:                                                         */
/*                                                                       */
/*  XTIS     H                                                           */
/*                                                                       */
/*************************************************************************/

#include "xti.h"
#include "xti1006.h"
#include "stdio.h"

/*
```

Figure 61. Sample server code for XTI (Part 1 of 9)

```
*  bind request structure for t_bind()
*/

struct t_bind req,ret;

/*
*  for server to listen for calls with
*/

struct t_call call;

/*
*  descriptor to t_listen() on
*/

int fd;

/*
*  descriptor to t_accept() on
*/

int resfd;

int tot_received;

/*
*  data buffer
*/

char buf[25];

int looking;

/*
*  flags returned from t_rcv()
*/

int rflags,sflags;

/*
*  transport provider for t_open()
*/

char tprov[1][8] =
     { "RFC1006" } ;

/*
*  args that are optional
*/

int args;

int tot_sent;
int pnum = 102;
char *port = "102";
```

Figure 61. Sample server code for XTI (Part 2 of 9)

```
char *hostnm;
char *stsel = "server";
unsigned int rqlen = 0;
struct xti1006tsap tsap, tsapret;
void cleanup(int);
void form_addr_1006(struct xti1006tsap *,int, char *, char*, int, int);

/*
*  MAIN line program starts here !!!
*/

main(argc,argv)
int argc;
char *argv[];
{

  /*
  *  Check arguments. No arguments should be passed to the server
  */

  if (argc > 2) {
    fprintf(stderr,"Usage : XTIS <port>\n");
    exit(1);
  }

  if(argc == 2)
  {
    pnum = (unsigned short) atoi(argv[1]);
    port = argv[1];
  }
  /*
  *  assume normal data
  */

  sflags = 0;

  /*
  *  establish endpoint to t_listen() on
  */

  if ((fd = t_open(tprov[0],O_NONBLOCK,NULL)) < 0)
  {
    t_error("Error on t_open");
    exit(t_errno);
  }

  /*
  *  establish endpoint to t_accept() on
  */

  if ((resfd = t_open(tprov[0],O_NONBLOCK,NULL)) < 0)
  {
    t_error("Error on t_open");
    cleanup(fd);
    exit(t_errno);
```

Figure 61. Sample server code for XTI (Part 3 of 9)

```
}

/*
*  compose req structure for t_bind() calls
*/

/*
*  length of tsap
*/

req.addr.len = sizeof(tsap);

/*
*  allocate the buffer to contain the
*  port and tsel to bind server to
*/

req.addr.buf = (char *)malloc(sizeof(tsap));

/*
*  fill address buffer with the address information
*/

form_addr_1006((struct xti1006tsap *)req.addr.buf, \
                pnum,                              \
                NULL,                              \
                stsel,                             \
                fd,                                \
                resfd);

/*
*  length of tsap
*/

ret.addr.maxlen = sizeof(tsapret);
ret.addr.buf = (char *)malloc(sizeof(tsapret));

/*
*  listening endpoint needs qlen > 0,
*  ability to queue 10 requests
*/

req.qlen = 10;
ret.qlen = rqlen;

/*
*  now that we're done composing the req,
*  do the bind of fd to addr in req
*/

if (t_bind(fd,&req,&ret) != 0)
{
  t_error("Error on t_bind");
  cleanup(fd);
  cleanup(resfd);
```

Figure 61. Sample server code for XTI (Part 4 of 9)

```
  exit(t_errno);
}

/*
*  accepting endpoint with same addr needs qlen == 0
*/

req.qlen = 0;

/*
*  now that we're done composing the req,
*  do the bind of resfd to addr in req
*/

if (t_bind(resfd,&req,&ret) != 0)
{
  t_error("Error on t_bind");
  cleanup(fd);
  cleanup(resfd);
  exit(t_errno);
}

/*
*  initialize call receipt structure for t_listen()
*/

call.opt.maxlen = 0;
call.addr.len = 0;
call.opt.len = 0;
call.udata.len = 0;
call.opt.buf = NULL;

call.addr.maxlen = sizeof(tsapret); /* listen for return*/
call.addr.buf = (char *)malloc(sizeof(tsapret));

call.udata.maxlen = 0;
call.udata.buf = NULL;

/*
*  wait for connect req & get seq num in the call variable
*/

looking = 1;
while (looking)
  if (t_listen(fd,&call) == 0)
    looking = 0;
  else
    if (t_errno != TNODATA)
    {
      t_error("Error on t_accept");
      cleanup(fd);
      cleanup(resfd);
      exit(t_errno);
    }
```

Figure 61. Sample server code for XTI (Part 5 of 9)

```
/*
*  accept the connection on the accepting endpoint
*/

if (t_accept(fd,resfd,&call) != 0)
{
  t_error("Error on t_accept");
  cleanup(fd);
  cleanup(resfd);
  exit(t_errno);
}

/*
*  receive data from the client
*/

looking = 1;
while (looking)
  if (t_rcv(resfd,buf,sizeof(buf),&rflags) > 0)
    looking = 0;
  else
    if (t_errno != TNODATA)
    {
      t_error("Error on t_rcv");
      cleanup(fd);
      cleanup(resfd);
      exit(t_errno);
    }

/*
*  sent data back to the client
*/

strcpy(buf,"DATA FROM SERVER");

looking = 1;
while (looking)
  if (t_snd(resfd,buf,sizeof(buf),sflags) > 0)
    looking = 0;

/*
*  wait for disconnect from the client
*/

looking = 1;
while (looking)
  if (t_look(resfd) == T_DISCONNECT)
    looking = 0;

/*
*  receive the disconnect request
*/

looking = 1;
while (looking)
```

Figure 61. Sample server code for XTI (Part 6 of 9)

```
    if (t_rcvdis(resfd,NULL) == 0)
      looking = 0;

  /*
  *  unbind the endpoints
  */

  if (t_unbind(resfd) != 0)
  {
    t_error("Error on t_unbind for resfd");
    cleanup(fd);
    cleanup(resfd);
    exit(t_errno);
  }

  if (t_unbind(fd) != 0)
  {
    t_error("Error on t_unbind for fd");
    cleanup(fd);
    cleanup(resfd);
    exit(t_errno);
  }

  /*
  *  if fd is an endpoint, try to close it
  */

  cleanup(fd);

  /*
  *  if resfd is an endpoint, try to close it
  */

  cleanup(resfd);

  printf("Server ended successfully\n");
  exit(0);

}

/*********************************************************************/

void form_addr_1006(addrbuf1006,portnum,hostnmstr,tselstr1006,fd1,fd2)

/*
*  formats the provided address information
*  into the buffer for RFC1006
*/

/*
*  address buffer to be filled in
*/

struct xti1006tsap *addrbuf1006;
```

Figure 61. Sample server code for XTI (Part 7 of 9)

```
int   portnum;

/*
*  hostnmstr represented as a string
*/

char            *hostnmstr;

/*
*  tsel represented as a string
*/

char            *tselstr1006;

/*
*  one possible endpoint to close if
*  an error occurs in forming address
*/

int   fd1;

/*
*  other possible endpoint to close
*/

int   fd2;

{


  /*
  *  check validity of hostname
  *  there's no way program can
  *  continue without valid addr
  */

  if (strlen(hostnmstr) > 64)
  {
     fprintf(stderr,"hostname %s too long\n",hostnmstr);
     /*
     *  don't want TADDRBUSY when you try to reuse the address
     */
     cleanup(fd1);
     cleanup(fd2);
     exit(TBADADDR);
  }

  addrbuf1006->xti1006_hostnm_len = strlen(hostnmstr);
  strcpy(addrbuf1006->xti1006_hostnm,hostnmstr);

  /*
  *  check validity of hostname
  *  there's no way program can
  *  continue without valid addr
  */
```

Figure 61. Sample server code for XTI (Part 8 of 9)

```
  if (strlen(tselstr1006) > 64)
  {
     fprintf(stderr,"tsel %s too long\n",tselstr1006);
     /*
     *  don't want TADDRBUSY when you try to reuse the address
     */
     cleanup(fd1);
     cleanup(fd2);
     exit(TBADADDR);
  }

  addrbuf1006->xti1006_tsel_len = strlen(tselstr1006);
  strcpy(addrbuf1006->xti1006_tsel,tselstr1006);

  if (tselstr1006 == "Nulltsap")
  {
     addrbuf1006->xti1006_tsel_len = 0;
     strcpy(addrbuf1006->xti1006_tsel,NULL);
  }
  else
  {
     addrbuf1006->xti1006_tsel_len = strlen(tselstr1006);
     strcpy(addrbuf1006->xti1006_tsel,tselstr1006);
  } /* endif */

  if (portnum != -1)
     addrbuf1006->xti1006_tset = portnum;

}
/*********************************************************************/

void cleanup(fd)

int fd;

{
  if (fd >= 0)
    if (t_close(fd) != 0)
    {
       fprintf(stderr,"unable to t_close() endpoint while");
       fprintf(stderr," cleaning up from error\n");
     }
}
```

Figure 61. Sample server code for XTI (Part 9 of 9)

Chapter 12. Macro application programming interface

This information describes the macro API for IPv4 or IPv6 socket application programs written in z/OS assembler language. The macro interface can be used to produce reentrant modules and can be used in a multithread environment.

The following topics are included:

- Environmental restrictions and programming requirements
- Input register information
- Output register information
- Compatibility considerations
- Defining storage for the API macro
- Understanding common parameter descriptions
- Error messages and return codes
- Characteristics of sockets
- Task management and asynchronous function processing
- Using an unsolicited event exit routine
- Diagnosing problems in applications using the macro API
- Macros for assembler programs
- Macro interface assembler language sample programs

Sockets API environmental restrictions and programming requirements

The following restrictions apply to both the Macro Socket API and the Callable Socket API:

Function	Restriction
SRB mode	These APIs can only be invoked in TCB mode (task mode).
Cross-memory mode	These APIs can only be invoked in a non-cross-memory environment (PASN=SASN=HASN).
Functional Recovery Routine (FRR)	Do not invoke these APIs with an FRR set. This will cause system recovery routines to be bypassed and severely damage the system.
Locks	No locks should be held when issuing these calls.
INITAP and TERMAPI socket commands	The INITAPI and TERMAPI socket commands must be issued under the same task.
Storage	Storage acquired for the purpose of containing data returned from a socket call must be obtained in the same key as the application program status word (PSW) at the time of the socket call. This includes the ECB that is posted upon completion of an asynchronous EZASMI call that is issued after an EZASMI TYPE=INITAPI with the ASYNC=('ECB') option has been issued.

© Copyright IBM Corp. 1989, 2010

Function	Restriction
Nested socket API calls	You cannot issue nested API calls within the same task. That is, if a request block (RB) issues a socket API call and is interrupted by an interrupt request block (IRB) in an STIMER exit, any additional socket API calls that the IRB attempts to issue are detected and flagged as an error.
Addressability mode (Amode) considerations	The EZASMI interface can be invoked while the caller is in either 31-bit or 24-bit Amode. However, if the application is running in 24-bit addressability mode at the time of the call, all addresses of parameters passed by the application must be addressable in 31-bit Amode. This implies that even if the addresses being passed reside in storage below the 16 MB line (and therefore addressable by 24-bit Amode programs) the high-order byte of these addresses needs to be 0.
Use of z/OS UNIX System Services	Each z/OS UNIX process within an address space that uses the EZASMI API should not use any z/OS UNIX System Services socket API facilities such as z/OS UNIX Assembler Callable Services or Language Environment for z/OS C/C++. Doing so can yield unpredictable results.
Dynamic allocation	Socket calls should not be issued during START (initialization) processing for LOGONs, MOUNTs, or started tasks. This is because they require dynamic allocation that can fail during these times.

The EZASMI macro is located in SEZACMAC.

Sockets API input register information

Before invoking the sockets API, the general purpose registers (GPRs) need to contain the following:

Register	Contents
0-1	N/A
2-12	N/A, unless referenced by a macro parameter
13	Pointer to a standard save area in the key of the caller
14-15	N/A

The contents of the access registers (ARs) on entry to the sockets API call are not used.

When control returns to the caller, the access registers (ARs) contain:

Register	Contents
0-1	Used as work registers by the system
2-14	Unchanged
15	Used as a work register by the system

If a caller depends on register contents to remain the same before and after issuing a service, the caller must save the contents of a register before issuing the service and restore them after the system returns control.

Sockets API output register information

When control returns to the caller, the general purpose registers (GPRs) contain:

Register	Contents
0-1	Used as work registers by the system
2-13	Unchanged
14	Used as a work register by the system
15	• For synchronous calls, it contains the entry point address of EZBSOH03. • For asynchronous calls, see Task management and asynchronous function processing.

When control returns to the caller, the access registers (ARs) contain:

Register	Contents
0-1	Used as work registers by the system
2-14	Unchanged
15	Used as a work register by the system

If a caller depends on register contents to remain the same before and after issuing a service, the caller must save the contents of a register before issuing the service and restore them after the system returns control.

Sockets API compatibility considerations

Unless noted in *z/OS Communications Server: New Function Summary*, an application program compiled and link edited on a release of z/OS Communications Server IP can be used on higher level releases. That is, the API is upward compatible.

Application programs that are compiled and link edited on a release of z/OS Communications Server IP cannot be used on older releases. That is, the API is not downward compatible.

Defining storage for the macro API

The macro API requires the definition of a task storage area.

The task storage area must be known to and addressable by all socket users communicating across a specified connection. A connection runs between the application and TCP/IP. The most common way to organize storage is to assign one connection to each MVS subtask. If there are multiple modules using sockets within a single task or connection, you must provide the address of the task storage to every user.

The following describes how to define the address of the task storage:

- Code the instruction EZASMI TYPE=TASK with STORAGE=CSECT as part of the program code. This makes the program nonreentrant, but simplifies the code.
- Code the instruction EZASMI TYPE=TASK with STORAGE=DSECT as part of the program code. The expansion of this instruction generates the equate field, TIELENTH, which is equal to the length of the storage area. This can be used to issue an MVS GETMAIN to allocate the required storage.

The defining program must make the address of this storage available to all other programs using this connection. Programs running in these tasks must define the storage mapping with an EZASMI TYPE=TASK with STORAGE=DSECT.
Restriction: The task storage area used on an INITAPI call cannot be moved or copied to other storage locations. Attempting to do so will result in an implicit INITAPI being performed with unexpected results.

The EZASMI TYPE=TASK macro generates only one parameter list for a connection. This can lead to overlay problems for programs using APITYPE=3 connections (multiple calls can be issued simultaneously). For more detail on APITYPE=3 connections, see "Task management and asynchronous function processing" on page 267. A program should use the following format to build unique parameter list storage areas if it will be issuing multiple calls simultaneously on one connection:

```
BINDPRML   EZASMI    MF=L  This will generate the storage used for
                     building the parm list in the following BIND call
           EZASMI    TYPE=BIND,                                          X
                       S=SOCKDESC,                                       X
                       NAME=NAMEID,                                      X
                       ERRNO=ERRNO,                                      X
                       RETCODE=RETCODE,                                  X
                       ECB=ECB1,                                         X
                       MF=(E,BINDPRML)
```

This example of an asynchronous BIND macro would use the MF=L macro to generate the parameter list. The fields that are common across all macro calls, for example, RETCODE and ERRNO, must be unique for each outstanding call.

You can create multiple connections to TCP/IP from a single task. Each of these connections functions independently of the other and is identified by its own task interface element (TIE). The TASK parameter can be used to explicitly reference a TIE. If you do not include the TASK parameter, the macro uses the TIE generated by the EZASMI TYPE=TASK macro.

```
TIE1    DS XL(TIELENTH)                                      Length of TIE

  EZASMI TYPE=INITAPI,
         MAXSOC=MAX75,                                                 X
          ERRNO=ERRNO,                                                 X
          RETCODE=RETCODE,                                             X
          APITYPE=2,                                                   X
          MAXSNO=MAXS,                                                 X
          TASK=TIE1

  EZASMI  TYPE=SOCKET,
           AF='INET',                                                  X
           SOCTYPE='STREAM',                                           X
           ERRNO=ERRNO,                                                X
           RETCODE=RETCODE,                                            X
           TASK=TIE1
```

In this example, the TIE TIE1 is used for the connection, not the TIE generated by the EZASMI TYPE=TASK macro.

Understanding common parameter descriptions

The following describes the parameters and concepts common to the macros described in this topic.

Parameter **Description**

address The name of the field that contains the value of the parameter. The following example illustrates a BIND macro where SOCKNO is set to 2.

```
MVC   SOCKNO,=H'2'
EZASMI TYPE=BIND,S=SOCKNO
```

**indaddr* The name of the address field that contains the address of the field containing the parameter. The following example produces the same result as the example above.

```
MVC   SOCKNO,=H'2'
LA    0,SOCKNO
ST    0,SOCKADD
EZASMI TYPE=BIND,S=*SOCKADD
```

(reg) The name (equated to a number) or the number of a general purpose register. Do not use a register 0, 1, 14, or 15. The following example produces the same result as the previous examples.

```
MVC   SOCKNO,=H'2'
LA    3,SOCKNO
EZASMI TYPE=BIND,SOCKNO=(3)
```

'value' A literal value for the parameter; for example, AF='INET'

Sockets API error messages and return codes

For information about error messages, see *z/OS Communications Server: IP Messages Volume 1 (EZA)*.

For information about codes returned by TCP/IP, see Appendix B, "Socket call error return codes," on page 885.

Characteristics of sockets

For stream sockets, data is processed as streams of information with no boundaries separating data. For example, if applications A and B are connected with a stream socket and application A sends 1000 bytes, each call to the SEND function can return 1 byte, 10 bytes, or the entire 1000 bytes, with the number of bytes sent returned in the RETCODE call. Therefore, applications using stream sockets should place the READ call and the SEND call in a loop that repeats until all of the data has been sent or received.

PROTO specifies a particular protocol to be used with the socket. In most cases, a single protocol exists to support one type of socket in a domain (not true with raw sockets). If **PROTO** is set to 0, the system selects the default protocol number for the domain and socket type requested. The **PROTO** defaults are TCP for stream sockets and UDP for datagram sockets. There is no default for raw sockets.

SOCK_STREAM sockets model duplex byte streams. They provide reliable, flow-controlled connections between peer applications. Stream sockets are either active or passive. Active sockets are used by clients who initiate connection requests with CONNECT. By default, SOCKET creates active sockets. Passive sockets are used by servers to accept connection requests with the CONNECT macro. An active socket is transformed into a passive socket by binding a name to the socket with the BIND macro and by indicating a willingness to accept connections with the LISTEN macro. Once a socket is passive, it cannot be used to initiate connection requests.

In the AF_INET or AF_INET6 domain, the BIND macro, applied to a stream socket, lets the application specify the networks from which it is willing to accept connection requests. The application can fully specify the network interface by setting the Internet address field in the address structure to the Internet address of a network interface. Alternatively, the application can set the address in the name structure to zeros to indicate that it wants to receive connection requests from any network.

Once a connection has been established between stream sockets, the data transfer macros READ, WRITE, SEND, RECV, SENDTO, and RECVFROM can be used. Usually, the READ-WRITE or SEND-RECV pairs are used for sending data on stream sockets.

SOCK_DGRAM sockets are used to model datagrams. They provide connectionless message exchange without guarantees of reliability. Messages sent have a maximum size. Datagram sockets are not supported in the AF_IUCV domain.

The active or passive concepts for stream sockets do not apply to datagram sockets. Servers must still call BIND to name a socket and to specify from which network interfaces it wants to receive datagrams. Wildcard addressing, as described for stream sockets, also applies to datagram sockets. Because datagram sockets are connectionless, the LISTEN macro has no meaning for them and must not be used.

After an application receives a datagram socket, it can exchange datagrams using the SENDTO and RECVFROM macros. If the application goes one step further by calling CONNECT and fully specifying the name of the peer with which all messages are exchanged, then the other data transfer macros READ, WRITE, SEND, and RECV can be used as well. For more information about placing a socket into the connected state, see “CONNECT” on page 482.

Datagram sockets allow message broadcasting to multiple recipients. Setting the destination address to a broadcast address depends on the network interface (address class and whether subnets are used).

SOCK_RAW sockets supply an interface to lower layer protocols, such as IP. You can use this interface to bypass the transport layer when you need direct access to lower layer protocols. Raw sockets are also used to test new protocols. Raw sockets are not supported in the AF_IUCV domain.

Raw sockets are connectionless and data transfer is the same as for datagram sockets. You can also use the CONNECT macro to specify a peer socket in the same way that is previously described for datagram sockets.

Outgoing datagrams have an IP header prefixed to them. Your program receives incoming datagrams with the IP header intact. You can set and inspect IP options by using the SETSOCKOPT and GETSOCKOPT macros.

Use the CLOSE macro to deallocate sockets.

Regardless of the type of socket (SOCK_STREAM, SOCK_DGRAM or SOCK_RAW), all commands that pass a socket address must be consistent with the address family specified when the socket was opened. If the socket was opened with an address family of AF_INET, then any command for that socket that includes a socket address must use an AF_INET socket address. If the socket was

opened with an address family of AF_INET6, then any command for that socket that includes a socket address must use an AF_INET6 socket address.

Task management and asynchronous function processing

The sockets extended interface allows asynchronous operation, although by default the task issuing a macro request is put into a WAIT state until the requested function completes. At that time, the issuing task resumes and continues execution.

If you do not want the issuing task to be placed into a WAIT while its request is processed, use asynchronous function processing.

Macro API asynchronous function processing: How it works

The macro API provides for asynchronous function processing in two forms. Both forms cause the system to return control to the application immediately after the function request has been sent to TCP/IP. The difference between the two forms is in how the application is notified when the function is completed:

ECB method
Enables you to pass an MVS event control block (ECB) on each socket call. The socket library returns control to the program immediately and posts the ECB when the call has completed.

EXIT method
Enables you to specify the entry point of an exit routine using the INITAPI() call. The individual socket calls immediately return control to the program and the socket library drives the specified exit routine when the socket call is complete.

In either case, the function is completed when the notification is delivered. Note that the notification can be delivered at any time, in some cases even before the application has received control back from the EZASMI macro call. It is therefore important that the application is ready to handle a notification as soon as it issues the EZASMI macro call.

Like nonblocking calls, asynchronous calls return control to your program immediately. But in this case, there is no need to reissue the call. When the requested event has taken place, an ECB is posted or an exit routine is driven.

Using the API macro, you can specify APITYPE=2 or APITYPE=3

APITYPE=2 Allows an asynchronous macro API program to have only one outstanding socket call per socket descriptor. An APITYPE=2 program can use macro API asynchronous calls, but synchronous calls are equally well supported.

APITYPE=3 Allows an asynchronous macro API program to have many outstanding socket calls per socket descriptor. Only the macro API supports APITYPE=3. An APITYPE=3 program must use macro API asynchronous calls with either an ECB or REQAREA parameter.

The REQAREA parameter is used in macros using the EXIT form. This parameter is mutually exclusive with the ECB parameter used with the ECB form.

Figure 62. ECB input parameter

Like the ECB parameter, the REQAREA parameter points to an area that contains:

- A 4-byte token that is presented to your asynchronous exit routine when the response to this function request is complete
- A 100-byte storage area that is used by the interface to save the state information

Note: This storage must not be modified or freed until the macro function has completed and the ECB has been posted, or the asynchronous exit has been driven.

Figure 63. User token setting

Before you issue the macro, you must set the first word of the 104 bytes to a token of any value. The token is used by your asynchronous exit routine to determine the function completion event for which it is being invoked.

Asynchronous functions are processed in the following sequence:

1. The application must issue the EZASMI TYPE=INITAPI with ASYNC='ECB' or ASYNC=('EXIT', AEEXIT). The ASYNC parameter notifies the API that asynchronous processing is to be used for this connection. The API notes the type of asynchronous processing to be used, ECB or EXIT, and specifies the use of the asynchronous exit routine for this connection.
2. When a function request is issued by the application, the API does one of the following:
   - If the type of asynchronous processing is ECB, and an ECB is supplied in the function request, the API returns control to the application. If Register 15 is 0, the ECB is posted when the function has completed. Note that the ECB might be posted prior to when control is returned to the application.
   - If the type of asynchronous processing is EXIT, and a REQAREA parameter is supplied in the function request, the API returns control to the application. If Register 15 is 0, the exit routine is invoked when the function has completed. Note that the exit can be invoked prior to when control is returned to the application.

   In either case, Register 15 is used to inform the caller whether or not the ECB is posted or asynchronous exit driven. Therefore, you must not use Register 15 for the RETCODE parameter.

When the asynchronous exit routine is invoked, the following linkage conventions are used:

GPR0 Register Setting

0 Normal return

1 TCP/IP address space has terminated (TCPEND).

GPR1 Points to a doubleword field containing the following:

WORD1
The token specified by the INITAPI macro

WORD2
The token specified by the functional request macro (First 4 bytes of the REQAREA storage)

GPR13
Points to standard MVS save area in the same key as the application PSW at the time of the INITAPI command.

GPR14
Return address

GPR15
Entry point of the exit routine

The following example shows how to code an asynchronous macro function:

```
*********************************************************************
*   READ A BUFFER OF DATA FROM THE CONNECTION PEER. I MAY NEED TO    *
*   WAIT SO GIVE CONTROL BACK TO ME AND LET ME ISSUE MY OWN WAIT.    *
*   IT COULD BE PART OF A WAIT WHICH WOULD INCLUDE OTHER EVENTS.     *
*   SPECIFY ECB/STORAGE AREA FOR INTERFACE.                          *
*********************************************************************

         EZASMI TYPE=READ,                                          X
               S=SOCKNO,                                            X
               NBYTES=COUNT,                                        X
               BUF=DATABUF,                                         X
               ERRNO=ERROR,                                         X
               RETCODE=RCODE,                                       X
               ECB=MYECB,                                           X
               ERROR=ERRORRTN

         LTR    R15,R15        Was macro function passed to TCP/IP?
         BNZ    BADRCODE       If no, ECB will not be posted
         WAIT   ECB=MYECB      TELL MVS TO WAIT UNTIL READ IS DONE
```

Asynchronous exit environmental and programming considerations

When utilizing the ASYNC=EXIT option of the EZASMI macro, the following requirements need to be considered:

- Asynchronous calls can only be issued from a single request block (RB) in a given task (TCB).

  The first RB that issues an ASYNC EZASMI call under a given task is deemed as the target RB that is interrupted when an asynchronous exit needs to be driven. This means that after an asynchronous EZASMI macro call is invoked you should not invoke any services that cause the current RB to no longer be the top RB for this task (for example, a LINK call). If the target RB is no longer the top RB at the time that the exit needs to be driven, then the exit is deferred until the target RB becomes the top RB. One exception to this rule is that EZASMI calls can be issued under the asynchronous user exit.

- EZASMI macro calls within the asynchronous exits.

  While running the asynchronous exit notification routine, an application can issue other EZASMI calls. However, the application should avoid issuing any blocking calls and should not enter into long delays. Doing so delays any

additional exits from being driven and also blocks the TCB that made the original call. Note that TERMAPI should not be issued under the asynchronous exit.

- Linkage stack.

  Applications issuing EZASMI macro asynchronous exit calls should not issue any PC instructions that cause the system linkage to be used. Doing so delays the asynchronous exits from being driven until the linkage stack entry is removed. If the linkage stack entry is not removed, the exit will not be driven.
- Asynchronous exits are given control in the same key as the program status word (PSW) key of the TCB from which the EZASMI call was issued.

Using an unsolicited event-exit routine

The unsolicited event-exit routine enables an application to specify an event exit routine that is invoked when an unsolicited event occurs. This exit routine can be a part of the program that specifies it, or it can be a separate module. The exit routine must be resident at the time that the EZASMI TYPE=INITAPI macro is issued, and it must stay resident until the EZASMI TYPE=TERMAPI macro is issued.

The user invokes this facility by the issuing the optional *UEEXIT* parameter that is used in the EZASMI TYPE=INITAPI macro, as shown in the following syntax fragment:

Keyword **Description**

UEEXIT A double word value that is composed of two positional parameters. The first parameter is the address of the event-exit routine that is invoked when an unsolicited event occurs. The second parameter is the address of the token that is passed to the exit routine. On entry to the unsolicited event-exit routine, the general purpose registers (GPRs) contain the following values:

GPR0 Register setting. The following values are supported:

0 TPC/IP is active

1 TCP/IP is inactive

GPR1 Address of the token that is specified in the INITAPI macro

GPR13
Pointer to a standard MVS save area. This save area is in the same key that the application program status word (PSW) was in when the EZASMI TYPE=INITAPI macro was issued.

GPR14
Return address

The following code example shows how the EZASMI TYPE=INITAPI macro can be used to specify an unsolicited event-exit routine (MYUEE). The MYUEE storage

definition contains the address of the exit routine, MYUEE1, followed by the address of the user exit token, UETOKEN:

```
         EZASMI TYPE=INITAPI,     Issue INITAPI Macro                  X
               SUBTASK=SUBTASK,   SPECIFY SUBTASK IDENTIFIER           X
               MAXSOC=MAXSOC,     SPECIFY MAXIMUM NUMBER OF SOCKETS    X
               MAXSNO=MAXSNO,     (HIGHEST SOCKET NUMBER ASSIGNED)     X
               ERRNO=ERRNO,       (Specify ERRNO field)                X
               RETCODE=RETCODE,   (Specify RETCODE field)              X
               APITYPE=APITYPE,   (SPECIFY APITYPE FIELD)              X
               ERROR=ERROR,       ABEND IF ERROR ON MACRO              X
               UEEXIT=MYUEE,                                           X
               ASYNC=('EXIT',MYEXIT)  (SPECIFY AN EXIT)

*-------------------------------------------------------------------*
*        UNSOLICITED EVENT EXIT
*-------------------------------------------------------------------*
         CNOP 0,4
MYUEE    DC   A(MYUEE1,UETOKEN)
UETOKEN  DS   F
MYUEE1   SAVE (14,12),T,*
         LR   R2,R15
         USING MYUEE1,R2
UEKEY    WTO 'UEEXIT BEING DRIVEN'
         EZASMI TYPE=TERMAPI      Issue EZASMI Macro for Termapi
         POST ECB,1
         RETURN (14,12),T,RC=0
         DROP  R2
```

Diagnosing problems in applications using the macro API

TCP/IP provides a trace facility that can be helpful in diagnosing problems in applications using the Macro API. The trace is implemented using the TCP/IP Component Trace (CTRACE) SOCKAPI trace option. The SOCKAPI trace option allows all Macro socket API calls issued by an application to be traced in the TCP/IP CTRACE. The SOCKAPI trace records include information such as the type of socket call, input, and output parameters and return codes. This trace can be helpful in isolating failing socket API calls and in determining the nature of the error or the history of socket API calls that might be the cause of an error. For more information about the SOCKAPI trace option, see *z/OS Communications Server: IP Diagnosis Guide*.

Macros for assembler programs

This information contains the description, syntax, parameters, and other related information for every macro included in this API.

The EZASMI macro is located in the SEZACMAC library.

ACCEPT

The ACCEPT macro is issued when the server receives a connection request from a client. ACCEPT points to a socket that was created with a SOCKET macro and marked by a LISTEN macro. If a process waits for the completion of connection requests from several peer processes, a later ACCEPT macro can block until one of the CONNECT macros completes. To avoid this, issue a SELECT macro between the CONNECT and the ACCEPT macros. Concurrent server programs use the ACCEPT macro to pass connection requests to subtasks.

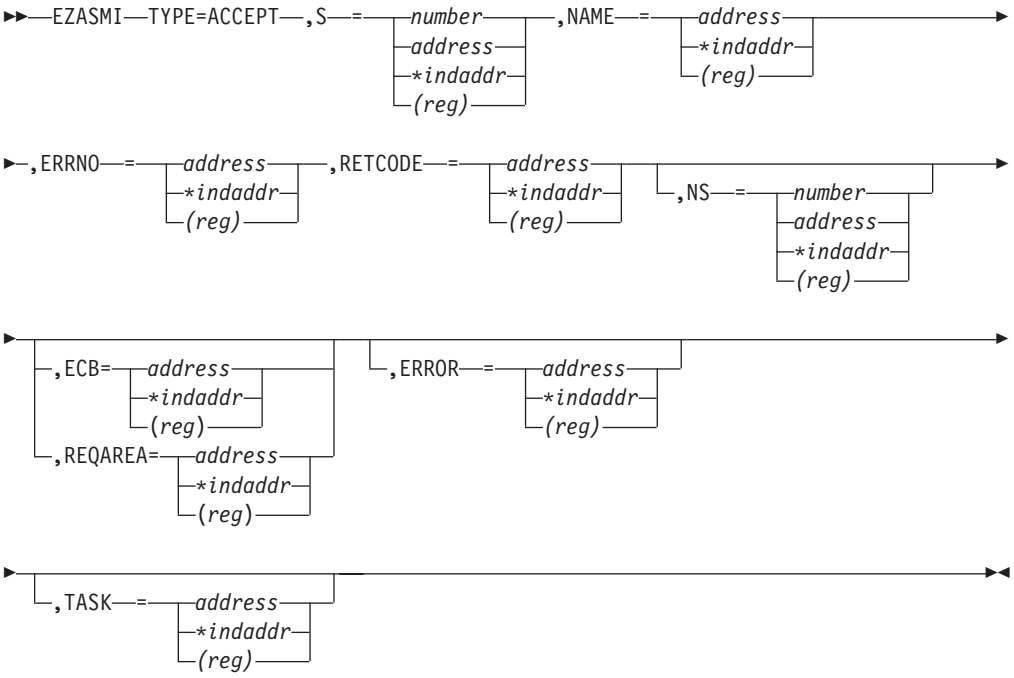
When issued, the ACCEPT macro does the following:

1. Accepts the first connection on a queue of pending connections.

2. Creates a new socket with the same properties as the socket used in the macro and returns the address of the client for use by subsequent server macros. The new socket cannot be used to accept new connections, but can be used by the calling program for its own connection. The original socket remains available to the calling program for more connection requests.
3. Returns the new socket descriptor to the calling program.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.



Keyword	Description
S	Input parameter. A value or the address of a halfword binary number specifying the descriptor of the socket from which the connection is accepted.
NAME	

Output parameter. Initially, the IPv4 or IPv6 application provides a pointer to the IPv4 or IPv6 socket address structure, which is filled on completion of the call with the socket address of the connection peer. Include the SYS1.MACLIB(BPXYSOCK) macro to get the assembler mappings for the socket address structure. The socket address structure mappings begin at the SOCKADDR label. The AF_INET socket address structure fields start at the SOCK_SIN label. The AF_INET6 socket address structure fields start at the SOCK_SIN6 label.

The IPv4 socket address structure contains the following fields:

Field Description

FAMILY
A halfword binary field specifying the IPv4 addressing family. For IPv4 the value is a decimal 2, indicating AF_INET.

PORT A halfword binary field that is set to the client port number.

IPv4-ADDRESS
A fullword binary field that is set to the 32-bit IPv4 Internet address, in network byte order, of the client host machine.

RESERVED
Specifies eight bytes of binary zeros. This field is required, but not used.

The IPv6 socket address structure contains the following fields:

Field Description

NAMELEN
A 1-byte binary field specifying the length of this IPv6 socket address structure. Any value specified by the use of this field is ignored when processed as input and the field is set to 0 when processed as output.

FAMILY
A 1-byte binary field specifying the IPv6 addressing family. For IPv6 the value is a decimal 19, indicating AF_INET6.

PORT A halfword binary field that is set to the client port number.

FLOW-INFO
A fullword binary field specifying the traffic class and flow label. This value of this field is undefined.

IPv6-ADDRESS
A 16-byte binary field that is set to the 128-bit IPv6 Internet address, in network byte order, of the client host machine.

SCOPE-ID
A fullword binary field which identifies a set of interfaces as appropriate for the scope of the address carried in the **IPv6-ADDRESS** field. For a link scope **IPv6-ADDRESS**, **SCOPE-ID** contains the link index for the **IPv6-ADDRESS**. For all other address scopes, **SCOPE-ID** is undefined.

ERRNO Output parameter. A fullword binary field. If **RETCODE** is negative, **ERRNO** contains a valid error number. Otherwise, ignore **ERRNO**.

See Appendix B, "Socket call error return codes," on page 885 for information about **ERRNO** return codes.

RETCODE Output parameter. If **RETCODE** is positive, **RETCODE** is the new socket number.

If **RETCODE** is negative, check **ERRNO** for an error number.

Value	Description
>0	Successful call.
−1	Check **ERRNO** for an error code.

NS Input parameter. A value or the address of a halfword binary number specifying the descriptor number chosen for the new socket, which is the socket for the client at the time. If NS is not specified, the interface assigns it.

ECB or REQAREA
Input parameter. This parameter is required if you are using APITYPE=3. It points to a 104-byte field containing:

For ECB
A 4-byte **ECB** posted by TCP/IP when the macro completes.

For REQAREA
A 4-byte user token (set by you) that is presented to your exit when the response to this function request is complete.

For ECB/REQAREA
The last 100 bytes is a storage field used by the interface to save the state information.

Note: This storage must not be modified until the macro function has completed and the **ECB** has been posted, or the asynchronous exit has been driven.

ERROR Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

TASK Input parameter. The location of the task storage area in your program.

BIND

In a server program, the BIND macro normally follows a SOCKET macro to complete the new socket creation process.

The BIND macro can specify the port or let the system choose the port. A listener program should always bind to the same well-known port so that clients know the socket address to use when issuing a CONNECT, SENDTO, or SENDMSG request.

In addition to the port, the application also specifies an IP address on the BIND macro. Most applications typically specify a value of 0 for the IP address, which allows these applications to accept new TCP connections or receive UDP

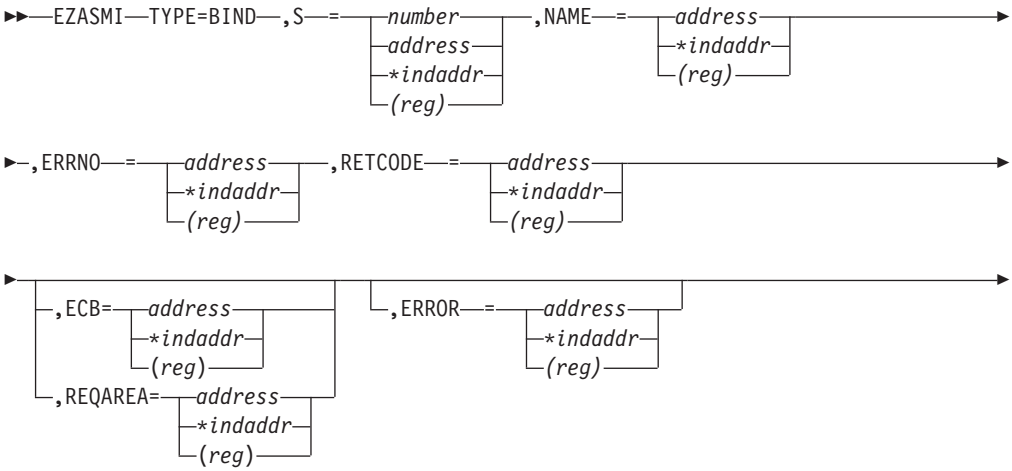
datagrams that arrive over any of the network interfaces of the local host. This enables client applications to contact the application using any of the IP addresses associated with the local host.

Alternatively, an application can indicate that it is only interested in receiving new TCP connections or UDP datagrams that are targeted towards a specific IP address associated with the local host. This can be accomplished by specifying the IP address in the appropriate field of the socket address structure passed on the NAME parameter.

Tip: Even if an application specifies the value 0 for the IP address on the BIND, the system administrator can override that value by specifying the BIND parameter on the PORT reservation statement in the TCP/IP profile. The effect of this override is similar to the effect of the application specifying an explicit IP address on the BIND macro. For more information, see *z/OS Communications Server: IP Configuration Reference*.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.



Keyword	Description
S	Input parameter. A value or the address of a halfword binary number specifying the socket descriptor.
NAME	Input parameter. The IPv4 or IPv6 application provides a pointer to an IPv4 or IPv6 socket address structure. This structure specifies the port number and an IPv4 or IPv6 IP address from which the application can accept connections. Include the SYS1.MACLIB(BPXYSOCK) macro to get the assembler mappings for the socket address structure. The socket address structure mappings begin at the SOCKADDR label. The AF_INET socket address structure fields start at the SOCK_SIN label. The AF_INET6 socket address structure fields start at the SOCK_SIN6 label. See Chapter 3, "Designing an iterative server program," on page 27 for more information. The IPv4 socket structure must specify the following fields:

Field	Description
FAMILY	A halfword binary field specifying the IPv4 addressing family. For IPv4 the value is a decimal 2, indicating AF_INET.
PORT	A halfword binary field set to the port number that binds to the socket. The application can call the GETSOCKNAME macro after the BIND macro to discover the assigned port number.
IPv4-ADDRESS	A fullword binary field that is set to the 32-bit IPv4 Internet address, in network byte order, of the host machine.
RESERVED	Specifies eight bytes of binary zeros. This field is required, but not used.

The IPv6 socket structure must specify the following fields:

Field	Description
NAMELEN	A 1-byte binary field specifying the length of this IPv6 socket address structure. Any value specified by the use of this field is ignored when processed as input and the field is set to 0 when processed as output.
FAMILY	A 1-byte binary field specifying the IPv6 addressing family. For IPv6 the value is a decimal 19, indicating AF_INET6.

PORT A halfword binary field set to the port number that binds to the socket. The application can call the GETSOCKNAME macro after the BIND macro to discover the assigned port number.

FLOW-INFO
A fullword binary field specifying the traffic class and flow label. This field must be set to 0.

IPv6-ADDRESS
A 16-byte binary field that is set to the 128-bit IPv6 Internet address, in network byte order, of the host machine.

SCOPE-ID
A fullword binary field which identifies a set of interfaces as appropriate for the scope of the address carried in the **IPv6-ADDRESS** field. A value of 0 indicates that the **SCOPE-ID** field does not identify the set of interfaces to be used, and can be specified for any address types and scopes. For a link scope **IPv6-ADDRESS**, **SCOPE-ID** can specify a link index which identifies a set of interfaces. For all other address scopes, **SCOPE-ID** must be set to 0.

ERRNO Output parameter. A fullword binary field. If **RETCODE** is negative, **ERRNO** contains a valid error number. Otherwise, ignore **ERRNO**.

See Appendix B, "Socket call error return codes," on page 885 for information about **ERRNO** return codes.

RETCODE Output parameter. A fullword binary field that returns one of the following:

Value	Description
0	Successful call.
−1	Check **ERRNO** for an error code.

ECB or REQAREA
Input parameter. This parameter is required if you are using APITYPE=3. It points to a 104-byte field containing:

For ECB
A 4-byte **ECB** posted by TCP/IP when the macro completes.

For REQAREA
A 4-byte user token (set by you) that is presented to your exit when the response to this function request is complete.

For ECB/REQAREA
The last 100 bytes is a storage field used by the interface to save the state information.

Note: This storage must not be modified until the macro function has completed and the **ECB** has been posted, or the asynchronous exit has been driven.

ERROR Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

TASK Input parameter. The location of the task storage area in your program.

BIND2ADDRSEL

The BIND2ADDRSEL macro binds a socket to the local IP address that would be selected by the stack to communicate with the input destination IP address.

Use the BIND2ADDRSEL macro when the application must verify that the local IP address assigned by the stack meets its address selection criteria as specified by the IPV6_ADDR_PREFERENCES socket option before the stack sends any packets to the remote host. In a TCP or UDP application, the BIND2ADDRSEL macro usually follows the SETSOCKOPT macro with option IPV6_ADDR_PREFERENCES and precedes any communication with a remote host.

Result: The stack attempts to select a local IP address according to your application preferences. However, a successful BIND2ADDRSEL macro does not guarantee that all of your selection preferences of source IP address were met.

Guidelines:

- Use the SETSOCKOPT macro to set the IPV6_ADDR_PREFERENCES option to indicate your selection preferences of source IP address before binding the socket and before allowing an implicit bind of the socket to occur.

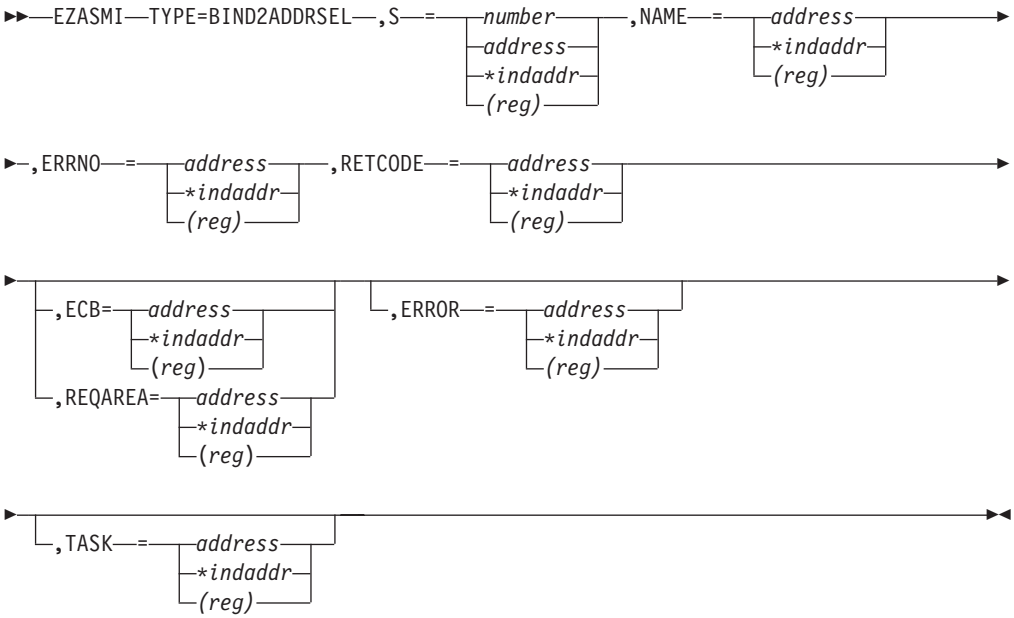
  Result: If a socket has not been explicitly bound to a local IP address with a BIND or BIND2ADDRSEL macro when a CONNECT, SENDTO, or SENDMSG macro is issued, an implicit bind occurs. The stack chooses the local IP address used for outbound packets.

  Requirement: When your application is using stream sockets, and must prevent the stack from sending any packets whatsoever (such as SYN) to the remote host before it can verify that the local IP address meets the values specified for the IPV6_ADDR_PREFERENCES option, do not allow the CONNECT macro to implicitly bind the socket to a local IP address. Instead, bind the socket with the BIND2ADDRSEL macro and test the local IP address assigned with the INET6_IS_SRCADDR macro. If the assigned local IP address is satisfactory, you can then use the CONNECT macro to establish communication with the remote host.
- After you successfully issue the BIND2ADDRSEL macro, use the GETSOCKNAME macro to obtain the local IP address that is bound to the socket. When the local IP address is obtained, use the INET6_IS_SRCADDR macro to verify that the local IP address meets your address selection criteria.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.

Control parameters:	All parameters must be addressable by the caller and in the primary address space.



Keyword **Description**

S Input parameter. A value or the address of a halfword binary number that specifies the socket descriptor.

Requirements: The socket must be an AF_INET6 socket. The type can be SOCK_STREAM or SOCK_DGRAM.

NAME

Input parameter. The application provides a pointer to an AF_INET6 socket address structure. You can specify an IPv4 address by using its IPv4-mapped IPv6 format.

Guidelines:

- Include the SYS1.MACLIB(BPXYSOCK) macro to get the assembler mappings for the socket address structure.
- Begin the socket address structure mappings at the SOCKADDR label.
- Begin the AF_INET6 socket address structure fields at the SOCK_SIN6 label.

The IPv6 socket structure must specify the following fields:

Field **Description**

FAMILY
A halfword binary field that specifies the IPv6 addressing family. For IPv6 the value is the decimal value 19, indicating AF_INET6.

PORT A halfword binary field. This field is ignored by BIND2ADDRSEL processing.

Guideline: The application can call the GETSOCKNAME macro after the BIND2ADDRSEL macro to discover the assigned port number.

FLOW-INFO
A fullword binary field that specifies the traffic class and flow label. This field is ignored by BIND2ADDRSEL processing.

IPv6-ADDRESS
A 16-byte binary field that is set to the 128-bit IPv6 Internet address, in network byte order, of the remote host machine that the application communicates with.

Rule: Specify an IPv4 address by using its IPv4-mapped IPv6 format.

SCOPE-ID
A fullword binary field that identifies a set of interfaces as appropriate for the scope of the address that is specified in the **IPv6-ADDRESS** field. The value 0 indicates that the **SCOPE-ID** field does not identify the set of interfaces to be used.

Requirement: The **SCOPE-ID** field must be nonzero if the address is a link-local address. For all other address scopes, the **SCOPE-ID** value must be set to 0.

ERRNO Output parameter. A fullword binary field. If the **RETCODE** value is negative, the **ERRNO** field contains a valid error number; otherwise, ignore **ERRNO**.

See Appendix B, "Socket call error return codes," on page 885 for information about **ERRNO** return codes.

RETCODE Output parameter. A fullword binary field that returns one of the following values:

Value	Description
0	Successful call.
−1	Check **ERRNO** for an error code.

ECB or REQAREA
Input parameter. This parameter is required if you use APITYPE=3. This parameter points to a 104-byte field containing one of the following values:

For ECB
A 4-byte **ECB** that is posted by TCP/IP when the macro completes.

For REQAREA
A 4-byte user token (set by you) that is presented to your exit when the response to this function request is complete.

For ECB/REQAREA
The last 100 bytes is a storage field that is used by the interface to save the state information.

Note: This storage must not be modified until the macro function has completed and the **ECB** has been posted, or the asynchronous exit has been driven.

ERROR Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

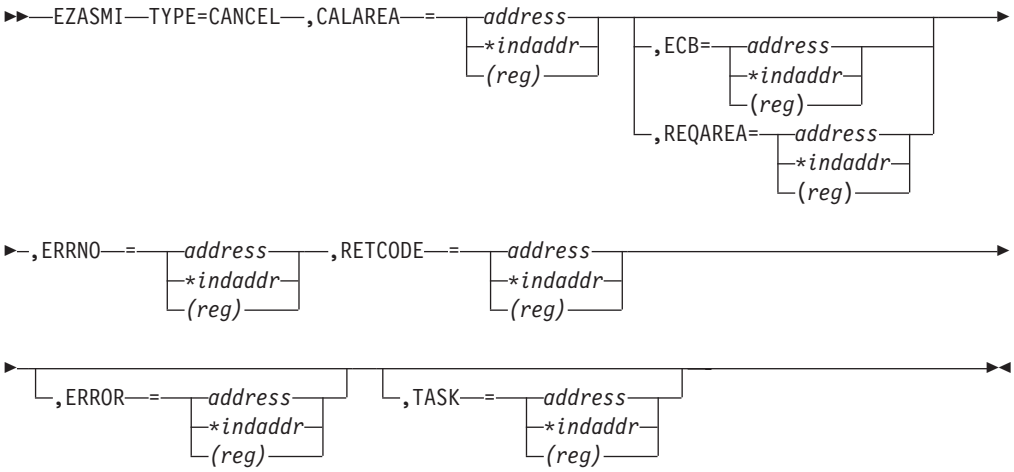
TASK Input parameter. The location of the task storage area in your program.

CANCEL

The CANCEL function terminates a call in progress. The call being canceled must have specified **ECB** or **REQAREA**.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.



Keyword **Description**

CALAREA Input parameter. The **ECB** or **REQAREA** specified in the call being canceled.

Note: To be compatible with TCP/IP for MVS V3R1, **CALAREA** can be specified as **CALLAREA**.

ECB or REQAREA
Input parameter. This parameter is required if you are using APITYPE=3. It points to a 104-byte field containing:

For ECB
A 4-byte **ECB** posted by TCP/IP when the macro completes.

For REQAREA
A 4-byte user token (set by you) that is presented to your exit when the response to this function request is complete.

For ECB/REQAREA
The last 100 bytes is a storage field used by the interface to save the state information.

Note: This storage must not be modified until the macro function has completed and the **ECB** has been posted, or the asynchronous exit has been driven.

ERRNO Output parameter. A fullword binary field. If **RETCODE** is negative, this contains an error number.

RETCODE Output parameter. A fullword binary field. If **RETCODE** is 0, the CANCEL was successful.

Value	Description
0	Successful call.
−1	Check **ERRNO** for an error code.

ERROR Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

TASK Input parameter. The location of the task storage area in your program.

CLOSE

The CLOSE macro shuts down the socket and frees the resources that are allocated to the socket. Issue the SHUTDOWN macro before you issue the CLOSE macro.

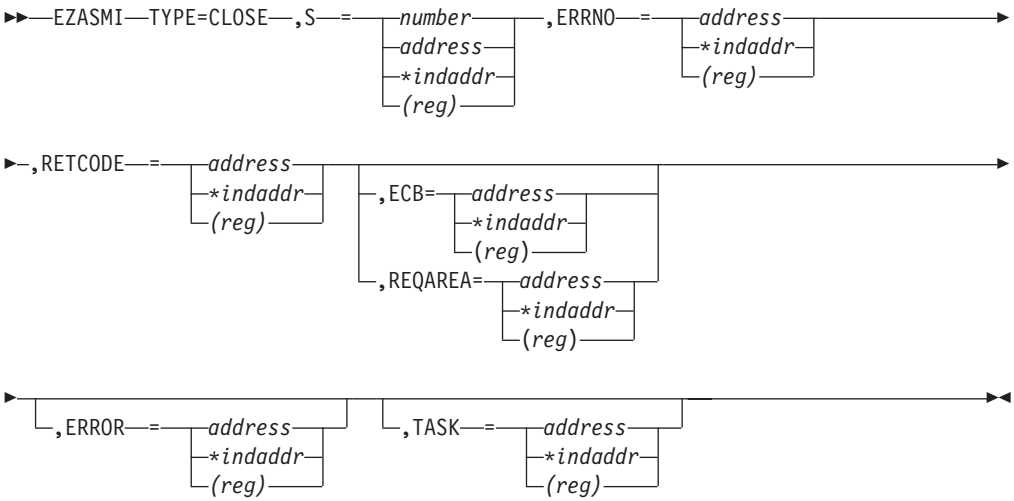
CLOSE can also be issued by a concurrent server after it gives a socket to a subtask program. After issuing GIVESOCKET and receiving notification that the client child has successfully issued TAKESOCKET, the concurrent server issues the CLOSE macro to complete the transfer of ownership.

Note: If a stream socket is closed while input or output data is queued, the stream connection is reset and data transmission can be incomplete. SETSOCKOPT can be used to set a SO_LINGER condition, in which TCP/IP continues to send data for a specified period of time after the CLOSE macro is issued. For information about SO_LINGER, see "SETSOCKOPT" on page 589.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.

ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.



Keyword	Description
S	Input parameter. A value or the address of a halfword binary number specifying the socket to be closed.
ERRNO	Output parameter. A fullword binary field. If **RETCODE** is negative, **ERRNO** contains a valid error number. Otherwise, ignore **ERRNO** field. See Appendix B, "Socket call error return codes," on page 885 for information about **ERRNO** return codes.
RETCODE	Output parameter. A fullword binary field that returns one of the following: **Value** **Description** **0** Successful call. **−1** Check **ERRNO** for an error code.
ECB or REQAREA	Input parameter. This parameter is required if you are using APITYPE=3. It points to a 104-byte field containing: **For ECB** A 4-byte **ECB** posted by TCP/IP when the macro completes. **For REQAREA** A 4-byte user token (set by you) that is presented to your exit when the response to this function request is complete. **For ECB/REQAREA** The last 100 bytes is a storage field used by the interface to save the state information.

Note: This storage must not be modified until the macro function has completed and the **ECB** has been posted, or the asynchronous exit has been driven.

ERROR Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

TASK Input parameter. The location of the task storage area in your program.

CONNECT

The CONNECT macro is used by a client to establish a connection between a local socket and a remote socket.

For stream sockets, the CONNECT macro:

- Completes the binding process for a stream socket if BIND has not been previously issued.
- Attempts connection to a remote socket. This connection must be completed before data can be transferred.

For datagram sockets, CONNECT is not essential, but you can use it to send messages without specifying the destination.

For both types of sockets, the following CONNECT macro sequence applies:

1. The server issues BIND and LISTEN (stream sockets only) to create a passive open socket.
2. The client issues CONNECT to request a connection.
3. The server creates a new connected socket by accepting the connection on the passive open socket.

If the socket is in blocking mode, CONNECT blocks the calling program until the connection is established or until an error is received.

If the socket is in nonblocking mode, the return code indicates the success of the connection request.

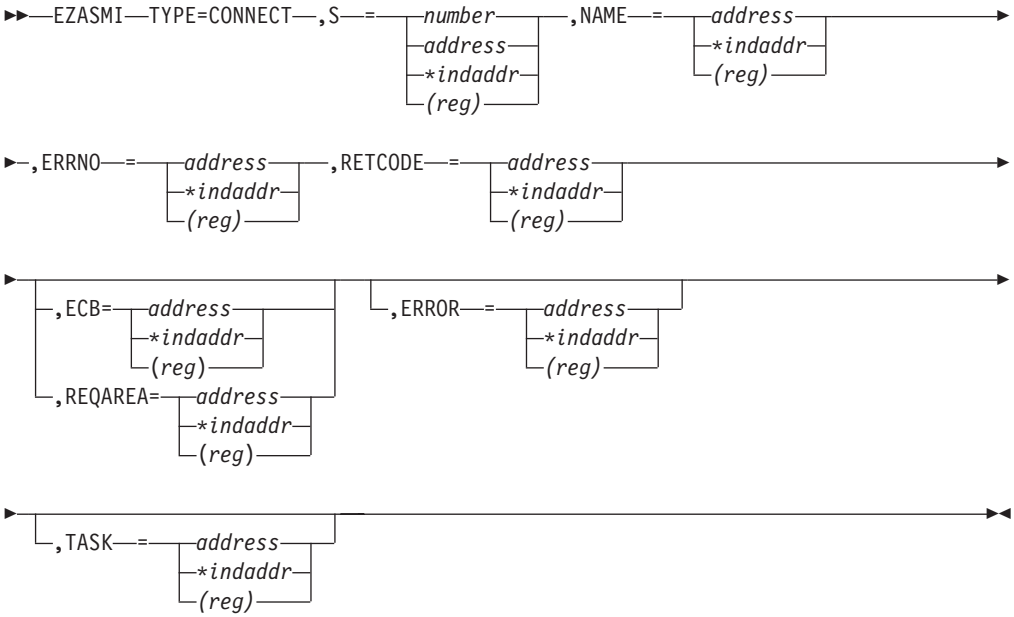
- A 0 RETCODE indicates that the connection was completed.
- A nonzero RETCODE with an ERRNO of 36 (EINPROGRESS) indicates that the connection could not be completed, but since the socket is nonblocking, the CONNECT macro completes its processing.

The caller must test the completion of the connection setup by calling SELECT and testing for the ability to write to the socket. The completion cannot be checked by issuing a second CONNECT.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.

Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.



Keyword **Description**

S Input parameter. A value or the address of a halfword binary number specifying the socket descriptor.

NAME

Input parameter. The NAME parameter for CONNECT specifies the IPv4 or IPv6 socket address of the IPv4 or IPv6 IP connection peer. Include the SYS1.MACLIB(BPXYSOCK) macro to get the assembler mappings for the socket address structure. The socket address structure mappings begin at the SOCKADDR label. The AF_INET socket address structure fields start at the SOCK_SIN label. The AF_INET6 socket address structure fields start at the SOCK_SIN6 label.

The IPv4 socket structure must specify the following fields:

Field **Description**

FAMILY
A halfword binary field specifying the IPv4 addressing family. For IPv4 the value is always a decimal 2, indicating AF_INET.

PORT A halfword binary field that is set to the server port

number in network byte order. For example, if the port number is 5000 in decimal, it is set to X'1388'.

IPv4-ADDRESS
A fullword binary field specifying the 32-bit IPv4 Internet address of the server host machine in network byte order. For example, if the Internet address is 129.4.5.12 in dotted decimal notation, it is set to X'8104050C'.

RESERVED
Specifies eight bytes of binary zeros. This field is required, but not used.

The IPv6 socket structure must specify the following fields:

Field Description

NAMELEN
A 1-byte binary field specifying the length of this IPv6 socket address structure. Any value specified by the use of this field is ignored when processed as input and the field is set to 0 when processed as output.

FAMILY
A 1-byte binary field specifying the IPv6 addressing family. For IPv6 the value is a decimal 19, indicating AF_INET6.

PORT A halfword binary field that is set to the port number in network byte order. For example, if the port number is 5000 in decimal, it is set to X'1388'.

FLOW-INFO
A fullword binary field specifying the traffic class and flow label. This field must be set to 0.

IPv6-ADDRESS
A 16-byte binary field that is set to the 128-bit IPv6 Internet address, in network byte order, of the client host machine. For example, if the IPv6 Internet address is 12ab:0:0:cd30:123:4567:89AB:cedf in colon hex notation, it is set toX'12AB00000000CD300123456789ABCDEF'.

SCOPE-ID
A fullword binary field which identifies a set of interfaces as appropriate for the scope of the address carried in the **IPv6-ADDRESS** field. A value of 0 indicates the **SCOPE-ID** field does not identify the set of interfaces to be used, and can be specified for any address types and scopes. For a link scope **IPv6-ADDRESS**, **SCOPE-ID** can specify a link index which identifies a set of interfaces. For all other address scopes, **SCOPE-ID** must be set to 0.

ERRNO Output parameter. A fullword binary field. If **RETCODE** is negative, **ERRNO** contains a valid error number. Otherwise, ignore **ERRNO**.

See Appendix B, “Socket call error return codes,” on page 885 for information about **ERRNO** return codes.

RETCODE Output parameter. A fullword binary field that returns one of the following:

Value Description

0 Successful call.
−1 Check **ERRNO** for an error code.

ECB or REQAREA
Input parameter. This parameter is required if you are using APITYPE=3. It points to a 104-byte field containing:

For ECB
A 4-byte **ECB** posted by TCP/IP when the macro completes.

For REQAREA
A 4-byte user token (set by you) that is presented to your exit when the response to this function request is complete.

For ECB/REQAREA
The last 100 bytes is a storage field used by the interface to save the state information.

Note: This storage must not be modified until the macro function has completed and the **ECB** has been posted, or the asynchronous exit has been driven.

ERROR Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

TASK Input parameter. The location of the task storage area in your program.

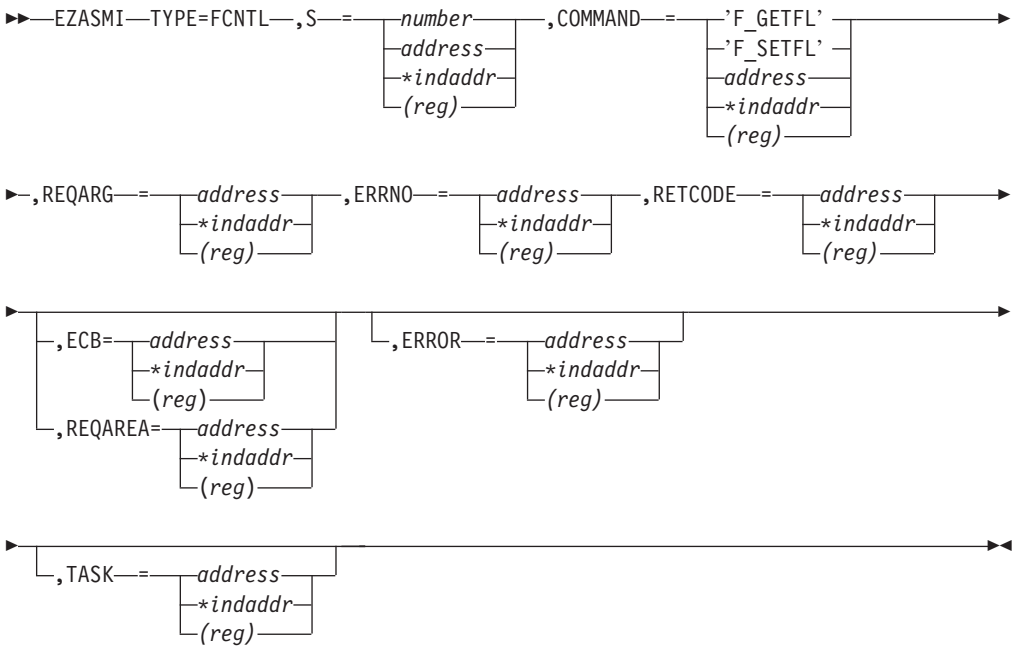
FCNTL

The blocking mode for a socket can be queried or set to nonblocking using the FNDELAY flag. You can query or set the FNDELAY flag even though it is not defined in your program.

See "IOCTL" on page 540 for another way to control socket blocking.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.



Keyword	Description
S	Input parameter. A value or the address of a halfword binary number specifying the socket descriptor for the socket that you want to unblock or query.
COMMAND	Input parameter. A fullword binary field or a literal that sets the FNDELAY flag to one of the following values: **Value Description** **3 or 'F_GETFL'** Query the blocking mode for the socket. **4 or 'F_SETFL'** Set the mode to nonblocking for the socket. **REQARG** is set by TCP/IP. The FNDELAY flag sets the nonblocking mode for the socket. If data is not present on calls that can block (READ, READV, and RECV), the call returns a -1, and **ERRNO** is set to 35 (EWOULDBLOCK). **Note:** Values for **COMMAND** that are supported by the z/OS UNIX System Services FCNTL callable service are supported also. see *z/OS UNIX System Services Programming: Assembler Callable Services Reference* for more information.
REQARG	A fullword binary field containing a mask that TCP/IP uses to set the FNDELAY flag. • If **COMMAND** is set to 3 (query), the **REQARG** field should be set to 0. • If **COMMAND** is set to 4 (set), – Set **REQARG** to 4 to turn the FNDELAY flag on. This places the socket in nonblocking mode. – Set **REQARG** to 0 to turn the FNDELAY flag off. This places the socket in blocking mode.

ERRNO Output parameter. A fullword binary field. If **RETCODE** is negative, **ERRNO** contains a valid error number. Otherwise, ignore the **ERRNO** field.

See Appendix B, "Socket call error return codes," on page 885 for information about **ERRNO** return codes.

RETCODE Output parameter. A fullword binary field that returns one of the following:

- If **COMMAND** was set to 3 (query), a bit string is returned.
  - If **RETCODE** contains X'00000004', the socket is nonblocking. The FNDELAY flag is on.
  - If **RETCODE** contains X'00000000', the socket is blocking. The FNDELAY flag is off.
- If the **COMMAND** field was 4 (set), a successful call returns 0 in **RETCODE**. For either **COMMAND**, a **RETCODE** of -1 indicates an error. Check **ERRNO** for the error number.

ECB or REQAREA

Input parameter. This parameter is required if you are using APITYPE=3. It points to a 104-byte field containing:

For ECB

A 4-byte **ECB** posted by TCP/IP when the macro completes.

For REQAREA

A 4-byte user token (set by you) that is presented to your exit when the response to this function request is complete.

For ECB/REQAREA

The last 100 bytes is a storage field used by the interface to save the state information.

Note: This storage must not be modified until the macro function has completed and the **ECB** has been posted, or the asynchronous exit has been driven.

ERROR Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

TASK Input parameter. The location of the task storage area in your program.

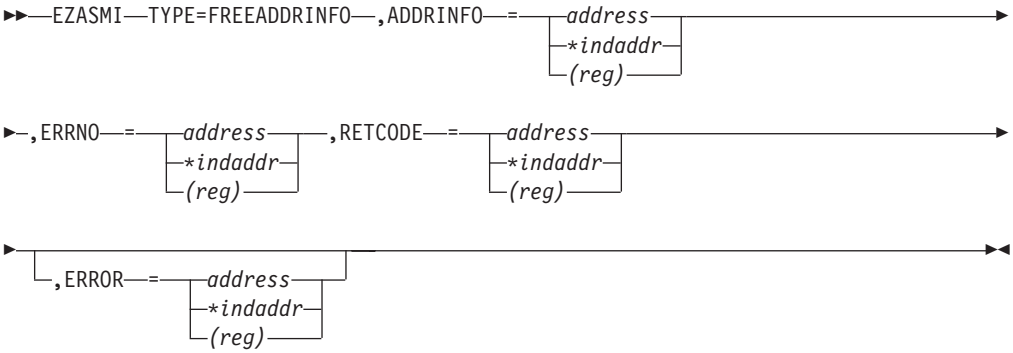
FREEADDRINFO

The FREEADDRINFO macro frees all the address information structures returned by GETADDRINFO in the RES parameter.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.

Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.



Keyword	Description
ADDRINFO	Input parameter. The address of a set of address information structures returned by **TYPE=GETADDRINFO RES** argument.
ERRNO	Output parameter. A fullword binary field. If **RETCODE** is negative, **ERRNO** contains a valid error number. Otherwise, ignore the **ERRNO** field. See Appendix B, "Socket call error return codes," on page 885 for information about **ERRNO** return codes.
RETCODE	Output parameter. A fullword binary field that returns one of the following: **Value** **Description** **0** Successful call. **–1** Check **ERRNO** for an error code.
ERROR	Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

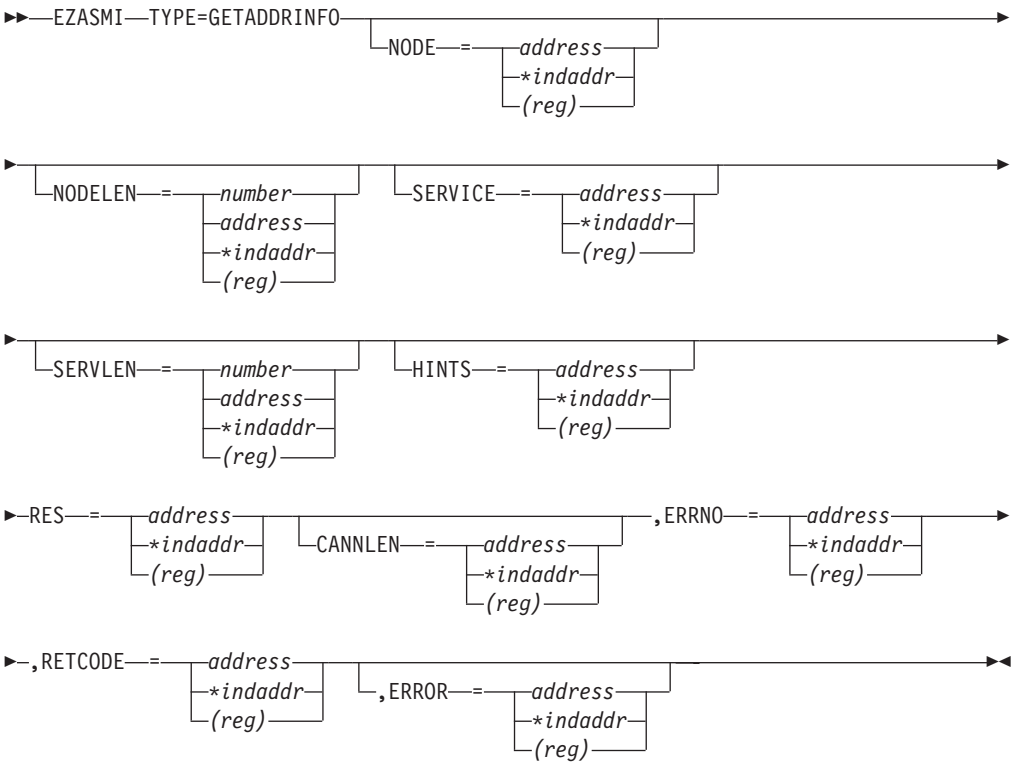
GETADDRINFO

The GETADDRINFO macro translates either the name of a service location (for example, a host name), a service name, or both, and returns a set of socket addresses and associated information to be used in creating a socket with which to address the specified service or sending a datagram to the specified service.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.

Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.



Keyword	Description
NODE	An input parameter. Storage up to 255 bytes long that contains the host name being queried. If the **AI_NUMERICHOST** flag is specified in the storage pointed to by the **HINTS** operand, then **NODE** should contain the queried host's IP address in network byte order presentation form. This is an optional field, but if specified you must also code **NODELEN**. The **NODE** name being queried consists of up to **NODELEN** or up to the first binary zero. You can append scope information to the host name by using the format *node%scope information*. The combined information must be 255 bytes or less. For more information, see *z/OS Communications Server: IPv6 Network and Application Design Guide*.
NODELEN	An input parameter. A fullword binary field set to the length of the

host name specified in the **NODE** field and should not include extraneous blanks. This is an optional field, but if specified you must also code **NODE**.

SERVICE An input parameter. Storage up to 32 bytes long that contains the service name being queried. If the **AI_NUMERICSERV** flag is specified in the storage pointed to by the **HINTS** operand, then **SERVICE** should contain the queried port number in presentation form. This is an optional field, but if specified you must also code **SERVLEN**. The **SERVICE** name being queried consists of up to **SERVLEN** or up to the first binary zero.

SERVLEN An input parameter. A fullword binary field set to the length of the service name specified in the **SERVICE** field and should not include extraneous blanks. This is an optional field but if specified you must also code **SERVICE**.

HINTS An input parameter. If the **HINTS** argument is specified, then it contains the address of an addrinfo structure containing input values that can direct the operation by providing options and limiting the returned information to a specific socket type, address family, or protocol. If the **HINTS** argument is not specified, then the information returned is as if it referred to a structure containing the value 0 for the **FLAGS**, **SOCTYPE** and **PROTO** fields, and **AF_UNSPEC** for the AF field. Include the **EZBREHST** Resolver macro to enable your program to contain the assembler mappings for the **ADDR_INFO** structure.

This is an optional field.

The address information structure has the following fields:

Field Description

FLAGS

A fullword binary field. Must have the value of 0 or the bitwise OR of one or more of the following values:

AI_PASSIVE (X'00000001')

- Specifies how to fill in the **NAME** pointed to in the returned **RES**. If this flag is specified, then the returned address information is suitable for use in binding a socket for accepting incoming connections for the specified service (that is the **TYPE=BIND** call). In this case, if the **NODE** argument is not specified, then the IP address portion of the socket address structure pointed to by the returned **RES** is set to **INADDR_ANY** for an IPv4 address or to the IPv6 unspecified address (in6addr_any) for an IPv6 address.
- If this flag is not set, the returned address information is suitable for the **TYPE=CONNECT** call (for a connection-mode protocol) or for a **TYPE=CONNECT**, **TYPE=SENDTO**, or **TYPE=SENDMSG** call (for a connectionless protocol). In this case, if the **NODE** argument is not specified, then the IP address portion of the socket address structure pointed to by the returned **RES** is set to the default loopback

address for an IPv4 address (127.0.0.0) or the default loopback address for an IPv6 address (::1).

- This flag is ignored if the **NODE** argument is specified.

AI_CANONNAMEOK (X'00000002')

- If this flag is specified and the **NODE** argument is specified, then the **TYPE=GETADDRINFO** call attempts to determine the canonical name corresponding to the **NODE** argument.

AI_NUMERICHOST (X'00000004')

- If this flag is specified then the **NODE** argument must be a numeric host address in presentation form. Otherwise, an error of host not found **[EAI_NONAME]** is returned.

AI_NUMERICSERV (X'00000008')

- If this flag is specified then the **SERVICE** argument must be a numeric port in presentation form. Otherwise, an error **[EAI_NONAME]** is returned.

AI_V4MAPPED (X'00000010')

- If this flag is specified along with the **AF** field with the value of **AF_INET6**, or a value of **AF_UNSPEC** when IPv6 is supported on the system, then the caller accepts IPv4-mapped IPv6 addresses. When the AI_ALL flag is not also specified and no IPv6 addresses are found, then a query is made for IPv4 addresses. If any IPv4 addresses are found, they are returned as IPv4-mapped IPv6 addresses.
- If the **AF** field does not have the value of **AF_INET6** or the **AF** field contains **AF_UNSPEC** but IPv6 is not supported on the system, this flag is ignored.

AI_ALL (X'00000020')

- When the **AF** field has a value of AF_INET6 and **AI_ALL** is set, the **AI_V4MAPPED** flag must also be set to indicate that the caller accepts all addresses (IPv6 and IPv4-mapped IPv6 addresses). When the **AF** field has a value of AF_UNSPEC when the system supports IPv6 and **AI_ALL** is set, the caller accepts IPv6 addresses and either IPv4 (if AI_V4MAPPED is not set) or IPv4-mapped IPv6 (if AI_V4MAPPED is set) addresses. A query is first made for IPv6 addresses and if successful, the IPv6 addresses are returned. Another query is then made for IPv4 addresses and any found are returned as IPv4 addresses (if AI_V4MAPPED was not set) or as IPv4-mapped IPv6 addresses (if AI_V4MAPPED was set).

- If the **AF** field does not have the value of **AF_INET6**, or the value of **AF_UNSPEC** when the system supports IPv6, the flag is ignored.

AI_ADDRCONFIG (X'00000040')
If this flag is specified, then a query for IPv6 on the **NODE** will occur if the Resolver determines whether either of the following is true:

- If the system is IPv6 enabled and has at least one IPv6 interface, the Resolver makes a query for IPv6 (AAAA or A6 DNS) records.
- If the system is IPv4 enabled and has at least one IPv4 interface, the Resolver makes a query for IPv4 (A DNS) records.

The loopback address is not considered in this case as a valid interface.

AI_EXTFLAGS (X'00000080') or a decimal value of 128
Requests the extended form of the getaddrinfo function. The extended form allows for additional hints to be passed to the resolver for determining the order of destination addresses that is returned. If this flag is specified, the EFLAGS field is required.

AF A fullword binary field. Used to limit the returned information to a specific address family. The value of **AF_UNSPEC** means that the caller accepts any protocol family. The value of a decimal 0 indicates **AF_UNSPEC**. The value of a decimal 2 indicates **AF_INET**, and the value of a decimal 19 indicates **AF_INET6**.

SOCTYPE

A fullword binary field. Used to limit the returned information to a specific socket type. A value of 0 means that the caller accepts any socket type. If a specific socket type is not given (for example, a value of 0), then information on all supported socket types is returned.

The following are the acceptable socket types:

Type name	Decimal value	Description
SOCK_STREAM	1	for stream socket
SOCK_DGRAM	2	for datagram socket
SOCK_RAW	3	for raw-protocol interface

Anything else will fail with return code **EAI_SOCKTYPE**. Note that although **SOCK_RAW** is accepted, it is valid only when **SERVICE** is numeric (for example, **SERVICE**=23). A lookup for a **SERVICE** name will never occur in the appropriate services file (for example, *hlq*.**ETC.SERVICES**) using any protocol value other than SOCK_STREAM or SOCK_DGRAM.

If **PROTO** is not 0 and **SOCTYPE** is 0, then the only acceptable input values for **PROTO** are **IPPROTO_TCP**

and **IPPROTO_UDP**. Otherwise, the **TYPE=GETADDRINFO** fails with return code **EAI_BADFLAGS**.

If **SOCTYPE** and **PROTO** are both specified as 0 then **TYPE=GETADDRINFO** proceeds as follows:

- If **SERVICE** is null, or if **SERVICE** is numeric, then any returned addrinfos defaults to a specification of **SOCTYPE** as **SOCK_STREAM**.
- If **SERVICE** is specified as a service name (for example, **SERVICE=FTP**), then **TYPE=GETADDRINFO** searches the appropriate services file (such as, *hlq*.**ETC.SERVICES**) twice. The first search uses **SOCK_STREAM** as the protocol, and the second search uses SOCK_DGRAM as the protocol. No default socket type provision exists in this case.

If both **SOCTYPE** and **PROTO** are specified as a value other than 0 then they should be compatible, regardless of the value specified by **SERVICE**. In this context, *compatible* means one of the following:

- SOCTYPE=SOCK_STREAM and PROTO=IPPROTO_TCP
- SOCTYPE=SOCK_DGRAM and PROTO=IPPROTO_UDP
- SOCTYPE=SOCK_RAW and PROTO can be anything

PROTO

A fullword binary field. Used to limit the returned information to a specific protocol. A value of 0 means that the caller accepts any protocol.

The following are the acceptable protocols:

Protocol name	Decimal value	Description
IPPROTO_TCP	6	TCP
IPPROTO_UDP	17	user datagram

If **SOCKTYPE** is 0 and **PROTO** is not 0, then the only acceptable input values for **PROTO** are **IPPROTO_TCP** and **IPPROTO_UDP**. Otherwise, the **TYPE=GETADDRINFO** is failed with return code **EAI_BADFLAGS**.

If **PROTO** and **SOCKTYPE** are both specified as 0, then **TYPE=GETADDRINFO** proceeds as follows:

- If **SERVICE** is null, or if **SERVICE** is numeric, then any returned addrinfos default to a specification of **SOCKTYPE** as **SOCK_STREAM**.
- If **SERVICE** is specified as a service name (for example, **SERVICE=FTP**), then **TYPE=GETADDRINFO** searches the appropriate services file (such as, *hlq*.**ETC.SERVICES**) twice. The first search uses **SOCK_STREAM** as the protocol, and the second search uses **SOCK_DGRAM** as the protocol. No default socket type provision exists in this case.

If both **PROTO** and **SOCKTYPE** are specified as nonzero, then they should be compatible, regardless of the value specified by **SERVICE**. In this context, compatible means one of the following:

- SOCTYPE=SOCK_STREAM and PROTO=IPPROTO_TCP
- SOCTYPE=SOC_DGRAM and PROTO=IPPROTO_UDP
- SOCTYPE=SOCK_RAW and PROTO can be anything

If the lookup for the value specified in **SERVICE** fails [that is, the service name does not appear in the appropriate services file (for example, *hlq*.**ETC.SERVICES**) using the input protocol], then the **TYPE=GETADDRINFO** fails with return code **EAI_SERVICE**.

NAMELEN
A fullword binary field followed by 8 padding bytes. This field must be 0.

CANONNAME
A fullword binary field followed by 4 padding bytes. This field must be 0.

NAME
A fullword binary field followed by 4 padding bytes. This field must be 0.

NEXT A fullword binary field. This field must be 0.

EFLAGS
A fullword binary field that specifies the source IPv6 address selection preferences. This field is required if AI_EXTFLAGS is specified in the FLAGS field.

This field must contain the value 0 or the bitwise OR of one or more of the following values:

IPV6_PREFER_SRC_HOME (X'00000001') or the decimal value 1
Indicates that home source IPv6 addresses are preferred over care-of source IPv6 addresses.

IPV6_PREFER_SRC_COA (X'00000002') or the decimal value 2
Indicates that care-of source IPv6 addresses are preferred over home source IPv6 addresses.

IPV6_PREFER_SRC_TMP (X'00000004') or the decimal value 4
Indicates that temporary source IPv6 addresses are preferred over public source IPv6 addresses.

IPV6_PREFER_SRC_PUBLIC (X'00000008') or the decimal value 8
Indicates that public source IPv6 addresses are preferred over temporary source IPv6 addresses.

IPV6_PREFER_SRC_CGA (X'00000010') or the decimal value 16
Indicates that cryptographically generated source

IPv6 addresses are preferred over non-cryptographically generated source IPv6 addresses.

IPV6_PREFER_SRC_NONCGA (X'00000020') or the decimal value 32
Indicates that non-cryptographically generated source IPv6 addresses are preferred over crytographically generated source IPv6 addresses.

If contradictory EFLAGS (for example, IPV6_PREFER_SRC_TMP and IPV6_PREFER_SRC_PUBLIC) or invalid EFLAGS (for example, X'00000040' or a decimal value 64) are specified, then the GETADDRINFO call fails with RETCODE -1 and ERRNO EAI_BADEXTFLAGS (decimal value 11).

RES

Initially a fullword binary field. On a successful return, this field contains a pointer to a chain of one or more address information structures. Use the EZBREHST macro to establish address information mapping. The structures are allocated in the key of the calling application. The structures that are returned by a TYPE=GETADDRINFO call are serially reusable storage for the z/OS UNIX process. They can be used or referenced between process threads, but should not be used or referenced between processes. When you finish using the structures, explicitly release their storage by specifying the returned pointer on a TYPE=FREEADDRINFO call.

The address information structure contains the following fields. All fields in this structure that are not filled in with an explicit value are set to 0:

Field Description

FLAGS
A fullword binary field that is not used as output.

AF A fullword binary field. The value returned in this field can be used as the **AF=** argument on the **TYPE=SOCKET** macro to create a socket suitable for use with the returned address **NAME**.

SOCTYPE
A fullword binary field. The value returned in this field can be used as the **SOCTYPE=** argument on the **TYPE=SOCKET** macro to create a socket suitable for use with the returned address **NAME**.

PROTO
A fullword binary field. The value returned in this field can be used as the **PROTO=** argument on the **TYPE=SOCKET** macro to create a socket suitable for use with the returned address **NAME**.

NAMELEN
A fullword binary field followed by 8 padding bytes. The length of the **NAME** socket address structure. The value returned in this field can be used as the arguments for the

TYPE=CONNECT or **TYPE=BIND** macros with such a socket, according to the **AI_PASSIVE** flag.

CANONNAME
A fullword binary field followed by 4 padding bytes. The address of storage containing the canonical name for the value specified by **NODE**. Initially, this field must be 0. If the **NODE** argument is specified, and if the **AI_CANONNAMEOK** flag was specified by the **HINTS** argument, then the **CANONNAME** field in the first returned address information structure contains the address of storage containing the canonical name corresponding to the input **NODE** argument. If the canonical name is not available, then the **CANONNAME** field refers to the **NODE** argument or a string with the same contents. The **CANNLEN** field contains the length of the returned canonical name.

NAME
A fullword binary field followed by 4 padding bytes. The address of the returned socket address structure. The value returned in this field can be used as the arguments for the **TYPE=CONNECT** or **TYPE=BIND** macros with such a socket, according to the **AI_PASSIVE** flag.

NEXT A fullword binary field. Contains the address of the next address information structure on the list, or 0's if it is the last structure on the list.

EFLAGS
A fullword binary field that is not used as output.

CANNLEN Initially an input parameter. A fullword binary field used to contain the length of the canonical name returned by the **RES CANONNAME** field. This is an optional field.

ERRNO Output parameter. A fullword binary field. If **RETCODE** is negative, **ERRNO** contains a valid error number. Otherwise, ignore the **ERRNO** field.

See Appendix B, "Socket call error return codes," on page 885 for information about **ERRNO** return codes.

RETCODE Output parameter. A fullword binary field that returns one of the following:

Value	Description
0	Successful call.
–1	Check **ERRNO** for an error code.

ERROR Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

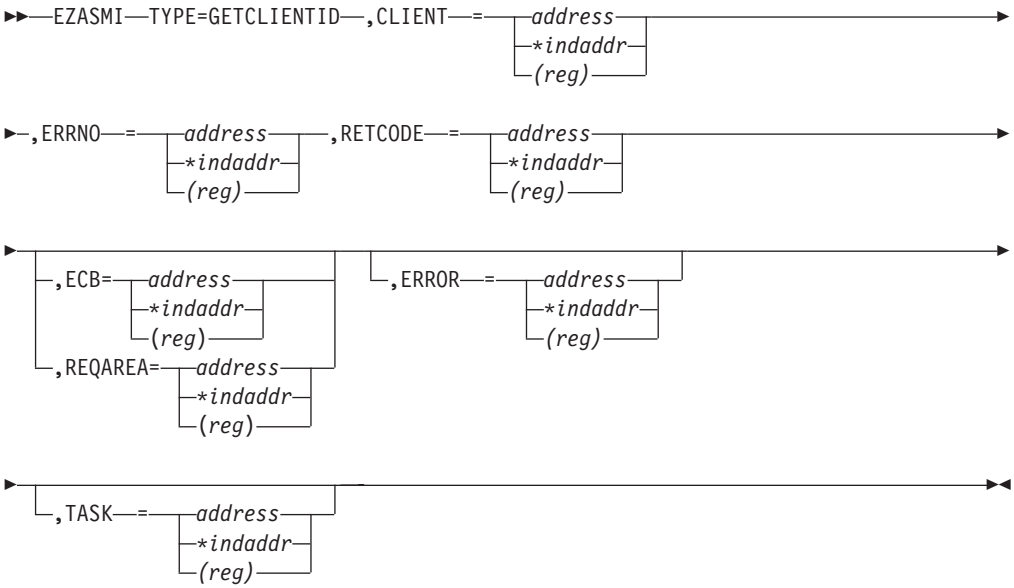
GETCLIENTID

The GETCLIENTID macro returns the identifier by which the calling application is known to the TCP/IP address space. The client ID structure returned is used by the GIVESOCKET and TAKESOCKET macros.

When GETCLIENTID is called by a server or client, the identifier of the calling application is returned.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.



Keyword **Description**

CLIENT Input/Output parameter. A client ID structure describing the identifier for your application, regardless whether a server or client.

Field **Description**

DOMAIN
A fullword binary number specifying the domain of the client. On input, this is an optional parameter for AF_INET, and a required parameter for AF_INET6 to specify the domain of the client. For TCP/IP, the value is a decimal 2 indicating AF_INET, or decimal 19 indicating AF_INET6. On output, this is the returned domain of the client.

NAME
An 8-byte character field that is filled, on completion of the call, with the client address space identifier.

TASK Output parameter. An 8-byte field set to the client task identifier.

RESERVED
Output parameter. Specifies 20 bytes of binary zeros. This field is required, but it is not used.

ERRNO Output parameter. A fullword binary field. If **RETCODE** is negative, **ERRNO** contains a valid error number. Otherwise, ignore **ERRNO**.

See Appendix B, "Socket call error return codes," on page 885 for information about **ERRNO** return codes.

RETCODE Output parameter. A fullword binary field that returns one of the following:

Value	Description
0	Successful call.
−1	Check **ERRNO** for an error code.

ECB or REQAREA
Input parameter. This parameter is required if you are using APITYPE=3. It points to a 104-byte field containing:

For ECB
A 4-byte **ECB** posted by TCP/IP when the macro completes.

For REQAREA
A 4-byte user token (set by you) that is presented to your exit when the response to this function request is complete.

For ECB/REQAREA
The last 100 bytes is a storage field used by the interface to save the state information.

Note: This storage must not be modified until the macro function has completed and the **ECB** has been posted, or the asynchronous exit has been driven.

ERROR Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

TASK Input parameter. The location of the task storage area in your program.

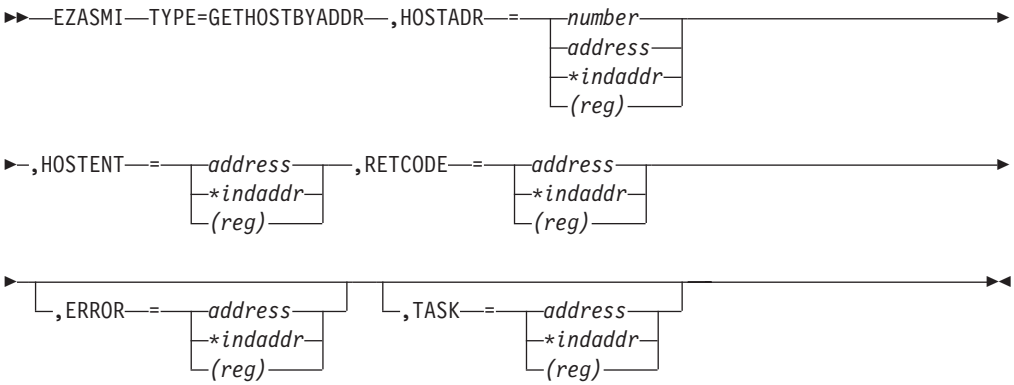
GETHOSTBYADDR

The GETHOSTBYADDR macro returns domain and alias names of the host whose IPv4 Internet address is specified by the macro. A TCP/IP host can have multiple alias names and host IPv4 Internet addresses.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state. The PSW key must match the key in which the MVS application task was attached.

Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.



Note: The storage for the HOSTENT structure returned by this call is released during TERMAPI processing; therefore, the application program must not use the HOSTENT storage after the TERMAPI.

Keyword	Description
HOSTADR	Input parameter. A fullword unsigned binary field set to the Internet address of the host whose name you want to find.
HOSTENT	Input parameter. A fullword containing the address of the HOSTENT structure returned by the macro. For information about the HOSTENT structure, see Figure 64 on page 302.
RETCODE	Output parameter. A fullword binary field that returns one of the following: **Value** **Description** **>0** Successful call. **−1** An error occurred.
ERROR	Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.
TASK	Input parameter. The location of the task storage area in your program.

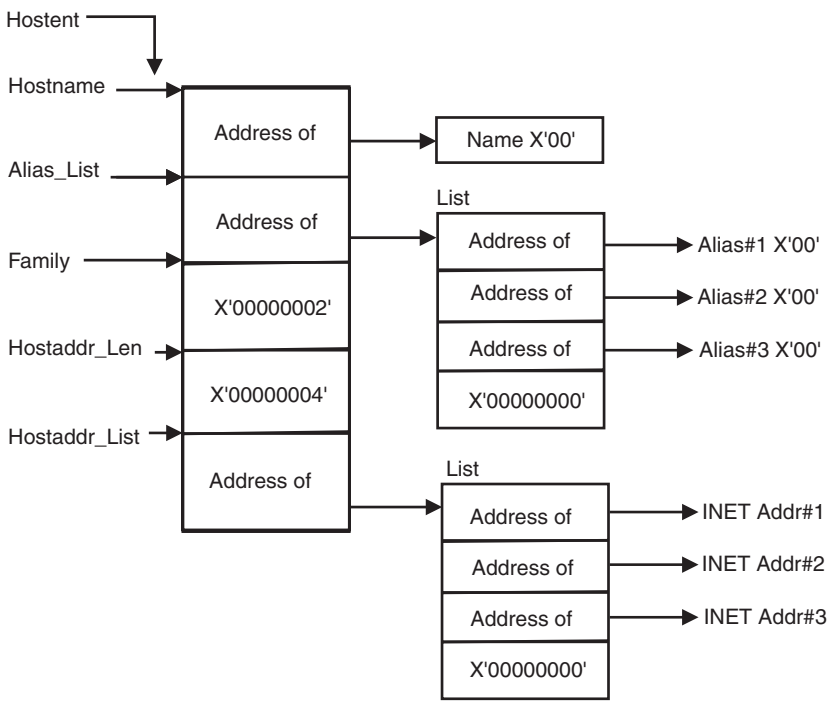


Figure 64. HOSTENT structure returned by the GETHOSTBYADDR macro

GETHOSTBYADDR returns the HOSTENT structure shown in Figure 64. The HOSTENT structure is a tasks's serially reusable storage area. It should not be used or referenced between MVS tasks. The storage is freed when the task terminates. The assembler mapping of the structure is defined in macro EZBREHST, which is installed in the data set specified on your SMP/E DDDEF for MACLIB. This structure contains:

- The address of the host name returned by the macro. The name length is variable and is ended by X'00'.
- The address of a list of addresses that point to the alias names returned by the GETHOSTBYADDR. This list is ended by the pointer X'00000000'. Each alias name is a variable length field ended by X'00'.
- The value returned in the FAMILY field is always 2 to signify AF_INET.
- The length of the host Internet address returned in the HOSTADDR_LEN field is always 4 to signify AF_INET.
- The address of a list of addresses that point to the host Internet addresses returned by the macro. The list is ended by the pointer X'00000000'.

The HOSTENT structure uses indirect addressing to return a variable number of alias names and Internet addresses.

GETHOSTBYNAME

The GETHOSTBYNAME macro returns the alias names and the IPv4 Internet addresses of a host whose domain name is specified in the macro.

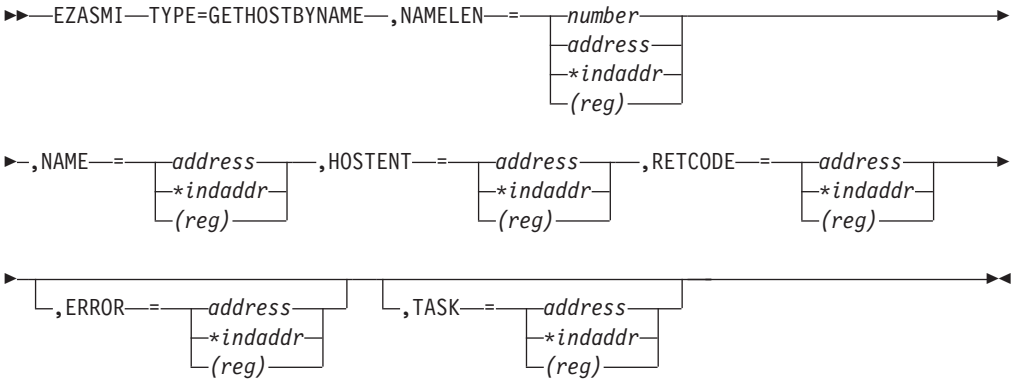
The name resolution attempted depends on how the resolver is configured and if any local host tables exist. See *z/OS Communications Server: IP Configuration Guide* for information about configuring the resolver and using local host tables.

If the host name is not found, the return code is -1.

Important: Repeated use of GETHOSTBYNAME before calls which implicitly or explicitly invoke INITAPI can result in the allocation of unreleased storage.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state. The PSW key must match the key in which the MVS application task was attached.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.



Note: The storage for the HOSTENT structure returned by this call is released during TERMAPI processing; therefore, the application program must not use the HOSTENT storage after the TERMAPI.

Keyword	Description
NAMELEN	Input parameter. A value or the address of a fullword binary field specifying the length of the name and alias fields. This length has a maximum value of 255 bytes.
NAME	A character string, up to 255 characters, set to a host name. This call returns the address of HOSTENT for this name. Any trailing blanks are removed from the specified name prior to trying to resolve it to an IP address.
HOSTENT	Output parameter. A fullword word containing the address of HOSTENT returned by the macro. For information about the HOSTENT structure, see Figure 65 on page 304.

RETCODE A fullword binary field that returns one of the following:

Value	Description
0	Successful call.
–1	An error occurred.

ERROR Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

TASK Input parameter. The location of the task storage area in your program.

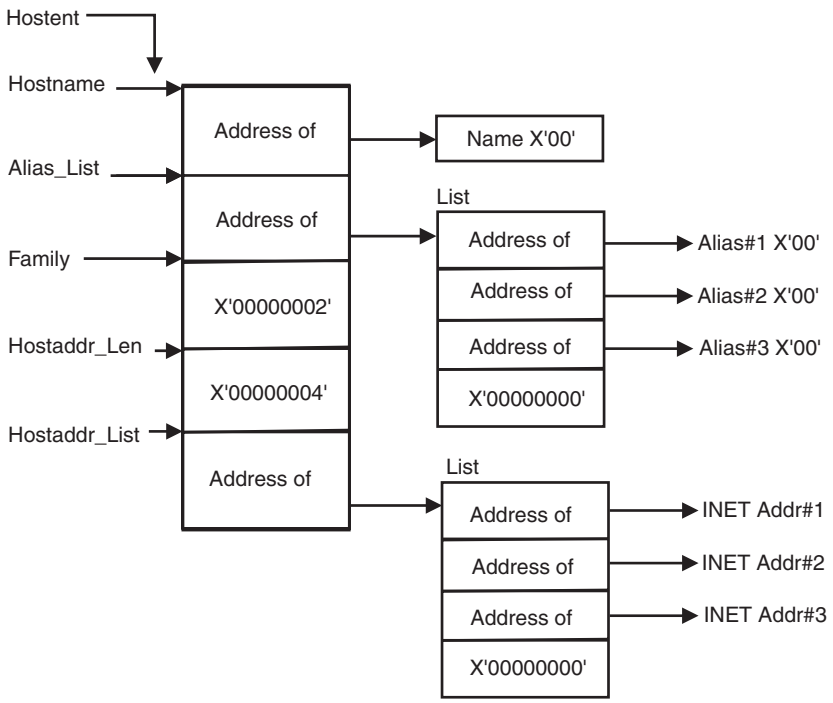


Figure 65. HOSTENT structure returned by the GETHOSTBYNAME macro

GETHOSTBYNAME returns the HOSTENT structure shown in Figure 65. The HOSTENT structure is a tasks's serially reusable storage area. It should not be used or referenced between MVS tasks. The storage is freed when the task terminates. The assembler mapping of the structure is defined in macro EZBREHST, which is installed in the data set specified on your SMP/E DDDEF for MACLIB. This structure contains:

- The address of the host name returned by the macro. The name length is variable and is ended by X'00'.
- The address of a list of addresses that point to the alias names returned by GETHOSTBYNAME. This list is ended by the pointer X'00000000'. Each alias name is a variable length field ended by X'00'.
- The value returned in the FAMILY field is always 2 to signify AF_INET.
- The length of the host Internet address returned in the HOSTADDR_LEN field is always 4 to signify AF_INET.
- The address of a list of addresses that point to the host Internet addresses returned by the macro. The list is ended by the pointer X'00000000'.

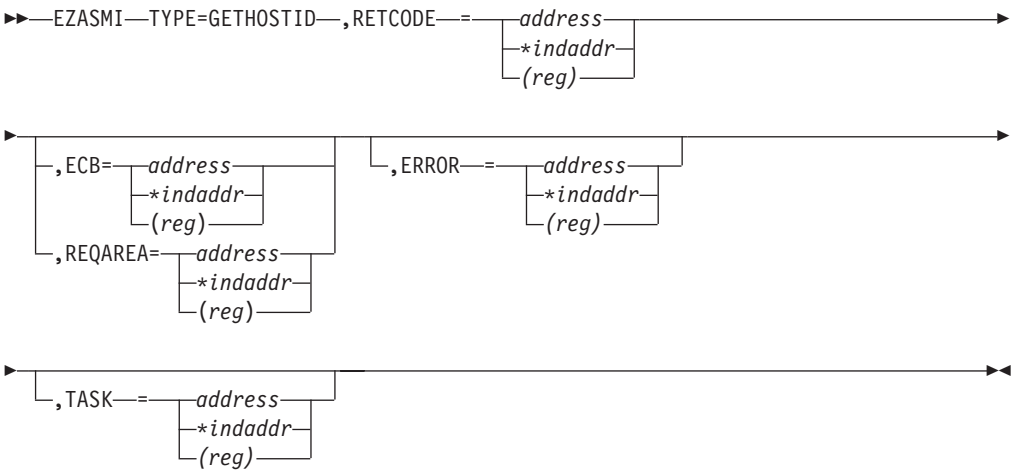
The HOSTENT structure uses indirect addressing to return a variable number of alias names and Internet addresses.

GETHOSTID

The GETHOSTID macro returns the 32-bit identifier for the current host. This value is the default home Internet address.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.



Keyword **Description**

RETCODE Output parameter. Returns a fullword binary field containing the 32-bit Internet address of the host. A -1 in **RETCODE** indicates an error. There is no **ERRNO** parameter for this macro.

ECB or REQAREA

Input parameter. This parameter is required if you are using APITYPE=3. It points to a 104-byte field containing:

For ECB

A 4-byte **ECB** posted by TCP/IP when the macro completes.

For REQAREA
A 4-byte user token (set by you) that is presented to your exit when the response to this function request is complete.

For ECB/REQAREA
The last 100 bytes is a storage field used by the interface to save the state information.

Note: This storage must not be modified until the macro function has completed and the **ECB** has been posted, or the asynchronous exit has been driven.

ERROR Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

TASK Input parameter. The location of the task storage area in your program.

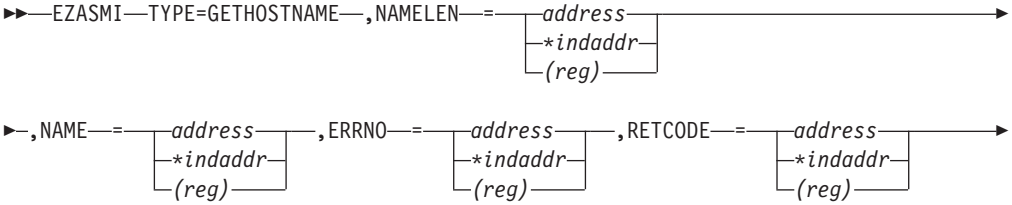
GETHOSTNAME

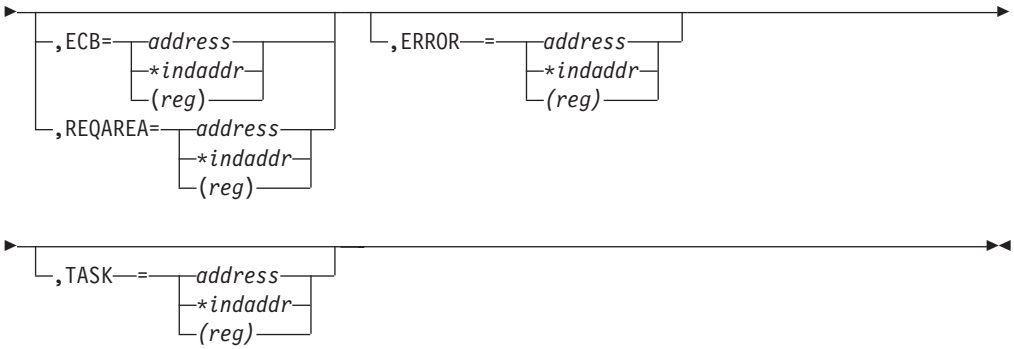
The GETHOSTNAME macro returns the name of the host processor on which the program is running. As many as NAMELEN characters are copied into the NAME field.

Note: The host name that is returned is the host name the TCPIP stack learned at startup from the TCPIP.DATA file that was found. For more information about host name, see HOSTNAME statement in *z/OS Communications Server: IP Configuration Reference*.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.





Keyword	Description
NAMELEN	Input parameter. A fullword set to a value or the address of a fullword binary field set to the length of the name field. The minimum length of the NAME field is 1 character. The maximum length of the NAME field is 255 characters.
NAME	The application provides a pointer to a receiving field for the host name. If the host name is shorter than the NAMELEN value, the NAME field is filled with binary zeros after the host name. If the host name is longer than the NAMELEN value, the name is truncated.
ERRNO	Output parameter. A fullword binary field. If **RETCODE** is negative, **ERRNO** contains a valid error number. Otherwise, ignore **ERRNO**. See Appendix B, "Socket call error return codes," on page 885 for information about **ERRNO** return codes.
RETCODE	Output parameter. A fullword binary field that returns one of the following: **Value** **Description** **0** Successful call. **−1** An error occurred.

ECB or REQAREA

Input parameter. This parameter is required if you are using APITYPE=3. It points to a 104-byte field containing:

For ECB

A 4-byte **ECB** posted by TCP/IP when the macro completes.

For REQAREA

A 4-byte user token (set by you) that is presented to your exit when the response to this function request is complete.

For ECB/REQAREA

The last 100 bytes is a storage field used by the interface to save the state information.

Note: This storage must not be modified until the macro function has completed and the **ECB** has been posted, or the asynchronous exit has been driven.

ERROR Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

TASK Input parameter. The location of the task storage area in your program.

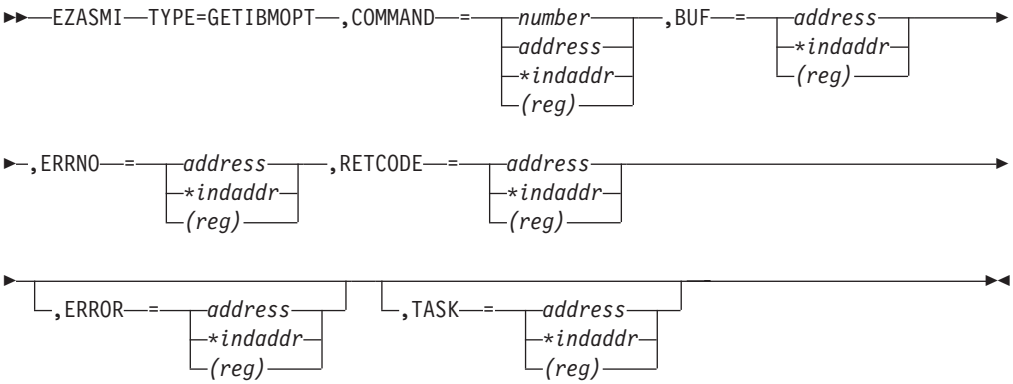
GETIBMOPT

The GETIBMOPT macro returns the number of TCP/IP images installed on a given MVS system and the status, version, and name of each image. With this information, the caller can dynamically choose the TCP/IP image with which to connect, using the INITAPI macro. The GETIBMOPT macro is optional. If you do not use this macro, follow the standard method to determine the connecting TCP/IP image:

1. Connect to the TCP/IP specified by TCPIPJOBNAME in the active TCPIP.DATA file.
2. Locate TCPIP.DATA using the search order described in the *z/OS Communications Server: IP Configuration Reference*.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.



Keyword **Description**

COMMAND Input parameter. A value or the address of a fullword binary number specifying the command to be processed. The only valid value is 1.

BUF Output parameter. A 100-byte buffer into which each active TCP/IP image status, version, and name are placed.

On successful return, these buffer entries contain the status, name and version of up to eight active TCP/IP images. The following layout shows BUF upon completion of the call.

NUM_IMAGES (4 bytes)		
Status (2 bytes)	Version (2 bytes)	Name (8 bytes)
Status (2 bytes)	**Version (2 bytes)**	**Name (8 bytes)**
Status (2 bytes)	**Version (2 bytes)**	**Name (8 bytes)**
Status (2 bytes)	**Version (2 bytes)**	**Name (8 bytes)**
Status (2 bytes)	**Version (2 bytes)**	**Name (8 bytes)**
Status (2 bytes)	**Version (2 bytes)**	**Name (8 bytes)**
Status (2 bytes)	**Version (2 bytes)**	**Name (8 bytes)**
Status (2 bytes)	**Version (2 bytes)**	**Name (8 bytes)**

Figure 66. NUM_IMAGES field settings

The NUM_IMAGES field indicates how many entries of TCP_IMAGE are included in the total BUF field. If the NUM_IMAGES returned is 0, there are no TCP/IP images present.

The status field can combine the following information:

Status Field	Meaning
X'8xxx'	Active
X'4xxx'	Terminating
X'2xxx'	Down
X'1xxx'	Stopped or stopping

Note: In the above status fields, *xxx* is reserved for IBM use and can contain any value.

When the status field returns Down and Stopped, TCP/IP abended. Stopped, returned alone, indicates that TCP/IP was stopped. The version field is:

Version	Field
TCP/IP z/OS Communications Server V1R4	X'0614'
TCP/IP z/OS Communications Server V1R5	X'0615'
TCP/IP z/OS Communications Server V1R6	X'0616'

Version	Field
TCP/IP z/OS Communications Server V1R7	X'0617'
TCP/IP z/OS Communications Server V1R8	X'0618'
TCP/IP z/OS Communications Server V1R9	X'0619'
TCP/IP z/OS Communications Server V1R10	X'061A'
TCP/IP z/OS Communications Server V1R11	X'061B'

The name field is the PROC name, left-aligned, and padded with blanks.

ERRNO
Output parameter. A fullword binary field. If **RETCODE** is negative, **ERRNO** contains a valid error number. Otherwise, ignore **ERRNO**.

See Appendix B, "Socket call error return codes," on page 885 for information about **ERRNO** return codes.

RETCODE
Output parameter. A fullword binary field with the following values:

Value	Description
-1	Call returned error. See **ERRNO**.
>=0	Successful call.

ERROR
Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

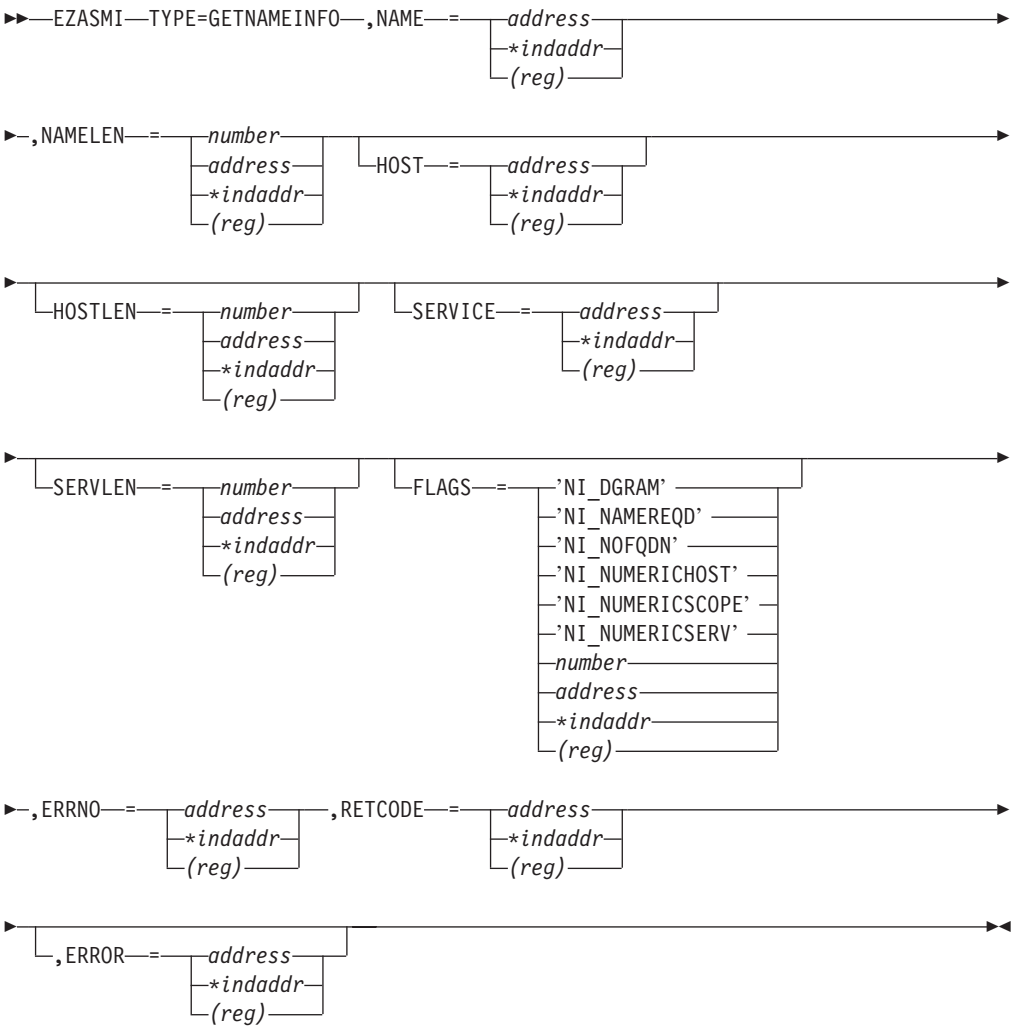
TASK Input parameter. The location of the task storage area in your program.

GETNAMEINFO

The **GETNAMEINFO** macro returns the node name and service location of a socket address that is specified in the macro. On successful completion, **GETNAMEINFO** returns the node and service named, if requested, in the buffers provided.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.



Keyword **Description**

NAME

An input parameter. An IPv4 or IPv6 socket address structure to be translated. Include the **SYS1.MACLIB(BPXYSOCK)** macro to get the assembler mappings for the socket address structure. The socket address structure mappings begin at the SOCKADDR label. The **AF_INET** socket address structure fields start at the **SOCK_SIN** label. The **AF_INET6** socket address structure fields start at the **SOCK_SIN6** label.

The IPv4 socket address structure must specify the following fields:

Field **Description**

FAMILY
A halfword binary number specifying the IPv4 addressing family. For TCP/IP the value is a decimal 2, indicating **AF_INET**.

PORT A halfword binary number specifying the port number.

IPv4–ADDRESS
A fullword binary number specifying the 32-bit IPv4 Internet address.

RESERVED
An 8-byte reserved field. This field is required, but is not used.

The IPv6 socket address structure specifies the following fields:

Field Description

NAMELEN
A 1-byte binary field that specifies the length of the IPv6 socket address structure. Any value specified by the use of this field is ignored when processed as input. The field is set to 0 when processed as output.

FAMILY
A 1-byte binary field that specifies the IPv6 addressing family. For TCP/IP the value is a decimal 19, indicating **AF_INET6**.

PORT A halfword binary number that specifies the port number.

FLOW-INFO
This field is ignored by the TYPE=GETNAMEINFO macro.

IPv6–ADDRESS
A 16-byte binary field that specifies the 128-bit IPv6 Internet address, in network byte order.

SCOPE-ID
A fullword binary field that specifies the scope for an IPv6 address as an interface index. The resolver ignores the SCOPE_ID field, unless the address in IPv6-ADDRESS is a link-local address and the HOST parameter also is specified.

NAMELEN An input parameter. A fullword binary field. The length of the socket address structure pointed to by the **NAME** argument.

HOST On input, storage capable of holding the returned resolved host name, which can be up to 255 bytes long, for the input socket address. If inadequate storage is specified to contain the resolved host name, then the resolver returns the host name up to the storage specified and truncation might occur. If the host's name cannot be located, the numeric form of the host's address is returned instead of its name. However, if the NI_NAMEREQD option is specified and no host name is located, an error is returned. One or both of the following groups of parameters are required:

- The HOST and HOSTLEN parameters
- The SERVICE and SERVLEN parameters

Otherwise, an error occurs. The HOST name being queried consists of up to HOSTLEN or up to the first binary 0.

If the IPv6-ADDRESS value is a link-local address, and the SCOPE_ID interface index is nonzero, scope information is appended to the resolved host name using the format *host%scope information*. The scope information can be the numeric form of the SCOPE_ID interface index or the interface name that is associated with the SCOPE_ID interface index. Use the NI_NUMERICSCOPE option to select which form is returned. The combined host name

and scope information is 255 bytes or less. For more information about scope information and TYPE=GETNAMEINFO processing, see *z/OS Communications Server: IPv6 Network and Application Design Guide*.

HOSTLEN Initially an input parameter. A fullword binary field that contains the length of the host storage that is used to contain the returned resolved host name. If HOSTLEN is 0 on input, then the resolved host name is not returned. The HOSTLEN value must be equal to or greater than the length of the longest host name, or hostname and scope information combination, to be returned. The TYPE=GETNAMEINFO returns the host name, or host name and scope information combination, up to the length specified by the HOSTLEN value. On output, HOSTLEN contains the length of the returned resolved host name, or host name and scope information combination. This is an optional field, but if you specify this field, you also must code the HOST value. One or both of the following groups of parameters are required:

- The HOST and HOSTLEN parameters
- The SERVICE and SERVLEN parameters

Otherwise, an error occurs.

SERVICE On input, storage capable of holding the returned resolved service name, which can be up to 32 bytes long, for the input socket address. If inadequate storage is specified to contain the resolved service name, then the resolver returns the service name up to the storage specified and truncation might occur. If the service name cannot be located, or if NI_NUMERICSERV was specified in the FLAGS operand, then the presentation form of the service address is returned instead of its name. This is an optional field, but if you specify this field, you also must code the SERVLEN parameter. The SERVICE name being queried consists of up to SERVLEN or up to the first binary zero. One or both of the following groups of parameters are required:

- The HOST and HOSTLEN parameters
- The SERVICE and SERVLEN parameters

Otherwise, an error occurs.

SERVLEN Initially an input parameter. A fullword binary field that contains the length of the SERVICE storage used to contain the returned resolved service name. If SERVLEN is 0 on input, then the service name information is not returned. SERVLEN must be equal to or greater than the length of the longest service name to be returned. The TYPE=GETNAMEINFO returns the service name up to the length specified by SERVLEN. On output, SERVLEN contains the length of the returned resolved service name. This is an optional field, but if you specify it, you also must code the SERVICE parameter. One or both of the following groups of parameters are required:

- The HOST and HOSTLEN parameters
- The SERVICE and SERVLEN parameters

Otherwise, an error occurs.

FLAGS An input parameter. A fullword binary field. This is an optional field. The FLAGS argument can be a literal value or a fullword

binary field:

Literal Value	Binary Value	Decimal Value	Description
'NI_NOFQDN'	X'00000001'	1	Return the NAME portion of the fully qualified domain name.
'NI_NUMERICHOST'	X'00000002'	2	Only return the numeric form of host's address.
'NI_NAMEREQD'	X'00000004'	4	Return an error if the host's name cannot be located.
'NI_NUMERICSERV'	X'00000008'	8	Only return the numeric form of the service address.
'NI_DGRAM'	X'00000010'	16	Indicates that the service is a datagram service. The default behavior is to assume that the service is a stream service.
'NI_NUMERICSCOPE'	X'00000020'	32	Only return the numeric form of the SCOPE-ID interface index, if applicable.

ERRNO Output parameter. A fullword binary field. If **RETCODE** is negative, **ERRNO** contains a valid error number. Otherwise, ignore the **ERRNO** field.

See Appendix B, "Socket call error return codes," on page 885 for information about **ERRNO** return codes.

RETCODE Output parameter. A fullword binary field that returns one of the following:

Value	Description
0	Successful call.
–1	Check **ERRNO** for an error code.

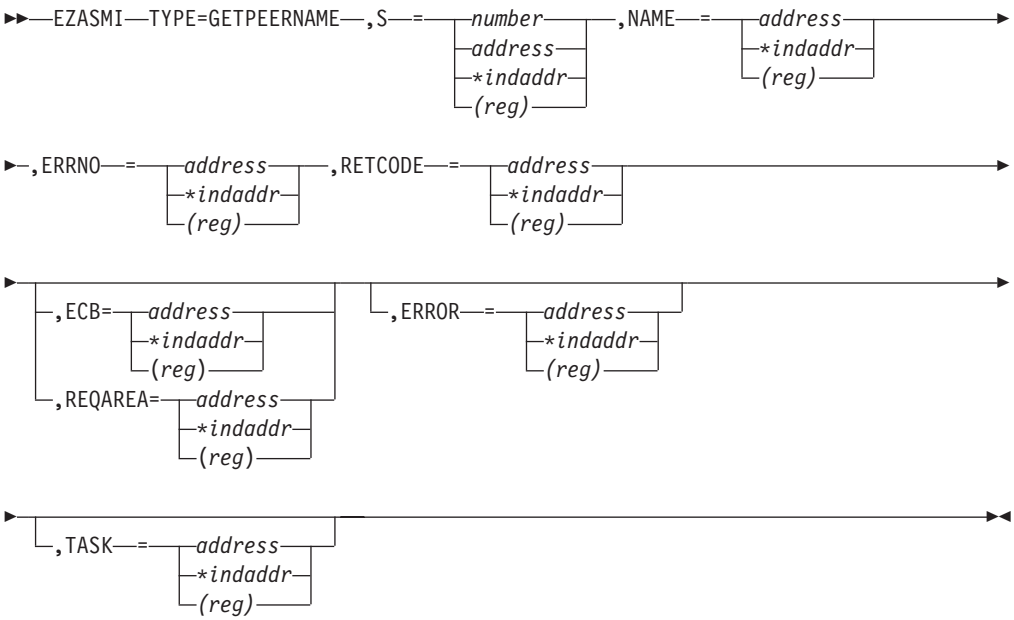
ERROR Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

GETPEERNAME

The GETPEERNAME macro returns the name of the remote socket to which the local socket is connected.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.



Keyword **Description**

S A value or the address of a halfword binary number specifying the local socket connected to the remote peer whose address is required.

NAME

Initially points to the peer name structure. It is filled when the call completes with the IPv4 or IPv6 address structure for the remote socket connected to the local socket, specified by **S**. Include the SYS1.MACLIB(BPXYSOCK) macro to get the assembler mappings for the socket address structure. The socket address structure mappings begin at the SOCKADDR label. The AF_INET socket address structure fields start at the SOCK_SIN label. The AF_INET6 socket address structure fields start at the SOCK_SIN6 label.

The IPv4 socket address structure must specify the following fields:

Field **Description**

FAMILY
A halfword binary field set to the connection peer IPv4 addressing family. The IPv4 value is always a decimal 2, indicating AF_INET.

PORT A halfword binary field set to the connection peer port number.

IPv4-ADDRESS
A fullword binary field set to the 32-bit IPv4 Internet address of the connection peer host machine.

RESERVED
Input parameter. Specifies an 8-byte reserved field. This field is required, but not used.

The IPv6 socket structure must specify the following fields:

Field **Description**

NAMELEN
A 1-byte binary field specifying the length of this IPv6 socket address structure. Any value specified by the use of this field is ignored when processed as input and the field is set to 0 when processed as output.

FAMILY
A 1-byte binary field specifying the IPv6 addressing family. For IPv6 the value is a decimal 19, indicating AF_INET6.

PORT A halfword binary field set to the connection peer port number.

FLOW-INFO
A fullword binary field specifying the traffic class and flow label. This value of this field is undefined.

IPv6-ADDRESS
A 16-byte binary field that is set to the 128-bit IPv6 Internet address, in network byte order, of the connection peer host machine.

SCOPE-ID
A fullword binary field which identifies a set of interfaces as appropriate for the scope of the address carried in the **IPv6-ADDRESS** field. For a link scope **IPv6-ADDRESS**, **SCOPE-ID** contains the link index for the **IPv6-ADDRESS**. For all other address scopes, **SCOPE-ID** is undefined.

ERRNO Output parameter. A fullword binary field. If **RETCODE** is negative, this field contains an error number. See Appendix B, "Socket call error return codes," on page 885 for information about **ERRNO** return codes.

RETCODE Output parameter. A fullword binary field.

Value	Description
0	Successful call.
−1	An error occurred.

ECB or REQAREA
Input parameter. This parameter is required if you are using APITYPE=3. It points to a 104-byte field containing:

For ECB
A 4-byte **ECB** posted by TCP/IP when the macro completes.

For REQAREA
A 4-byte user token (set by you) that is presented to your exit when the response to this function request is complete.

For ECB/REQAREA
The last 100 bytes is a storage field used by the interface to save the state information.

Note: This storage must not be modified until the macro function has completed and the **ECB** has been posted, or the asynchronous exit has been driven.

ERROR Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

TASK Input parameter. The location of the task storage area in your program.

GETSOCKNAME

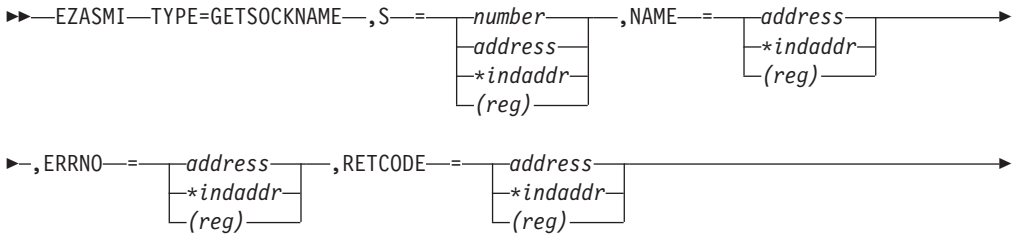
The GETSOCKNAME macro stores the name of the socket into the structure pointed to by NAME and returns the address to the socket that has been bound. If the socket is not bound to an address, the macro returns with the FAMILY field completed and the rest of the structure set to zeros.

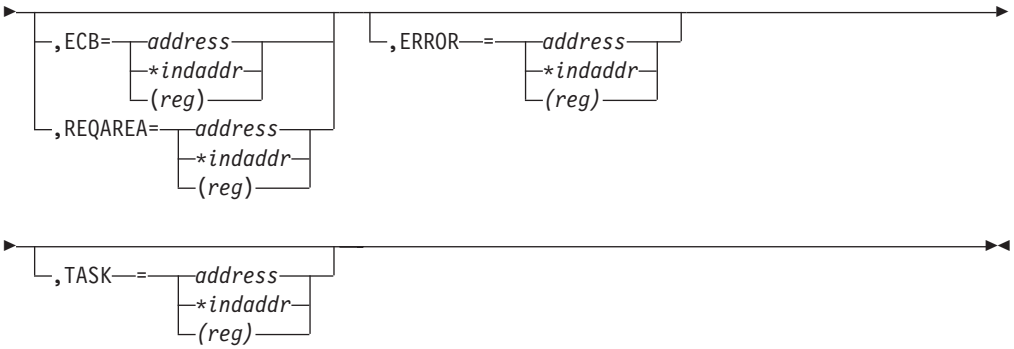
Stream sockets are not assigned a name until after a successful call to BIND, CONNECT, or ACCEPT.

Use the GETSOCKNAME macro to determine the port assigned to a socket after that socket has been implicitly bound to a port. If an application calls CONNECT without previously calling BIND, the CONNECT macro completes the binding necessary by assigning a port to the socket. You can determine the port assigned to the socket by issuing GETSOCKNAME.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.





Keyword	Description
S	Input parameter. A value or the address of a halfword binary number specifying the socket descriptor.

NAME

Initially, the application provides a pointer to the IPv4 or IPv6 socket address structure, which is filled in on completion of the call with the socket name. Include the SYS1.MACLIB(BPXYSOCK) macro to get the assembler mappings for the socket address structure. The socket address structure mappings begin at the SOCKADDR label. The AF_INET socket address structure fields start at the SOCK_SIN label. The AF_INET6 socket address structure fields start at the SOCK_SIN6 label.

The IPv4 socket address structure must specify the following fields:

Field	Description
FAMILY	Output parameter. A halfword binary field containing the IPv4 addressing family. The value for IPv4 socket descriptor (S parameter) is a decimal 2, indicating AF_INET.
PORT	Output parameter. A halfword binary field set to the port number bound to this socket. If the socket is not bound, a 0 is returned.
IPv4-ADDRESS	Output parameter. A fullword binary field set to the 32-bit IPv4 Internet address of the local host machine.
RESERVED	Output parameter. Specifies 8 bytes of binary zeros. This field is required, but not used.

The IPv6 socket structure must specify the following fields:

Field	Description
NAMELEN	Output parameter. A 1-byte binary field specifying the length of this IPv6 socket address structure. Any value specified by the use of this field is ignored when processed as input and the field is set to 0 when processed as output.
FAMILY	Output parameter. A 1-byte binary field specifying the IPv6

addressing family. The value for IPv6 socket descriptor (S parameter) is a decimal 19, indicating AF_INET6.

PORT Output parameter. A halfword binary field set to the port number bound to this socket. If the socket is not bound, a 0 is returned.

FLOW-INFO
Output parameter. A fullword binary field specifying the traffic class and flow label. This value of this field is undefined.

IPv6-ADDRESS
Output parameter. A 16-byte binary field that is set to the 128-bit IPv6 Internet address, in network byte order, of the local host machine.

SCOPE-ID
A fullword binary field which identifies a set of interfaces as appropriate for the scope of the address carried in the **IPv6-ADDRESS** field. For a link scope **IPv6-ADDRESS**, **SCOPE-ID** contains the link index for the **IPv6-ADDRESS**. For all other address scopes, **SCOPE-ID** is undefined.

ERRNO Output parameter. A fullword binary field. If **RETCODE** is negative, this field contains an error number. See Appendix B, "Socket call error return codes," on page 885 for information about **ERRNO** return codes.

RETCODE Output parameter. A fullword binary field that returns one of the following:

Value	Description
0	Successful call.
−1	An error occurred.

ECB or REQAREA
Input parameter. This parameter is required if you are using APITYPE=3. It points to a 104-byte field containing:

For ECB
A 4-byte **ECB** posted by TCP/IP when the macro completes.

For REQAREA
A 4-byte user token (set by you) that is presented to your exit when the response to this function request is complete.

For ECB/REQAREA
The last 100 bytes is a storage field used by the interface to save the state information.

Note: This storage must not be modified until the macro function has completed and the **ECB** has been posted, or the asynchronous exit has been driven.

ERROR Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

TASK Input parameter. The location of the task storage area in your program.

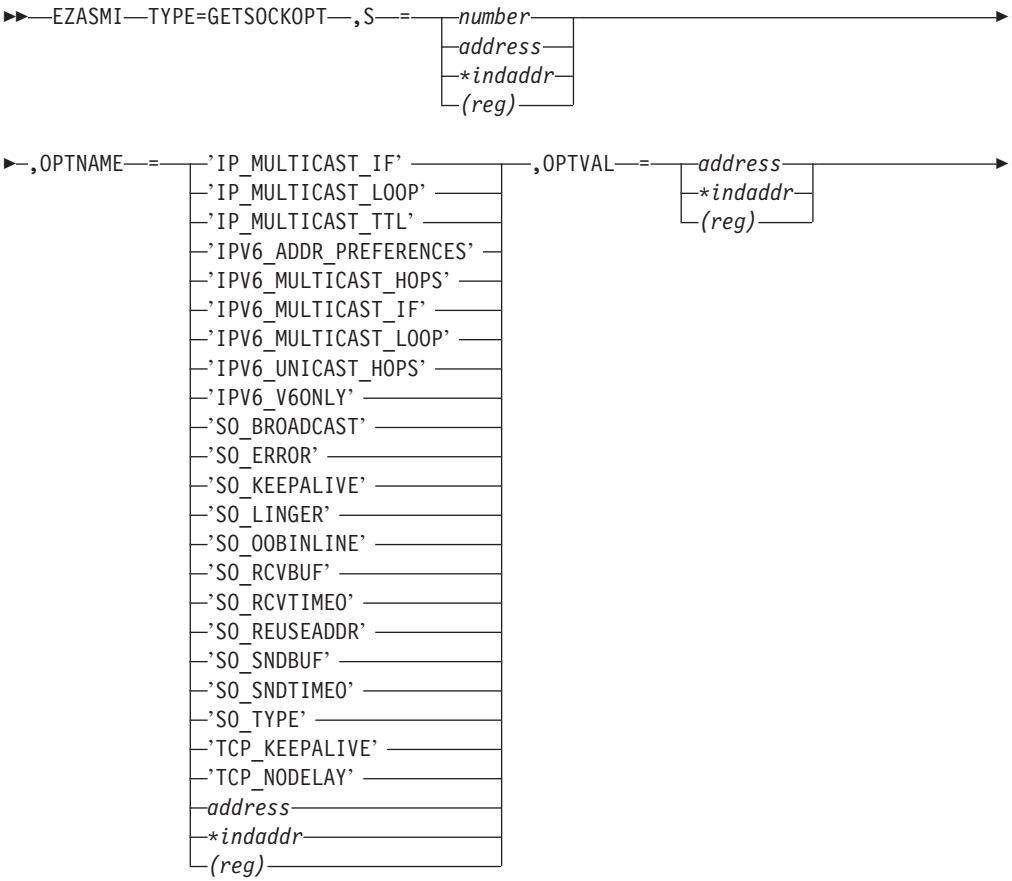
GETSOCKOPT

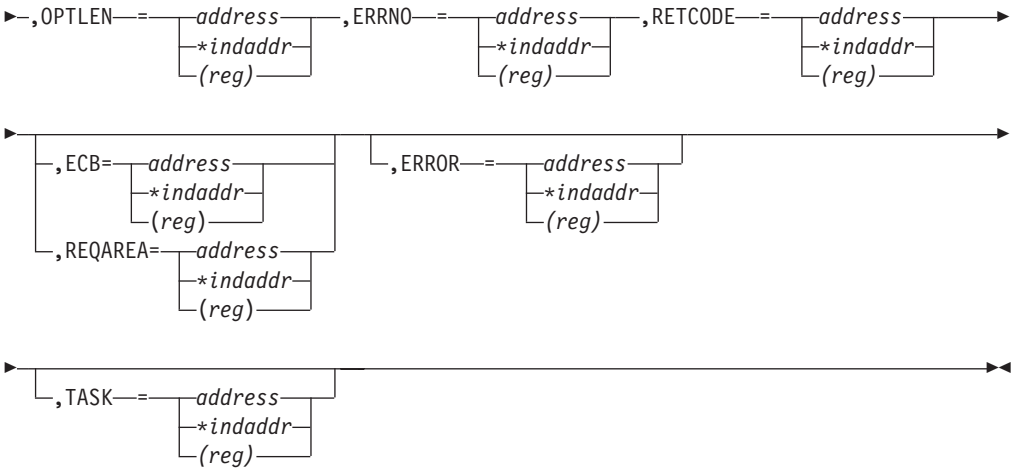
The GETSOCKOPT macro gets the options associated with a socket that were set using the SETSOCKOPT macro.

The options for each socket are described by the following parameters. You must specify the option that you want when you issue the GETSOCKOPT macro.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.





Keyword	Description
S	Input parameter. A value or the address of a halfword binary number specifying the socket descriptor of the socket requiring options.
OPTNAME	Input parameter. See the table below for a list of the options and their unique requirements. See Appendix D, "GETSOCKOPT/SETSOCKOPT command values," on page 917 for the numeric values of **OPTNAME**.
OPTLEN	Input parameter. A fullword binary field containing the length of the data returned in **OPTVAL**. See the table below for determining on what to base the value of **OPTLEN**.
OPTVAL	Output parameter. See the table below for a list of the options and their unique requirements.
ERRNO	Output parameter. A fullword binary field. If **RETCODE** is negative, this field contains an error number. See Appendix B, "Socket call error return codes," on page 885 for information about **ERRNO** return codes.
RETCODE	Output parameter. A fullword binary field that returns one of the following:

Value	Description
0	Successful call.
−1	Check **ERRNO** for an error code.

ECB or REQAREA

Input parameter. This parameter is required if you are using APITYPE=3. It points to a 104-byte field containing:

For ECB

A 4-byte **ECB** posted by TCP/IP when the macro completes.

For REQAREA

A 4-byte user token (set by you) that is presented to your exit when the response to this function request is complete.

For ECB/REQAREA

The last 100 bytes is a storage field used by the interface to save the state information.

Note: This storage must not be modified until the macro function has completed and the **ECB** has been posted, or the asynchronous exit has been driven.

ERROR Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

TASK Input parameter. The location of the task storage area in your program.

Table 15. OPTNAME options for GETSOCKOPT and SETSOCKOPT

OPTNAME options (input)	SETSOCKOPT, OPTVAL (input)	GETSOCKOPT, OPTVAL (output)
IP_ADD_MEMBERSHIP Use this option to enable an application to join a multicast group on a specific interface. An interface has to be specified with this option. Only applications that want to receive multicast datagrams need to join multicast groups. This is an IPv4-only socket option.	Contains the IP_MREQ structure as defined in SYS1.MACLIB(BPXYSOCK). The IP_MREQ structure contains a 4-byte IPv4 multicast address followed by a 4-byte IPv4 interface address. See SEZAINST(CBLOCK) for the PL/I example of IP_MREQ. See SEZAINST(EZACOBOL) for the COBOL example of IP-MREQ.	N/A
IP_ADD_SOURCE_MEMBERSHIP Use this option to enable an application to join a source multicast group on a specific interface and a specific source address. You must specify an interface and a source address with this option. Applications that want to receive multicast datagrams need to join source multicast groups. This is an IPv4-only socket option.	Contains the IP_MREQ_SOURCE structure as defined in SYS1.MACLIB(BPXYSOCK). The IP_MREQ_SOURCE structure contains a 4-byte IPv4 multicast address followed by a 4-byte IPv4 source address and a 4-byte IPv4 interface address. See SEZAINST(CBLOCK) for the PL/I example of IP_MREQ_SOURCE. See SEZAINST(EZACOBOL) for the COBOL example of IP-MREQ-SOURCE.	N/A
IP_BLOCK_SOURCE Use this option to enable an application to block multicast packets that have a source address that matches the given IPv4 source address. You must specify an interface and a source address with this option. The specified multicast group must have been joined previously. This is an IPv4-only socket option.	Contains the IP_MREQ_SOURCE structure as defined in SYS1.MACLIB(BPXYSOCK). The IP_MREQ_SOURCE structure contains a 4-byte IPv4 multicast address followed by a 4-byte IPv4 source address and a 4-byte IPv4 interface address. See SEZAINST(CBLOCK) for the PL/I example of IP_MREQ_SOURCE. See SEZAINST(EZACOBOL) for the COBOL example of IP-MREQ-SOURCE.	N/A

Table 15. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

OPTNAME options (input)	SETSOCKOPT, OPTVAL (input)	GETSOCKOPT, OPTVAL (output)
IP_DROP_MEMBERSHIP Use this option to enable an application to exit a multicast group or to exit all sources for a multicast group. This is an IPv4-only socket option.	Contains the IP_MREQ structure as defined in SYS1.MACLIB(BPXYSOCK). The IP_MREQ structure contains a 4-byte IPv4 multicast address followed by a 4-byte IPv4 interface address. See SEZAINST(CBLOCK) for the PL/I example of IP_MREQ. See SEZAINST(EZACOBOL) for the COBOL example of IP-MREQ.	N/A
IP_DROP_SOURCE_MEMBERSHIP Use this option to enable an application to exit a source multicast group. This is an IPv4-only socket option.	Contains the IP_MREQ_SOURCE structure as defined in SYS1.MACLIB(BPXYSOCK). The IP_MREQ_SOURCE structure contains a 4-byte IPv4 multicast address followed by a 4-byte IPv4 source address and a 4-byte IPv4 interface address. See SEZAINST(CBLOCK) for the PL/I example of IP_MREQ_SOURCE. See SEZAINST(EZACOBOL) for the COBOL example of IP-MREQ-SOURCE.	N/A
IP_MULTICAST_IF Use this option to set or obtain the IPv4 interface address used for sending outbound multicast datagrams from the socket application. This is an IPv4-only socket option. **Note:** Multicast datagrams can be transmitted only on one interface at a time.	A 4-byte binary field containing an IPv4 interface address.	A 4-byte binary field containing an IPv4 interface address.
IP_MULTICAST_LOOP Use this option to control or determine whether a copy of multicast datagrams are looped back for multicast datagrams sent to a group to which the sending host itself belongs. The default is to loop the datagrams back. This is an IPv4-only socket option.	A 1-byte binary field. To enable, set to 1. To disable, set to 0.	A 1-byte binary field. If enabled, will contain a 1. If disabled, will contain a 0.

Table 15. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

OPTNAME options (input)	SETSOCKOPT, OPTVAL (input)	GETSOCKOPT, OPTVAL (output)
IP_MULTICAST_TTL Use this option to set or obtain the IP time-to-live of outgoing multicast datagrams. The default value is '01'x meaning that multicast is available only to the local subnet. This is an IPv4-only socket option.	A 1-byte binary field containing the value of '00'x to 'FF'x.	A 1-byte binary field containing the value of '00'x to 'FF'x.
IP_UNBLOCK_SOURCE Use this option to enable an application to unblock a previously blocked source for a given IPv4 multicast group. You must specify an interface and a source address with this option. This is an IPv4-only socket option.	Contains the IP_MREQ_SOURCE structure as defined in SYS1.MACLIB(BPXYSOCK). The IP_MREQ_SOURCE structure contains a 4-byte IPv4 multicast address followed by a 4-byte IPv4 source address and a 4-byte IPv4 interface address. See SEZAINST(CBLOCK) for the PL/I example of IP_MREQ_SOURCE. See SEZAINST(EZACOBOL) for the COBOL example of IP-MREQ-SOURCE.	

Table 15. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

OPTNAME options (input)	SETSOCKOPT, OPTVAL (input)	GETSOCKOPT, OPTVAL (output)
IPV6_ADDR_PREFERENCES Use this option to query or set IPv6 address preferences of a socket. The default source address selection algorithm considers these preferences when it selects an IP address that is appropriate to communicate with a given destination address. This is an AF_INET6-only socket option. **Result:** These flags are only preferences. The stack could assign a source IP address that does not conform to the IPV6_ADDR_PREFERENCES flags that you specify. **Guideline:** Use the INET6_IS_SRCADDR function to test whether the source IP address matches one or more IPV6_ADDR_PREFERENCES flags.	Contains the 4-byte flags field IPV6_ADDR_PREFERENCES_ FLAGS that is defined in SYS1.MACLIB(BPXYSOCK) with the following flags: **IPV6_PREFER_SRC_HOME (X'00000001')** Prefer home address **IPV6_PREFER_SRC_COA (X'00000002')** Prefer care-of address **IPV6_PREFER_SRC_TMP (X'00000004')** Prefer temporary address **IPV6_PREFER_SRC_PUBLIC (X'00000008')** Prefer public address **IPV6_PREFER_SRC_CGA (X'00000010')** Prefer cryptographically generated address **IPV6_PREFER_SRC_NONCGA (X'00000020')** Prefer non-cryptographically generated address Some of these flags are contradictory. Combining contradictory flags, such as IPV6_PREFER_SRC_CGA and IPV6_PREFER_SRC_NONCGA, results in error code EINVAL. See IPV6_ADDR_PREFERENCES and Mapping of GAI_HINTS/GAI_ADDRINFO EFLAGS in SEZAINST(CBLOCK) for the PL/I example of the OPTNAME and flag definitions. See IPV6_ADDR_PREFERENCES and AI_EFLAGS mappings in SEZAINST(EZACOBOL) for the COBOL example of the OPTNAME and flag definitions.	Contains the 4-byte flags field IPV6_ADDR_PREFERENCES_ FLAGS that is defined in SYS1.MACLIB(BPXYSOCK) with the following flags: **IPV6_PREFER_SRC_HOME (X'00000001')** Prefer home address **IPV6_PREFER_SRC_COA (X'00000002')** Prefer care-of address **IPV6_PREFER_SRC_TMP (X'00000004')** Prefer temporary address **IPV6_PREFER_SRC_PUBLIC (X'00000008')** Prefer public address **IPV6_PREFER_SRC_CGA (X'00000010')** Prefer cryptographically generated address **IPV6_PREFER_SRC_ NONCGA (X'00000020')** Prefer non-cryptographically generated address See IPV6_ADDR_ PREFERENCES and Mapping of GAI_HINTS/GAI_ADDRINFO EFLAGS in SEZAINST(CBLOCK) for the PL/I example of the OPTNAME and flag definitions. See IPV6_ADDR_PREFERENCES and AI_EFLAGS mappings in SEZAINST(EZACOBOL) for the COBOL example of the OPTNAME and flag definitions.

Table 15. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

OPTNAME options (input)	SETSOCKOPT, OPTVAL (input)	GETSOCKOPT, OPTVAL (output)
IPV6_JOIN_GROUP Use this option to control the reception of multicast packets and specify that the socket join a multicast group. This is an IPv6-only socket option.	Contains the IPV6_MREQ structure as defined in SYS1.MACLIB(BPXYSOCK). The IPV6_MREQ structure contains a 16-byte IPv6 multicast address followed by a 4-byte IPv6 interface index number. If the interface index number is 0, then the stack chooses the local interface. See the SEZAINST(CBLOCK) for the PL/I example of IPV6_MREQ. See SEZAINST(EZACOBOL) for the COBOL example of IPV6-MREQ.	N/A
IPV6_LEAVE_GROUP Use this option to control the reception of multicast packets and specify that the socket leave a multicast group. This is an IPv6-only socket option.	Contains the IPV6_MREQ structure as defined in SYS1.MACLIB(BPXYSOCK). The IPV6_MREQ structure contains a 16-byte IPv6 multicast address followed by a 4-byte IPv6 interface index number. If the interface index number is 0, then the stack chooses the local interface. See the SEZAINST(CBLOCK) for the PL/I example of IPV6_MREQ. See SEZAINST(EZACOBOL) for the COBOL example of IPV6-MREQ.	N/A
IPV6_MULTICAST_HOPS Use to set or obtain the hop limit used for outgoing multicast packets. This is an IPv6-only socket option.	Contains a 4-byte binary value specifying the multicast hops. If not specified, then the default is 1 hop. -1 indicates use stack default. 0 – 255 is the valid hop limit range. **Note:** An application must be APF authorized to enable it to set the hop limit value above the system defined hop limit value. CICS applications cannot execute as APF authorized.	Contains a 4-byte binary value in the range 0 – 255 indicating the number of multicast hops.

Table 15. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

OPTNAME options (input)	SETSOCKOPT, OPTVAL (input)	GETSOCKOPT, OPTVAL (output)
IPV6_MULTICAST_IF Use this option to set or obtain the index of the IPv6 interface used for sending outbound multicast datagrams from the socket application. This is an IPv6-only socket option.	Contains a 4-byte binary field containing an IPv6 interface index number.	Contains a 4-byte binary field containing an IPv6 interface index number.
IPV6_MULTICAST_LOOP Use this option to control or determine whether a multicast datagram is looped back on the outgoing interface by the IP layer for local delivery when datagrams are sent to a group to which the sending host itself belongs. The default is to loop multicast datagrams back. This is an IPv6-only socket option.	A 4-byte binary field. To enable, set to 1. To disable, set to 0.	A 4-byte binary field. If enabled, contains a 1. If disabled, contains a 0.
IPV6_UNICAST_HOPS Use this option to set or obtain the hop limit used for outgoing unicast IPv6 packets. This is an IPv6-only socket option.	Contains a 4-byte binary value specifying the unicast hops. If not specified, then the default is 1 hop. -1 indicates use stack default. 0 – 255 is the valid hop limit range. **Note:** APF authorized applications are permitted to set a hop limit that exceeds the system configured default. CICS applications cannot execute as APF authorized.	Contains a 4-byte binary value in the range 0 – 255 indicating the number of unicast hops.
IPV6_V6ONLY Use this option to set or determine whether the socket is restricted to send and receive only IPv6 packets. The default is to not restrict the sending and receiving of only IPv6 packets. This is an IPv6-only socket option.	A 4-byte binary field. To enable, set to 1. To disable, set to 0.	A 4-byte binary field. If enabled, contains a 1. If disabled, contains a 0.

Table 15. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

OPTNAME options (input)	SETSOCKOPT, OPTVAL (input)	GETSOCKOPT, OPTVAL (output)
MCAST_BLOCK_SOURCE Use this option to enable an application to block multicast packets that have a source address that matches the given source address. You must specify an interface index and a source address with this option. The specified multicast group must have been joined previously.	Contains the GROUP_SOURCE_REQ structure as defined in SYS1.MACLIB(BPXYSOCK). The GROUP_SOURCE_REQ structure contains a 4-byte interface index number followed by a socket address structure of the multicast address and a socket address structure of the source address. See SEZAINST(CBLOCK) for the PL/I example of GROUP_SOURCE_REQ. See SEZAINST(EZACOBOL) for the COBOL example of GROUP-SOURCE-REQ.	N/A
MCAST_JOIN_GROUP Use this option to enable an application to join a multicast group on a specific interface. You must specify an interface index. Applications that want to receive multicast datagrams must join multicast groups.	Contains the GROUP_REQ structure as defined in SYS1.MACLIB(BPXYSOCK). The GROUP_REQ structure contains a 4-byte interface index number followed by a socket address structure of the multicast address. See SEZAINST(CBLOCK) for the PL/I example of GROUP_REQ. See SEZAINST(EZACOBOL) for the COBOL example of GROUP-REQ.	N/A
MCAST_JOIN_SOURCE_GROUP Use this option to enable an application to join a source multicast group on a specific interface and a source address. You must specify an interface index and the source address. Applications that want to receive multicast datagrams only from specific source addresses need to join source multicast groups.	Contains the GROUP_SOURCE_REQ structure as defined in SYS1.MACLIB(BPXYSOCK). The GROUP_SOURCE_REQ structure contains a 4-byte interface index number followed by a socket address structure of the multicast address and a socket address structure of the source address. See SEZAINST(CBLOCK) for the PL/I example of GROUP_SOURCE_REQ. See SEZAINST(EZACOBOL) for the COBOL example of GROUP-SOURCE-REQ.	N/A

Table 15. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

OPTNAME options (input)	SETSOCKOPT, OPTVAL (input)	GETSOCKOPT, OPTVAL (output)
MCAST_LEAVE_GROUP Use this option to enable an application to exit a multicast group or exit all sources for a given multicast groups.	Contains the GROUP_REQ structure as defined in SYS1.MACLIB(BPXYSOCK). The GROUP_REQ structure contains a 4-byte interface index number followed by a socket address structure of the multicast address. See SEZAINST(CBLOCK) for the PL/I example of GROUP_REQ. See SEZAINST(EZACOBOL) for the COBOL example of GROUP-REQ.	N/A
MCAST_LEAVE_SOURCE_GROUP Use this option to enable an application to exit a source multicast group.	Contains the GROUP_SOURCE_REQ structure as defined in SYS1.MACLIB(BPXYSOCK). The GROUP_SOURCE_REQ structure contains a 4-byte interface index number followed by a socket address structure of the multicast address and a socket address structure of the source address. See SEZAINST(CBLOCK) for the PL/I example of GROUP_SOURCE_REQ. See SEZAINST(EZACOBOL) for the COBOL example of GROUP-SOURCE-REQ.	N/A
MCAST_UNBLOCK_SOURCE Use this option to enable an application to unblock a previously blocked source for a given multicast group. You must specify an interface index and a source address with this option.	Contains the GROUP_SOURCE_REQ structure as defined in SYS1.MACLIB(BPXYSOCK). The GROUP_SOURCE_REQ structure contains a 4-byte interface index number followed by a socket address structure of the multicast address and a socket address structure of the source address. See SEZAINST(CBLOCK) for the PL/I example of GROUP_SOURCE_REQ. See SEZAINST(EZACOBOL) for the COBOL example of GROUP-SOURCE-REQ.	N/A

Table 15. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

OPTNAME options (input)	SETSOCKOPT, OPTVAL (input)	GETSOCKOPT, OPTVAL (output)
SO_ASCII Use this option to set or determine the translation to ASCII data option. When SO_ASCII is set, data is translated to ASCII. When SO_ASCII is not set, data is not translated to or from ASCII. **Note:** This is a REXX-only socket option.	To enable, set to ON. To disable, set to OFF. **Note:** The *optvalue* is returned and is optionally followed by the name of the translation table that is used if translation is applied to the data.	If enabled, contains ON. If disabled, contains OFF. **Note:** The *optvalue* is returned and is optionally followed by the name of the translation table that is used if translation is applied to the data.
SO_BROADCAST Use this option to set or determine whether a program can send broadcast messages over the socket to destinations that can receive datagram messages. The default is disabled. **Note:** This option has no meaning for stream sockets.	A 4-byte binary field. To enable, set to 1 or a positive value. To disable, set to 0.	A 4-byte field. If enabled, contains a 1. If disabled, contains a 0.
SO_DEBUG Use SO_DEBUG to set or determine the status of the debug option. The default is *disabled*. The debug option controls the recording of debug information. **Notes:** 1. This is a REXX-only socket option. 2. This option has meaning only for stream sockets.	To enable, set to ON. To disable, set to OFF.	If enabled, contains ON. If disabled, contains OFF.
SO_EBCDIC Use this option to set or determine the translation to EBCDIC data option. When SO_EBCDIC is set, data is translated to EBCDIC. When SO_EBCDIC is not set, data is not translated to or from EBCDIC. This option is ignored by EBCDIC hosts. **Note:** This is a REXX-only socket option.	To enable, set to ON. To disable, set to OFF. **Note:** The *optvalue* is returned and is optionally followed by the name of the translation table that is used if translation is applied to the data.	If enabled, contains ON. If disabled, contains OFF. **Note:** The *optvalue* is returned and is optionally followed by the name of the translation table that is used if translation is applied to the data.
SO_ERROR Use this option to request pending errors on the socket or to check for asynchronous errors on connected datagram sockets or for other errors that are not explicitly returned by one of the socket calls. The error status is clear afterwards.	N/A	A 4-byte binary field containing the most recent ERRNO for the socket.

Table 15. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

OPTNAME options (input)	SETSOCKOPT, OPTVAL (input)	GETSOCKOPT, OPTVAL (output)
SO_KEEPALIVE Use this option to set or determine whether the keep alive mechanism periodically sends a packet on an otherwise idle connection for a stream socket. The default is disabled. When activated, the keep alive mechanism periodically sends a packet on an otherwise idle connection. If the remote TCP does not respond to the packet or to retransmissions of the packet, the connection is terminated with the error ETIMEDOUT.	A 4-byte binary field. To enable, set to 1 or a positive value. To disable, set to 0.	A 4-byte binary field. If enabled, contains a 1. If disabled, contains a 0.

SO_LINGER
 	
Use this option to control or determine how TCP/IP processes data that has not been transmitted when a CLOSE is issued for the socket. The default is disabled.
 	
Notes:
1. This option has meaning only for stream sockets.
2. If you set a zero linger time, the connection cannot close in an orderly manner, but stops, resulting in a RESET segment being sent to the connection partner. Also, if the aborting socket is in nonblocking mode, the close call is treated as though no linger option had been set.
 	
When SO_LINGER is set and CLOSE is called, the calling program is blocked until the data is successfully transmitted or the connection has timed out.
 	
When SO_LINGER is not set, the CLOSE returns without blocking the caller, and TCP/IP continues to attempt to send data for a specified time. This usually allows sufficient time to complete the data transfer.
 	
Use of the SO_LINGER option does not guarantee successful completion because TCP/IP only waits the amount of time specified in OPTVAL for SO_LINGER.
	Contains an 8-byte field containing two 4-byte binary fields.
	
	Assembler coding:
	`ONOFF  DS F`
	`LINGER DS F`
	
	COBOL coding:
	`ONOFF  PIC 9(8) BINARY.`
	`LINGER PIC 9(8) BINARY.`
	
	Set ONOFF to a nonzero value to enable and set to 0 to disable this option. Set LINGER to the number of seconds that TCP/IP lingers after the CLOSE is issued.
		Contains an 8-byte field containing two 4-byte binary fields.
		
		Assembler coding:
		`ONOFF  DS F`
		`LINGER DS F`
		
		COBOL coding:
		`ONOFF  PIC 9(8) BINARY.`
		`LINGER PIC 9(8) BINARY.`
		
		A nonzero value returned in ONOFF indicates enabled, a 0 indicates disabled. LINGER indicates the number of seconds that TCP/IP will try to send data after the CLOSE is issued.

Table 15. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

OPTNAME options (input)	SETSOCKOPT, OPTVAL (input)	GETSOCKOPT, OPTVAL (output)
SO_OOBINLINE Use this option to control or determine whether out-of-band data is received. **Note:** This option has meaning only for stream sockets. When this option is set, out-of-band data is placed in the normal data input queue as it is received and is available to a RECV or a RECVFROM even if the OOB flag is not set in the RECV or the RECVFROM. When this option is disabled, out-of-band data is placed in the priority data input queue as it is received and is available to a RECV or a RECVFROM only when the OOB flag is set in the RECV or the RECVFROM.	A 4-byte binary field. To enable, set to 1 or a positive value. To disable, set to 0.	A 4-byte binary field. If enabled, contains a 1. If disabled, contains a 0.
SO_RCVBUF Use this option to control or determine the size of the data portion of the TCP/IP receive buffer. The size of the data portion of the receive buffer is protocol-specific, based on the following values prior to any SETSOCKOPT call: • TCPRCVBufrsize keyword on the TCPCONFIG statement in the PROFILE.TCPIP data set for a TCP Socket • UDPRCVBufrsize keyword on the UDPCONFIG statement in the PROFILE.TCPIP data set for a UDP Socket • The default of 65 535 for a raw socket	A 4-byte binary field. To enable, set to a positive value specifying the size of the data portion of the TCP/IP receive buffer. To disable, set to a 0.	A 4-byte binary field. If enabled, contains a positive value indicating the size of the data portion of the TCP/IP receive buffer. If disabled, contains a 0.

Table 15. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

OPTNAME options (input)	SETSOCKOPT, OPTVAL (input)	GETSOCKOPT, OPTVAL (output)
SO_RCVTIMEO Use this option to control or determine the maximum length of time that a receive-type function can wait before it completes. If a receive-type function has blocked for the maximum length of time that was specified without receiving data, control is returned with an errno set to EWOULDBLOCK. The default value for this option is 0, which indicates that a receive-type function does not time out. When the MSG_WAITALL flag (stream sockets only) is specified, the timeout takes precedence. The receive-type function can return the partial count. See the explanation of that operation's MSG_WAITALL flag parameter. The following receive-type functions are supported: • READ • READV • RECV • RECVFROM • RECVMSG	This option requires a TIMEVAL structure, which is defined in SYS1.MACLIB(BPXYRLIM) macro. The TIMEVAL structure contains the number of seconds and microseconds specified as fullword binary numbers. The seconds can be a value in the range 0 - 2 678 400 (equal to 31 days), and the microseconds can be a value in the range 0 - 1 000 000 (equal to 1 second). Although TIMEVAL value can be specified using microsecond granularity, the internal TCP/IP timers that are used to implement this function have a granularity of approximately 100 milliseconds.	This option stores a TIMEVAL structure that is defined in the SYS1.MACLIB(BPXYRLIM) macro. The TIMEVAL structure contains the number of seconds and microseconds, which are specified as fullword binary numbers. The number of seconds value that is returned is in the range 0 - 2 678 400 (equal to 31 days). The number of microseconds value that is returned is in the range 0 - 1 000 000.

Table 15. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

OPTNAME options (input)	SETSOCKOPT, OPTVAL (input)	GETSOCKOPT, OPTVAL (output)
SO_REUSEADDR Use this option to control or determine whether local addresses are reused. The default is disabled. This alters the normal algorithm used with BIND. The normal BIND algorithm allows each Internet address and port combination to be bound only once. If the address and port have been already bound, then a subsequent BIND will fail and result error will be EADDRINUSE. When this option is enabled, the following situations are supported: • A server can BIND the same port multiple times as long as every invocation uses a different local IP address and the wildcard address INADDR_ANY is used only one time per port. • A server with active client connections can be restarted and can bind to its port without having to close all of the client connections. • For datagram sockets, multicasting is supported so multiple bind() calls can be made to the same class D address and port number. • If you require multiple servers to BIND to the same port and listen on INADDR_ANY, see the SHAREPORT option on the PORT statement in TCPIP.PROFILE.	A 4-byte binary field. To enable, set to 1 or a positive value. To disable, set to 0.	A 4-byte binary field. If enabled, contains a 1. If disabled, contains a 0.
SO_SNDBUF Use this option to control or determine the size of the data portion of the TCP/IP send buffer. The size is of the TCP/IP send buffer is protocol specific and is based on the following: • The TCPSENDBufrsize keyword on the TCPCONFIG statement in the PROFILE.TCPIP data set for a TCP socket • The UDPSENDBufrsize keyword on the UDPCONFIG statement in the PROFILE.TCPIP data set for a UDP socket • The default of 65 535 for a raw socket	A 4-byte binary field. To enable, set to a positive value specifying the size of the data portion of the TCP/IP send buffer. To disable, set to a 0.	A 4-byte binary field. If enabled, contains a positive value indicating the size of the data portion of the TCP/IP send buffer. If disabled, contains a 0.

Table 15. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

OPTNAME options (input)	SETSOCKOPT, OPTVAL (input)	GETSOCKOPT, OPTVAL (output)
SO_SNDTIMEO Use this option to control or determine the maximum length of time that a send-type function can remain blocked before it completes. If a send-type function has blocked for this length of time, it returns with a partial count or, if no data is sent, with an errno set to EWOULDBLOCK. The default value for this is 0, which indicates that a send-type function does not time out. For a SETSOCKOPT, the following send-type functions are supported: • SEND • SENDMSG • SENDTO • WRITE • WRITEV	This option requires a TIMEVAL structure, which is defined in the SYS1.MACLIB(BPXYRLIM) macro. The TIMEVAL structure contains the number of seconds and microseconds specified as fullword binary numbers. The seconds value is in the range 0 - 2 678 400 (equal to 31 days), and the microseconds value is in the range 0 - 1 000 000 (equal to 1 second). Although the TIMEVAL value can be specified using microsecond granularity, the internal TCP/IP timers that are used to implement this function have a granularity of approximately 100 milliseconds.	This option stores a TIMEVAL structure that is defined in SYS1.MACLIB(BPXYRLIM). The TIMEVAL structure contains the number of seconds and microseconds, which are specified as fullword binary numbers. The number of seconds value that is returned is in the range 0 - 2 678 400 (equal to 31 days). The microseconds value that is returned is in the range 0 - 1 000 000.
SO_TYPE Use this option to return the socket type.	N/A	A 4-byte binary field indicating the socket type: X'1' indicates SOCK_STREAM. X'2' indicates SOCK_DGRAM. X'3' indicates SOCK_RAW.
TCP_KEEPALIVE Use this option to set or determine whether a socket-specific timeout value (in seconds) is to be used in place of a configuration-specific value whenever keep alive timing is active for that socket. When activated, the socket-specified timer value remains in effect until respecified by SETSOCKOPT or until the socket is closed. See the *z/OS Communications Server: IP Programmer's Guide and Reference* for more information about the socket option parameters.	A 4-byte binary field. To enable, set to a value in the range of 1 – 2 147 460. To disable, set to a value of 0.	A 4-byte binary field. If enabled, contains the specific timer value (in seconds) that is in effect for the given socket. If disabled, contains a 0 indicating keep alive timing is not active.

Table 15. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

OPTNAME options (input)	SETSOCKOPT, OPTVAL (input)	GETSOCKOPT, OPTVAL (output)

TCP_NODELAY
 	
Use this option to set or determine whether data sent over the socket is subject to the Nagle algorithm (RFC 896).
 	
Under most circumstances, TCP sends data when it is presented. When this option is enabled, TCP will wait to send small amounts of data until the acknowledgment for the previous data sent is received. When this option is disabled, TCP will send small amounts of data even before the acknowledgment for the previous data sent is received.
Note: Use the following to set **TCP_NODELAY OPTNAME** value for COBOL programs:
`01 TCP-NODELAY-VAL PIC 9(10) COMP VALUE 2147483649.`
`01 TCP-NODELAY-REDEF REDEFINES TCP-NODELAY-VAL.`
`05 FILLER PIC 9(6) BINARY.`
`05 TCP-NODELAY PIC 9(8) BINARY.`
	A 4-byte binary field.
	
	To enable, set to a 0.
	
	To disable, set to a 1 or nonzero.
		A 4-byte binary field.
		
		If enabled, contains a 0.
		
		If disabled, contains a 1.

GIVESOCKET

The GIVESOCKET macro makes the socket available for a TAKESOCKET macro issued by another program. The GIVESOCKET macro can specify any connected stream socket. Typically, the GIVESOCKET macro is issued by a concurrent server program that creates sockets to be passed to a subtask.

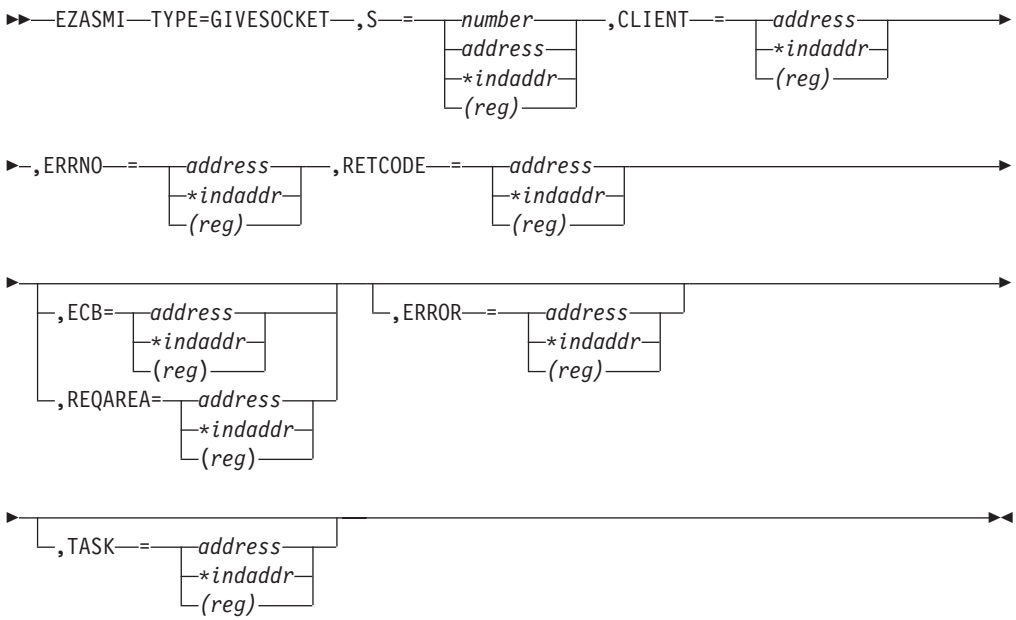
After a program has issued a GIVESOCKET macro for a socket, it can only issue a CLOSE macro for the same socket. Sockets which are given but not taken for a period of four days will be closed and will no longer be available for taking. If a select for the socket is outstanding, it is posted.

Note: Both concurrent servers and iterative servers use this interface. An iterative server handles one client at a time. A concurrent server receives connection requests from multiple clients and creates subtasks that process the client requests. When a subtask is created, the concurrent server gets a new socket, passes the new socket to the subtask, and dissociates itself from the connection. The TCP/IP Listener program is an example of a concurrent server.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.

ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.



Keyword **Description**

S Input parameter. A value or the address of a halfword binary number specifying the descriptor of the socket to be given.

CLIENT Input parameter. The client ID for this application.

Field **Description**

DOMAIN
Input parameter. A fullword binary number specifying the domain of the client. For TCP/IP the value is a decimal 2, indicating AF_INET, or a decimal 19, indicating AF_INET6.

Note: A socket given by GIVESOCKET can only be taken by a TAKESOCKET with the same DOMAIN, address family (AF_INET or AF_INET6).

NAME
An 8-character field, left-aligned, padded to the right with blanks. On completion of the call, this field contains the MVS address space name of the application that is going to take the socket. If the socket-taking application is in the same address space as the socket-giving application, **NAME** can be obtained using the GETCLIENTID call. If this field is set to blanks, any MVS address space requesting a socket can take this socket.

TASK Specifies an 8-byte field that is set to the MVS subtask identifier of the socket-taking task (specified on the

SUBTASK parameter on its INITAPI macro). If this field is set to blanks, any subtask in the address space specified in the **NAME** field can take the socket.

RESERVED
Input parameter. A 20-byte reserved field. This field is required, but not used.

ERRNO Output parameter. A fullword binary field. If **RETCODE** is negative, **ERRNO**contains a valid error number. Otherwise, ignore **ERRNO**.

See Appendix B, "Socket call error return codes," on page 885 for information about **ERRNO** return codes.

RETCODE Output parameter. A fullword binary field that returns one of the following:

Value	Description
0	Successful call.
−1	Check **ERRNO** for an error code.

ECB or REQAREA
Input parameter. This parameter is required if you are using APITYPE=3. It points to a 104-byte field containing:

For ECB
A 4-byte **ECB** posted by TCP/IP when the macro completes.

For REQAREA
A 4-byte user token (set by you) that is presented to your exit when the response to this function request is complete.

For ECB/REQAREA
The last 100 bytes is a storage field used by the interface to save the state information.

Note: This storage must not be modified until the macro function has completed and the **ECB** has been posted, or the asynchronous exit has been driven.

ERROR Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

TASK Input parameter. The location of the task storage area in your program.

GLOBAL

The GLOBAL macro allocates a global storage area that is addressable by all socket users in an address space. If more than one module is using sockets, you must supply the address of the global storage area to each user. Each program using the sockets interface should define global storage using the instruction EZASMI TYPE=GLOBAL with STORAGE=DSECT.

If this macro is not named, the default name EZASMGWA is assumed.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.

Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.

Keyword	Description
STORAGE	Input parameter. Defines one of the following storage definitions:

Keyword	Description
DSECT	Generates a DSECT.
CSECT	Generates an inline storage definition that can be used within a CSECT or as a part of a larger DSECT.

INET6_IS_SRCADDR

The INET6_IS_SRCADDR macro indicates whether an input IPV6 socket address matches an address that is defined to the stack, which conforms to one or more input IPV6_ADDR_PREFERENCES flags.

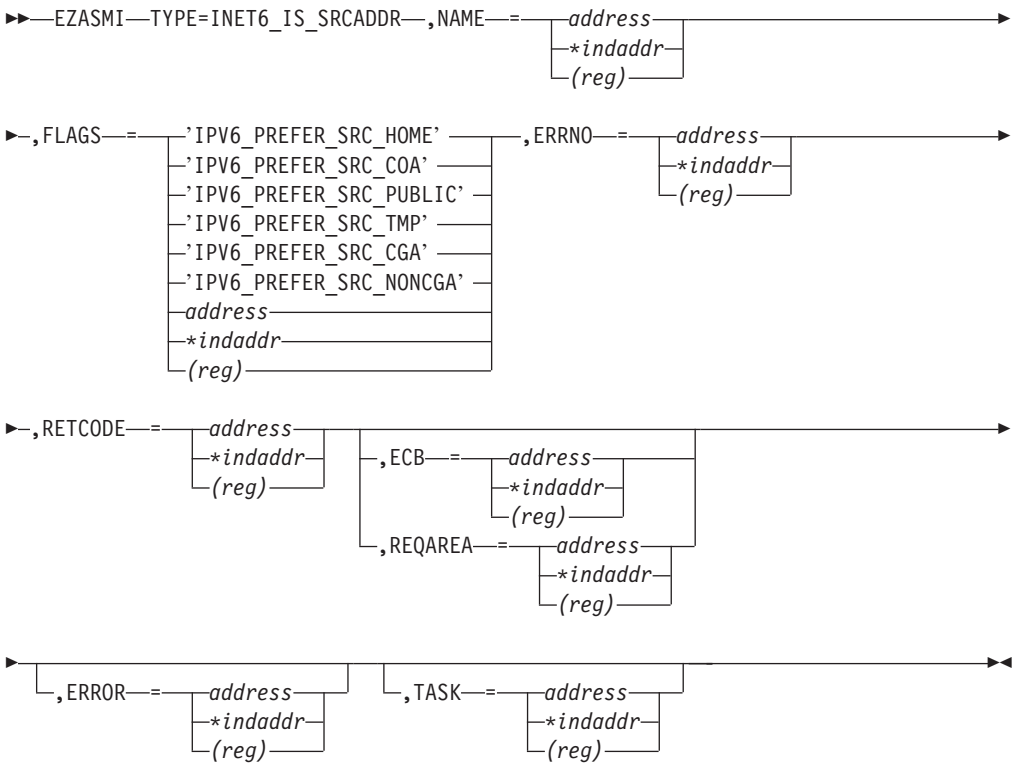
A client or server program can use the INET6_IS_SRCADDR macro when it strictly requires the IP addresses that it uses to have one or more specific attributes before allowing network activity. Such an application would perform the following tasks:

1. (Optional) Issue the SETSOCKOPT macro with the IPV6_ADDR_PREFERENCES option to set the selection preferences of the source IP address for the socket.
2. Issue the BIND2ADDRSEL macro to bind a socket to a local IP address. The BIND2ADDRSEL macro attempts to assign a local IP address that matches the IPV6_ADDR_PREFERENCES flags that are specified with the SETSOCKOPT macro, but does not guarantee that the local IP address that it selects satisfies all preferences.
3. Issue the GETSOCKNAME macro to obtain the local IP address bound to the socket.
4. Issue the INET6_IS_SRCADDR macro to verify whether the local IP address has the correct attributes.

The macro returns true (value 1) when the IPv6 address corresponds to a valid address in the node, and satisfies the given IPV6_ADDR_PREFERENCES flag or flags. If the IPv6 address input value does not correspond to any address in the node, or if the flags are not valid preference flags, the macro returns a failure

(value -1). If the input address is a valid address on the node, but does not satisfy the preference flags indicated, the function returns false (value 0).

You can specify more than one IPV6_ADDR_PREFERENCES flag on this macro. All flags must be satisfied for the result to be true. Some IPV6_ADDR_PREFERENCES flags are contradictory. If you combine contradictory flags on a single macro invocation, the result will be false.



Keyword	Descriptions
NAME	An input parameter. An IPv6 socket address structure describing the interface address to be tested. Include the SYS1.MACLIB(BPXYSOCK) macro in your program to get the assembler mappings for the socket address structure. The socket address structure mappings begin at the SOCKADDR label. The AF_INET6 socket address structure fields start at the SOCK_SIN6 label. The IPv6 socket address structure specifies the following fields: **FAMILY** A halfword binary field that specifies the IPv6 addressing family. This value must be set to AF_INET6. **Tip:** You can specify an IPv4-mapped IPv6 address. **PORT** This field is ignored by the TYPE=INET6_IS_SRCADDR macro. **FLOWINFO** This field is ignored by the TYPE=INET6_IS_SRCADDR macro.

IP-ADDRESS
A 16-byte binary field that specifies the 128-bit IPv6 Internet address, in network byte order.

SCOPE-ID
A fullword binary field that specifies the scope for an IPv6 address as an interface index. This field must be nonzero if the address specified in the IPv6-ADDRESS field is a link-local address and must be 0 for any other scope.

FLAGS An input parameter. The FLAGS argument can be a literal value or a fullword binary field. The following flags can be specified individually or in combination.

Flag name	Binary value	Description
IPV6_PREFER_SRC_HOME	X'00000001'	Test whether the input IP address is a home address.[1]
IPV6_PREFER_SRC_COA	X'00000002'	Test whether the input IP address is a care-of address.[2]
IPV6_PREFER_SRC_TMP	X'00000004'	Test whether the input IP address is a temporary address.
IPV6_PREFER_SRC_PUBLIC	X'00000008'	Test whether the input IP address is a public address.
IPV6_PREFER_SRC_CGA	X'00000010'	Test whether the input IP address is cryptographically generated.[2]
IPV6_PREFER_SRC_NONCGA	X'00000020'	Test whether the input IP address is not cryptographically generated.[1]

Notes:

1. Any valid IP address that is known to the stack satisfies this flag.
2. z/OS Communications Server does not support this type of address. The macro always returns FALSE if this flag is specified with a valid IP address that is known to the stack.

Requirement: You must pass a binary number to the macro to specify more than one preference flags. Include the BPXYSOCK macro in your program to get the binary values for the flags.

Tip: Some of these flags are contradictory, for example:

- The flag IPV6_PREFER_SRC_HOME contradicts the flag IPV6_PREFER_SRC_COA.
- The flag IPV6_PREFER_SRC_CGA contradicts the flag IPV6_PREFER_SRC_NONCGA.
- The flag IPV6_PREFER_SRC_TMP contradicts the flags IPV6_PREFER_SRC_PUBLIC.

Result: If you specify contradictory flags on the macro, the result is FALSE.

Example:

```
MYFLAGS  DC  A(IPV6_PREFER_SRC_HOME+IPV6_PREFER_SRC_NONCGA)  one way to combine flags
EZASMI    TYPE=INET6_IS_SRCADDR,
            NAME=name,
            FLAGS=MYFLAGS
```

ERRNO Output parameter. A fullword binary field. If the **RETCODE** value is negative, the **ERRNO** field contains a valid error number; otherwise, ignore **ERRNO**.

See Appendix B, "Socket call error return codes," on page 885 for information about **ERRNO** return codes.

ECB or REQAREA
Input parameter. This parameter is required if you use APITYPE=3. This parameter points to a 104-byte field that contains one of the following values:

For ECB
A 4-byte ECB that is posted by TCP/IP when the macro completes.

For REQAREA
A 4-byte user token (set by you) that is presented to your exit when the response to this function request is complete.

For both ECB and REQAREA
The last 100 bytes is a storage field that is used by the interface to save the state information.

Requirement: This storage must not be modified until the macro function has completed and the ECB has been posted, or the asynchronous exit has been driven.

RETCODE Output parameter. A fullword binary field that returns one of the following values:

Value	Description
0	False. The IPv6 address corresponds to a valid address in the node, but does not satisfy one or more of the input IPV6_ADDR_PREFERENCES flags.
1	True. The IPv6 address corresponds to a valid address in the node and satisfies the given IPV6_ADDR_PREFERENCES flag or flags. **Tip:** Any valid IPv6 address on a z/OS V1R12 node satisfies the following preference flags: • IPV6_PREFER_SRC_HOME • IPV6_PREFER_SRC_NONCGA
–1	The input IPV6 address does not correspond to an address on the node or the input flags are not valid IPV6_PREFER_SRC_ADDR flags. Check the **ERRNO** value for an error code.

ERROR Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

TASK Input parameter. The location of the task storage area in your program.

INITAPI

The INITAPI macro connects an application to the TCP/IP interface. Almost all sockets programs that are written in COBOL, PL/I, or assembler language must issue the INITAPI macro before they issue other sockets macros.

Note: Because the default INITAPI still requires the TERMAPI to be issued, you always code the INITAPI command.

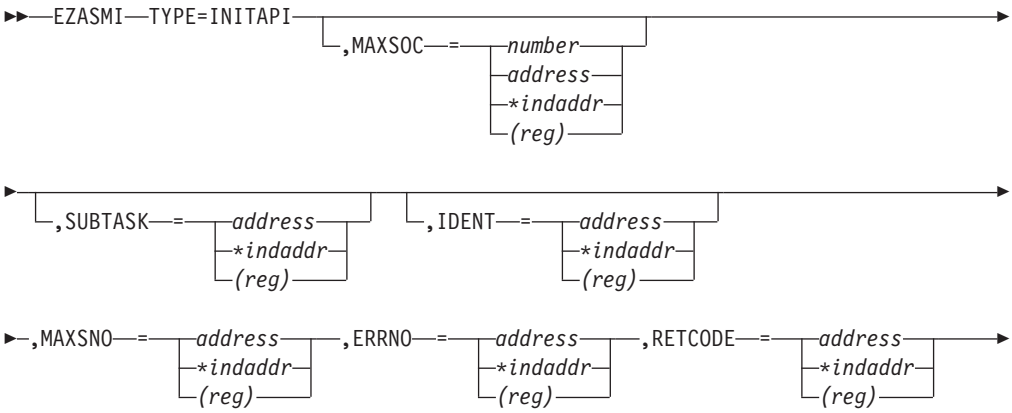
The exceptions to this rule are the following calls, which, when issued first, will generate a default INITAPI call:

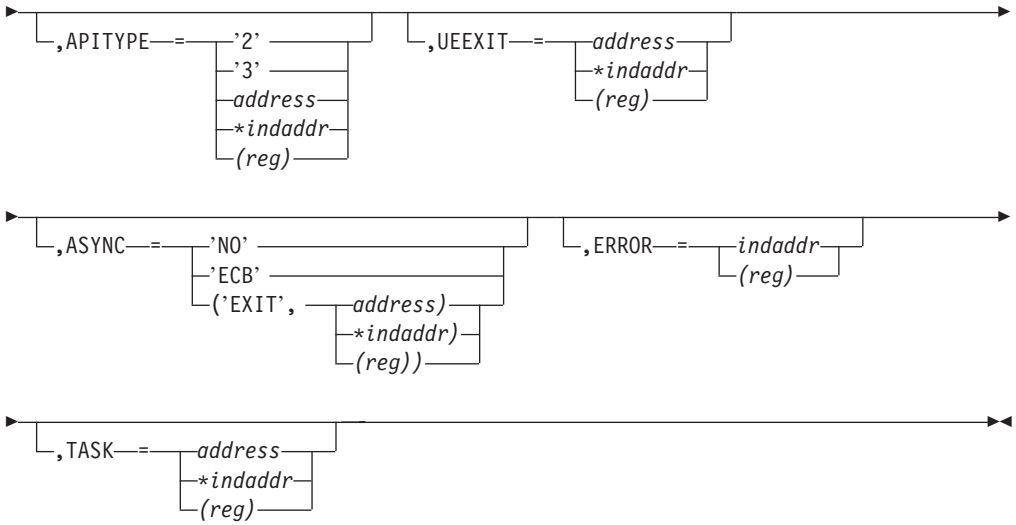
- GETCLIENTID
- GETHOSTID
- GETHOSTNAME
- GETIBMOPT
- SELECT
- SELECTEX
- SOCKET
- TAKESOCKET

Note: Only the first INITAPI triggers a read of the TCPIP.DATA and all other INITAPIs under that address space will use the values read by the first INITAPI.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.





Keyword	Descriptions
MAXSOC	Optional input parameter. A halfword binary field specifying the maximum number of sockets supported by this application. The maximum number is 65535 and the minimum number is 50. The default value for **MAXSOC** is 50. If less than 50 are requested, **MAXSOC** defaults to 50.
SUBTASK	Optional input parameter. An 8-byte field that is used to identify a subtask in an address space that can contain multiple subtasks. It is suggested that you use your own job name as part of your subtask name. This will ensure that, if you issue more than one INITAPI command from the same address space, each SUBTASK parameter will be unique.
IDENT	Optional input parameter. A structure containing the identities of the TCP/IP address space and your address space. Specify **IDENT** on the INITAPI macro from an address space. The structure is as follows:

Field	Description
TCPNAME	Input parameter. An 8-byte character field set to the name of the TCP/IP address space that you want to connect to. If this is not specified, the system derives a value from the configuration file, as described in the *z/OS Communications Server: IP Configuration Reference*.
ADSNAME	Input parameter. An 8-byte character field set to the name of the calling program's address space. If this is not specified, the system will derive a value from the MVS control block structure.

MAXSNO	Output parameter. A fullword binary field containing the greatest descriptor number assigned to this application. The lowest socket number is 0. If you have 50 sockets, they are numbered in the range 0 – 49. If **MAXNO** is not specified, the value for **MAXNO** is 49.

ERRNO Output parameter. A fullword binary field. If **RETCODE** is negative, **ERRNO** field contains a valid error number. Otherwise, ignore **ERRNO**.

See Appendix B, "Socket call error return codes," on page 885 for information about **ERRNO** return codes.

RETCODE Output parameter. A fullword binary field that returns one of the following:

Value	Description
0	Successful call.
–1	Check **ERRNO** for an error code.

APITYPE Optional input parameter. A halfword binary field specifying the APITYPE. For details on usage, see "Task management and asynchronous function processing" on page 267.

Value	Meaning
2	APITYPE 2. This is the default.
3	APITYPE 3

For an APITYPE value of 3, the ASYNC parameter must be either 'ECB' or 'EXIT'.

UEEXIT Optional input parameter. A doubleword value as follows:

- A fullword specifying the entry point address of the user unsolicited event exit.
- A fullword specifying the token that will be presented to the unsolicited event exit at invocation.

ASYNC Optional input parameter. One of the following:

- The literal 'NO' indicating no asynchronous support.
- The literal 'ECB' indicating the asynchronous support using ECBs is to be used.
- The combination of the literal 'EXIT' and the address of a doubleword value as follows:
  - A fullword specifying the entry point address of the user's asynchronous event exit.
  - A fullword specifying the token which will be presented to the asynchronous event exit at invocation.

ERROR Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

TASK Input parameter. The location of the task storage area in your program.

IOCTL

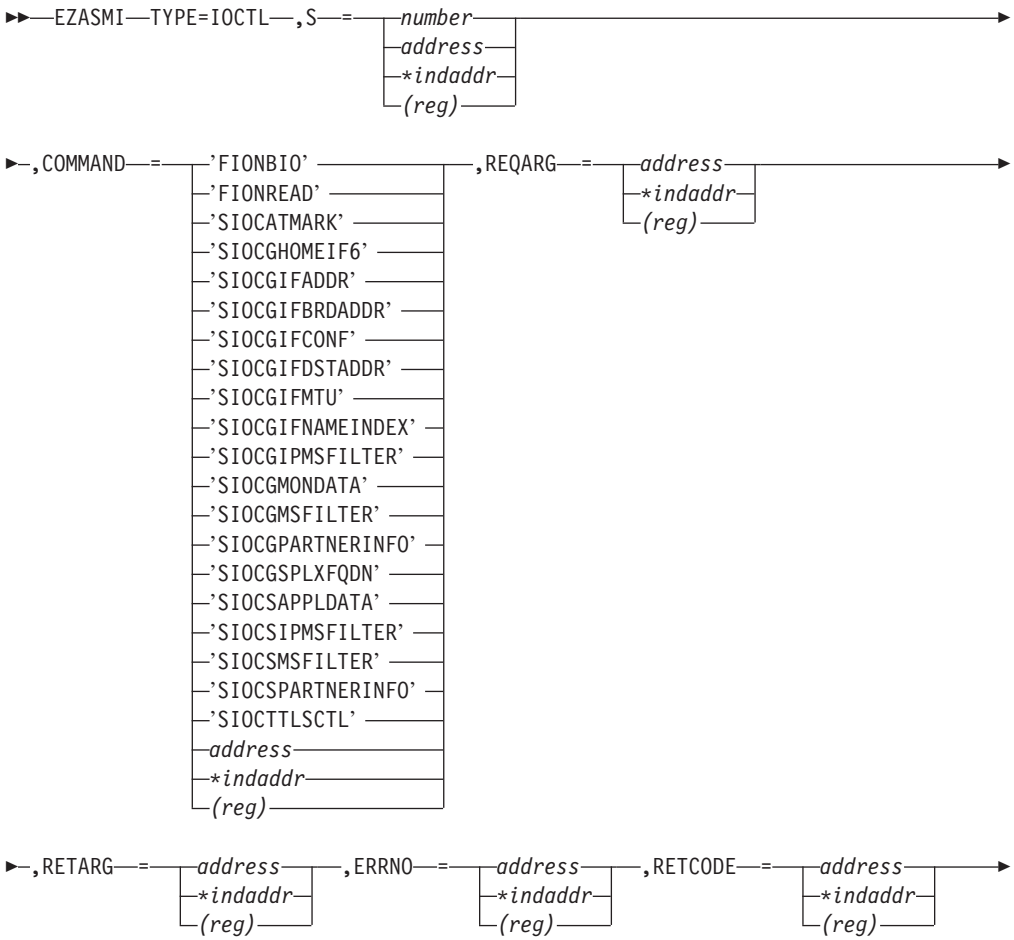
The IOCTL macro is used to control certain operating characteristics for a socket.

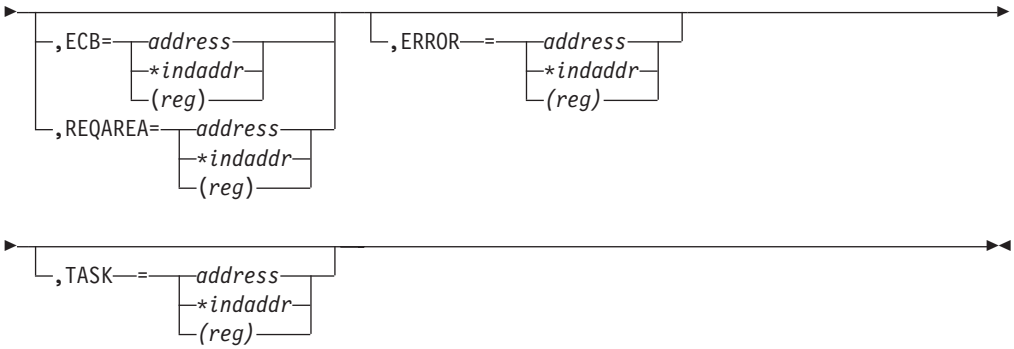
Before you issue an IOCTL macro, you must load a value representing the characteristic that you want to control in **COMMAND**.

Note: IOCTL can only be used with programming languages that support address pointers

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.





Keyword	Description
S	Input parameter. A value or the address of a halfword binary number specifying the socket to be controlled.
COMMAND	Input parameter. To control an operating characteristic, set this field to one of the following symbolic names. A value in a bit mask is associated with each symbolic name. By specifying one of these names, you are turning on a bit in a mask that communicates the requested operating characteristic to TCP/IP.

Value	Description
'FIONBIO'	Sets or clears blocking status.
'FIONREAD'	Returns the number of immediately readable bytes for the socket.

'SIOCATMARK'
Determines whether the current location in the data input is pointing to out-of-band data.

'SIOCGHOMEIF6'
Requests all IPv6 home interfaces.

- When the SIOCGHOMEIF6 IOCTL is issued, the REQARG must contain a Network Configuration Header. The NETCONFHDR is defined in the SYS1.MACLIB(BPXYIOC6). The following fields are input fields and must be filled out:

  NchEyeCatcher
  Contains Eye Catcher '6NCH'.

  NchIoctl
  Contains the command code.

  NchBufferLength
  Buffer length of storage pointed to by NchBufferPTR. This buffer needs to be large enough to contain all the IPv6 interface records. Each interface record is length of HOMEIFADDRESS. If the buffer is not large enough, then errno will be set to ERANGE and the NchNumEntryRet will be set to number of interfaces. Based on NchNumEntryRet

and size of HOMEIFADDRESS, calculate the necessary storage to contain the entire list.

NchBufferPtr
This is the pointer to an array of HOMEIF structures returned on a successful call. The size depends on the number of qualifying interfaces returned.

NchNumEntryRet
If return code is 0, this will be set to number of HOMEIFADDRESS returned. If errno is ERANGE, this will be set to number of qualifying interfaces. No interfaces are returned. Recalculate the NchBufferLength based on this value times the size of HOMEIFADDRESS.

'SIOCGIFADDR'
Requests the IPv4 network interface address for an interface name. For the address format, see the IOCN_SADDRIF field in the SYS1.MACLIB(BPXYIOCC) macro.

'SIOCGIFBRDADDR'
Requests the IPv4 network interface broadcast address for an interface name. For the address format, see the IOCN_SADDRIFBROADCAST field in the SYS1.MACLIB(BPXYIOCC) macro.

'SIOCGIFCONF'
Requests the IPv4 network interface configuration. The configuration consists of a variable number of 32-byte arrays. For the structure format, see the IOCN_IFREQ field in the SYS1.MACLIB(BPXYIOCC) macro.

- When IOCTL is issued, the first word in **REQARG** must contain the length (in bytes) of the array to be returned, and the second word in **REQARG** should be set to the number of interfaces requested times 32 (one address structure for each network interface). The maximum number of array elements that TCP/IP Services will return is 100.
- When IOCTL is issued, **RETARG** must be set to the beginning of the area in your program's storage, which is reserved for the array that is to be returned by IOCTL.
- The **COMMAND** 'SIOGIFCONF' returns a variable number of network interface configurations.

'SIOCGIFDSTADDR'
Requests the IPv4 network interface destination address. For the address format, see the IOCN_SADDRIFDEST field in the SYS1.MACLIB(BPXYIOCC) macro.

'SIOCGIFMTU'

Requests the IPv4 network interface MTU (maximum transmission unit). For the MTU format, see the IOCN_MTUSIZE field in the SYS1.MACLIB(BPXYIOCC) macro.

'SIOCGIFNAMEINDEX'

Requests all interface names and indexes including local loopback but excluding VIPAs. Information is returned for both IPv4 and IPv6 interfaces whether they are active or inactive. For IPv6 interfaces, information is only returned to an interface if it has at least one available IP address. See *z/OS Communications Server: IPv6 Network and Application Design Guide* for more information.

The configuration consists of the IF_NAMEINDEX structure which is defined in SYS1.MACLIB(BPX1IOCC).

- When the SIOCGIFNAMEINDEX IOCTL is issued, REQARG must contain the length of application storage (in bytes) being used to contain the returned IF_NAMEINDEX structure. The formula to compute this length is as follows:
  1. Determine the number of interfaces expected to be returned upon successful completion of this command.
  2. Multiply the number of interfaces by the array element (size of IF_NIINDEX, IF_NINAME, and IF_NIEXT) to determine the size of the array element.
  3. To the size of the array add the size of IF_NITOTALIF and IF_NIENTRIES to determine the total number of bytes needed to accommodate the name and index information returned.

  Upon successful completion of this call, the stack returns the number of entries required by the way of the IF_NITOTALIF field in the storage referenced by RETARG.
- When IOCTL is issued, RETARG must be set to the address of the beginning of the area in your program's storage which is reserved for the IF_NAMEINDEX structure that is to be returned by IOCTL.
- The command 'SIOCGIFNAMEINDEX' returns a variable number of all the qualifying network interfaces.

'SIOCGIPMSFILTER'

Requests a list of the IPv4 source addresses that comprise the source filter, with the current mode on a given interface and a multicast group for a socket. The source filter can include or exclude the set of source address, depending on the filter mode (MCAST_INCLUDE or MCAST_EXCLUDE). When

the SIOCGIPMSFILTER IOCTL is issued, the REQARG parameters must contain an IP_MSFILTER structure, which is defined in SYS1.MACLIB(BPXYIOCC). The IP_MSFILTER option must include an interface address (input), a multicast address (input), filter mode (output), the number of source addresses in the following array (input and output), and an array of source addresses (output). On input, the number of source addresses is the number of source addresses that fit in the input array. On output, the number of source addresses contains the total number of source filters in the source filter list for the multicast group. If the application does not know the size of the source list prior to processing, it makes a reasonable guess (for example, 0), and if when the call completes the number of source addresses is a greater value, then the IOCTL can be repeated with a larger buffer. On output, the number of source addresses is always updated to be the total number of sources in the filter, but the array holds as many source addresses as will fit, up to the minimum of the array size that is passed in as the input number.

Calculate the size of IP_MSFILTER value as follows:

1. Determine the expected number of source addresses.
2. Multiply the number of source addresses by the array element (size of the IMSF_SrcEntry value) to determine the size of all array elements.
3. Add the size of all array elements to the size of the IMSF_Header value to determine the total number of bytes that are needed to accommodate the source addresses information that is returned.

'SIOCGMONDATA'

Returns TCP/IP stack IPv4 and IPv6 statistical counters. REQARG must point to a MonDataIn structure. The counters are returned in a MonDataOut structure. Both of these structures are defined in EZBZMONP in SEZANMAC.

Note: The ARP counter data provided differs depending on the type of device. See the *z/OS Communications Server: IP Configuration Guide* for information about devices that support ARP Offload and what is supported for each device.

'SIOCGMSFILTER'

Requests a list of the IPv4 or IPv6 source addresses that comprise the source filter, with the current mode on a given interface index and a multicast group for a socket. The source filter can include or

exclude the set of source address, depending on the filter mode (MCAST_INCLUDE or MCAST_EXCLUDE). When the SIOCGMSFILTER IOCTL is issued, the REQARG parameter must contain a GROUP_FILTER structure, which is defined in SYS1.MACLIB(BPXYIOCC). The GROUP_FILTER option must include an interface index (input), a sockaddr_storage structure of the multicast address (input), filter mode (output), the number of source addresses in the following array (input and output), and an array of the sockaddr_storage structure of source addresses (output). On input, the number of source addresses is the number of source addresses that will fit in the input array. On output, the number of source addresses contains the total number of source filters in the source filter list for the multicast group. If the application does not know the size of the source list prior to processing, it can make a reasonable guess (for example, 0), and if when the call completes the number of source addresses is a greater value, the IOCTL can be repeated with a buffer that is large enough. That is, on output, the number of source addresses is always updated to be the total number of sources in the filter, but the array holds as many source addresses as will fit, up to the minimum of the array size passed in as the input number.

The application calculates the size of GROUP_FILTER value in the following way:

1. Determines the expected number of source addresses.
2. Multiplies the number of source addresses by the array element (size of the GF_SrcEntry value) to determine the size of all array elements.
3. Adds the size of all array elements to the size of the GF_Header value to determine the total number of bytes that are needed to accommodate the source-address information that is returned.

'SIOCGPARTNERINFO'

Provides an interface for an application to retrieve security credentials about its partner. When you issue the SIOCGPARTNERINFO IOCTL, the REQARG parameter must contain a PartnerInfo structure as defined by the EZBPINFA macro in SEZANMAC. For more information about using the SIOCGPARTNERINFO IOCTL, see *z/OS Communications Server: IP Programmer's Guide and Reference*.

'SIOCGSPLXFQDN'

Requests the fully qualified domain name for a given server and group name in a sysplex. This is a

special purpose command to support applications that have registered with WorkLoad Manager (WLM) for connection optimization services by way of the DNS. When IOCTL is issued, REQARG and RETARG must use the address structure sysplexFqDn, which contains the pointer for sysplexFqDnData structure. The fully qualified domain name is returned in the domainName field of sysplexFqDnData. The group name and the server name can be passed using the groupName and serverName fields of sysplexFqDnData structure. Their structures are defined in the EZBZSDNP MACRO file.

'SIOCSAPPLDATA'

The SIOCSAPPLDATA IOCTL enables an application to set 40 bytes of user-specified application data against a socket endpoint. You can use this application data to identify socket endpoints in interfaces such as Netstat, SMF, or network management applications. When you issue the SIOCSAPPLDATA IOCTL, the REQARG parameter must contain a SetApplData structure as defined by the EZBYAPPL macro. See *z/OS Communications Server: IP Programmer's Guide and Reference* for more information about programming the SIOCSAPPLDATA IOCTL.

SetAD_buffer: The user-defined application data is 40 bytes of data that identifies the endpoint with the application. You can obtain this application data from the following sources:

- Netstat reports. The information is displayed in the ALL/-A report. If you use the APPLDATA modifier, then the information also is displayed on the ALLConn/-a and COnn/-c reports.
- The SMF 119 TCP connection termination record. See TCP connection termination record (subtype 2) in *z/OS Communications Server: IP Programmer's Guide and Reference* for more information.
- Network management interfaces. See Network management interfaces in *z/OS Communications Server: IP Programmer's Guide and Reference* for more information.

Consider the following guidelines:

- The application must document the content, format and meaning of the ApplData strings that it associates with the sockets that it owns.
- The application should uniquely identify itself with printable EBCDIC characters at the beginning of the string. Strings beginning with 3-character IBM product identifiers, such as TCP/IP's EZA or EZB, are reserved for IBM use. IBM product identifiers begin with a letter in the range A-I.

- Use printable EBCDIC characters for the entire string to enable searching with Netstat filters.

Tip: Separate application data elements with a blank for easier reading.

'SIOCSIPMSFILTER'

Sets a list of the IPv4 source addresses that comprise the source filter, with the current mode on a given interface and a multicast group for a socket. The source filter can include or exclude the set of source address, depending on the filter mode (MCAST_INCLUDE or MCAST_EXCLUDE). When the SIOCSIPMSFILTER IOCTL is issued, the REQARG value must contain an IP_MSFILTER structure, which is defined in SYS1.MACLIB(BPXYIOCC). The IP_MSFILTER option must include an interface address, a multicast address, filter mode, the number of source addresses in the following array, and an array of source addresses.

Calculate the size of the IP_MSFILTER structure as follows:

1. Determine the expected number of source addresses.
2. Multiply the number of source addresses by the array element (size of IMSF_SrcEntry) to get the size of all array elements.
3. Add the size of all array elements to the size of the IMSF_Header value to get the total number of bytes needed to accommodate the source addresses information that is returned.

'SIOCSMSFILTER'

Sets a list of the IPv4 or IPv6 source addresses that comprise the source filter, with the current mode on a given interface index and a multicast group for a socket. The source filter can include or exclude the set of source address, depending on the filter mode (MCAST_INCLUDE or MCAST_EXCLUDE). When the SIOCSMSFILTER IOCTL is issued, the REQARG parameter must contain a GROUP_FILTER option structure, which is defined in SYS1.MACLIB(BPXYIOCC). The GROUP_FILTER option must include an interface index, a sockaddr_storage structure of the multicast address, filter mode, the number of source addresses in the following array, and an array of the sockaddr_storage structure of source addresses.

Calculate the size of the GROUP_FILTER value as follows:

1. Determine the expected number of source addresses.

2. Multiply the number of source addresses by the array element (size of the GF_SrcEntry value) to determine the size of all array elements.
3. Add the size of all array elements to the size of the GF_Header value to determine the total number of bytes needed to accommodate the source addresses information that is returned.

'SIOCSPARTNERINFO'

The SIOCSPARTNERINFO IOCTL sets an indicator to retrieve the partner security credentials during connection setup and saves the information. In this way, an application can issue a SIOCGPARTNERINFO IOCTL without suspending the application or can at least minimize the time it takes to retrieve the information. When you issue the SIOCSPARTNERINFO IOCTL, the REQARG parameter must contain a constant value, PI_REQTYPE_SET_PARTNERDATA, as defined by the EZBPINFA macro in SEZANMAC. For more information about using the SIOCSPARTNERINFO IOCTL, see *z/OS Communications Server: IP Programmer's Guide and Reference*.

SIOCTTLSCTL

Controls Application Transparent Transport Layer Security (AT-TLS) for the connection. REQARG and RETARG must contain a TTLS_IOCTL structure. If a partner certificate is requested, the TTLS_IOCTL must include a pointer to additional buffer space and the length of that buffer. Information is returned in the TTLS_IOCTL structure. If a partner certificate is requested and one is available, it is returned in the additional buffer space. The TTLS_IOCTL structure for assembler programs is defined in EZBZTLSP in SEZANMAC For details about usage, see the Application Transparent TLS information in *z/OS Communications Server: IP Programmer's Guide and Reference*.

Restriction: Use of this ioctl for functions other than query requires that the AT-TLS policy mapped to the connection be defined with the ApplicationControlled parameter set to On.

REQARG and RETARG

Point to arguments that are passed between the calling program and IOCTL. The length of the argument is determined by the **COMMAND** request. **REQARG** is an input parameter or an output parameter and is used to pass and receive arguments to and from IOCTL. **RETARG** is an output parameter and is used for arguments returned by IOCTL.

For the lengths and meanings of **REQARG** and **RETARG** for each **COMMAND** type, see Table 16 on page 355.

Table 16. IOCTL macro arguments

COMMAND/CODE	SIZE	REQARG	SIZE	RETARG
FIONBIO X'8004A77E'	4	Set socket mode to: X'00'=blocking; X'01'=nonblocking.	0	Not used.
FIONREAD X'4004A77F'	0	Not used.	4	Number of characters available for read.
SIOCATMARK X'4004A707'	0	Not used.	4	X'00'= not at OOB data X'01'= at OOB data.
SIOCGHOMEIF6 X'C014F608'	20	NetConfHdr		See NETCONFHDR in macro BPXYIOC6.
SIOCGIFADDR X'C020A70D'	32	First 16-bytes - interface name. Last 16-bytes - not used.	32	Network interface address, see the IOCN_SADDRIF field in the SYS1.MACLIB (BPXYIOCC) macro for format.
SIOCGIFBRDADDR X'C020A712'	32	First 16-bytes - interface name. Last 16-bytes - not used.	32	Network interface address, see the IOCN_SADDRIF BROADCAST field in the SYS1.MACLIB (BPXYIOCC) macro for format.
SIOCGIFCONF X'C008A714'	8	First 4 bytes- size of return buffer. Last 4 bytes - address of return buffer.	See note[1].	
SIOCGIFDSTADDR X'C020A70F'	32	First 16-bytes - interface name. Last 16-bytes - not used.	32	Destination interface address, see the IOCN_SADDRIFDEST field in the SYS1.MACLIB (BPXYIOCC) macro for format.
SIOCGIFMTU X'C020A726'	32	First 16-bytes - interface name. Last 16-bytes - not used.	32	IPv4 interface MTU (maximum transmission unit), see the IOCN_MTUSIZE field in the SYS1.MACLIB (BPXYIOCC) macro for format.
SIOCGIFNAMEINDEX X'4000F603'	4	First 4 bytes size of return buffer.		See IF_NAMEINDEX in macro BPXYIOCC.
SIOCGIPMSFILTER X'C000A724'	—	See IP_MSFILTER structure in macro BPXYIOCC. See note 3.	0	Not used
SIOCGMONDATA X'C018D902'	—	See MONDATAIN structure in macro EZBZMONP.	—	See MONDATAOUT structure in macro EZBZMONP.
SIOCGMSFILTER X'C000F610'	—	See GROUP_FILTER structure in macro BPXYIOCC. See note 4.	0	Not used
SIOCGPARTNERINFO X'C000F612'	—	For the PartnerInfo structure layout, see SEZANMAC(EZBPINFA). See note 5.	0	Not used
SIOCGSPLXFQDN X'C018D905'	408[2]	See sysplexFqDn and sysplexFqDnData in macro EZBZSDNP.	408[2]	See sysplexFqDn and sysplexFqDnData in macro EZBZSDNP.
SIOCSAPPLDATA X'8018D90C'	—	See SETAPPLDATA structure in macro EZBYAPPL.	0	Not used
SIOCSIPMSFILTER X'8000A725'	—	See IP_MSFILTER structure in macro BPXYIOCC. See note 3.	0	Not used
SIOCSMSFILTER X'8000F611'	—	See GROUP_FILTER structure in macro BPXYIOCC. See note 4.	0	Not used
SIOCSPARTNERINFO X'8004F613'	4	See PI_REQTYPE_SET_PARTNERDATA in SEZANMAC(EZBPINFA).	0	Not used
SIOCTTLSCTL X'C038D90B'	56	For IOCTL structure layout, see SEZANMAC (EZBZTLSP).	56	For IOCTL structure layout, see SEZANMAC (EZBZTLSP).

Notes:

1. The second 4-bytes in the RETARG is the address of the user buffer containing an array of 32-byte socket name structures (see IOCN_IFREQ in the SYS1.MACLIB(BPXYIOCC) macro for format). Each interface is assigned a 32-byte array element and the REQARG value should be set to the number of interfaces times 32. TCP/IP services can return up to 100 array elements.
2. REQARG and RETARG must contain both sysplexFqDn and sysplexFqDnData.
3. The size of the IP_MSFILTER structure must be equal to or greater than the size of the IMSF_Header.
4. The size of the GROUP_FILTER structure must be equal to or greater than the size of the GF_Header.
5. The size of the PartnerInfo structure must be equal to or greater than the PI_FIXED_SIZE value.

ERRNO Output parameter. A fullword binary field. If **RETCODE** is negative, **ERRNO** contains a valid error number. Otherwise, ignore **ERRNO**.

See Appendix B, "Socket call error return codes," on page 885 for information about **ERRNO** return codes.

RETCODE Output parameter. A fullword binary field that returns one of the following:

Value	Description
0	Successful call.
–1	Check **ERRNO** for an error code.

ECB or REQAREA

Input parameter. This parameter is required if you are using APITYPE=3. It points to a 104-byte field containing:

For ECB

A 4-byte **ECB** posted by TCP/IP when the macro completes.

For REQAREA

A 4-byte user token (set by you) that is presented to your exit when the response to this function request is complete.

For ECB/REQAREA

The last 100 bytes is a storage field used by the interface to save the state information.

Note: This storage must not be modified until the macro function has completed and the **ECB** has been posted, or the asynchronous exit has been driven.

ERROR Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

TASK Input parameter. The location of the task storage area in your program.

LISTEN

Only servers use the LISTEN macro. The LISTEN macro:

- Completes the bind, if BIND has not already been called for the socket. If the BIND has already been called for in the socket, the LISTEN macro uses what was specified in the BIND call.
- Creates a connection-request queue of a specified number of entries for incoming connection requests.

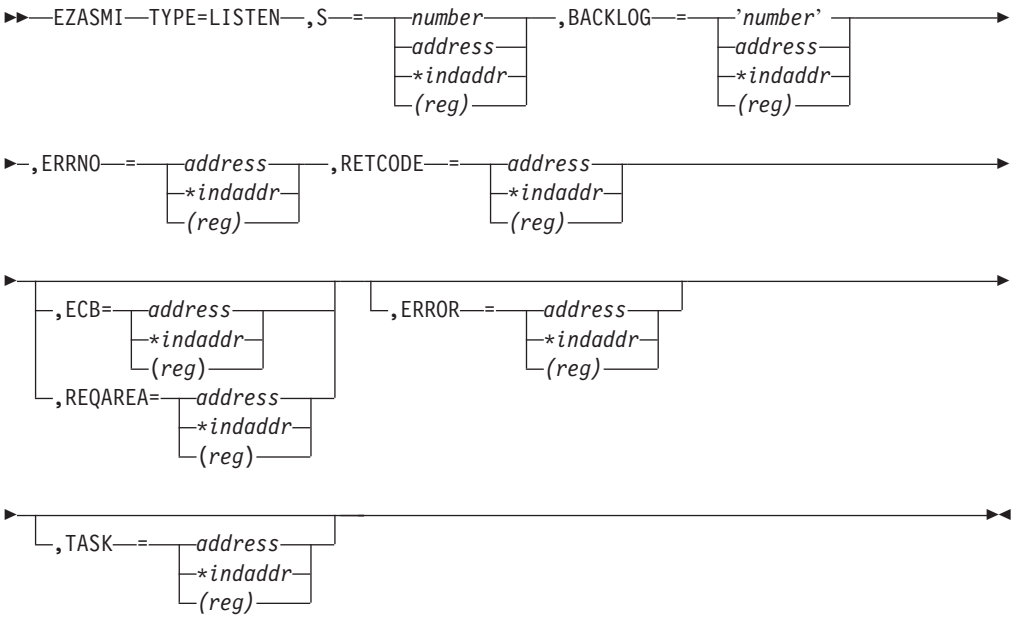
The LISTEN macro is typically used by a concurrent server to receive connection requests from clients. When a connection request is received, a new socket is created by a later ACCEPT macro. The original socket continues to listen for additional connection requests.

Note: Concurrent servers and iterative servers use this macro. An iterative server handles one client at a time. A concurrent server receives connection requests from multiple clients and creates subtasks that process the client requests. When a subtask is created, the concurrent server gets a new socket,

passes the new socket to the subtask, and dissociates itself from the connection. The TCP/IP Listener program is an example of a concurrent server.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode
Interrupt status:	Enabled for interrupts
Locks:	Unlocked
Control parameters:	All parameters must be addressable by the caller and in the primary address space



Keyword	Description
S	Input parameter. A value or the address of a halfword binary number specifying the socket descriptor.
BACKLOG	Input parameter. A value (enclosed in single quotation marks) or the address of a fullword binary number specifying the number of messages that can be backlogged. **Rule:** The BACKLOG value specified on the LISTEN macro is limited to the value configured by the SOMAXCONN statement in the stack's TCPIP PROFILE (default=10); no error is returned if a larger backlog is requested. You might need to update

SOMAXCONN if a larger backlog is desired. See the SOMAXCONN information in the *z/OS Communications Server: IP Configuration Reference* for details.

ERRNO Output parameter. A fullword binary field. If **RETCODE** is negative, **ERRNO** contains a valid error number. Otherwise, ignore **ERRNO**.

See Appendix B, "Socket call error return codes," on page 885 for information about **ERRNO** return codes.

RETCODE Output parameter. A fullword binary field that returns one of the following:

Value	Description
0	Successful call.
–1	Check **ERRNO** for an error code.

ECB or REQAREA

Input parameter. This parameter is required if you are using APITYPE=3. It points to a 104-byte field containing:

For ECB

A 4-byte **ECB** posted by TCP/IP when the macro completes.

For REQAREA

A 4-byte user token (set by you) that is presented to your exit when the response to this function request is complete.

For ECB/REQAREA

The last 100 bytes is a storage field used by the interface to save the state information.

Note: This storage must not be modified until the macro function has completed and the **ECB** has been posted, or the asynchronous exit has been driven.

ERROR Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

TASK Input parameter. The location of the task storage area in your program.

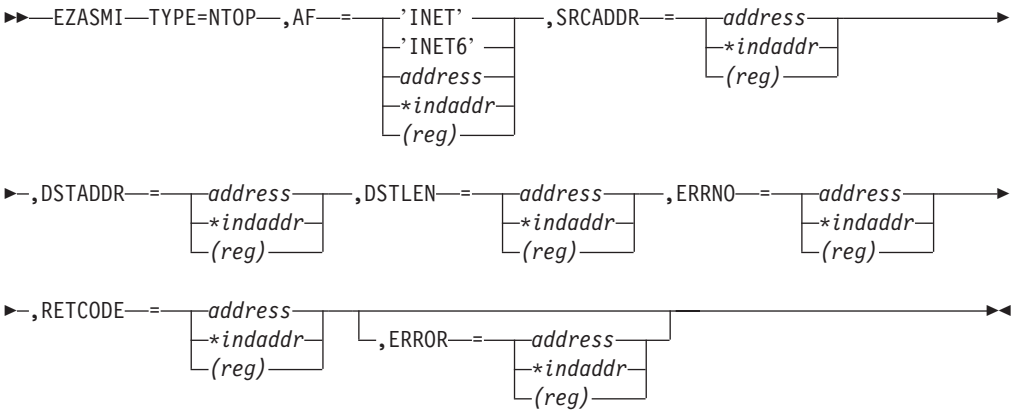
NTOP

The **NTOP** macro converts an IP address from its numeric binary form into a standard text presentation form. On successful completion, **NTOP** returns the converted IP address in the buffer provided.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.

ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.



Keyword **Description**

AF Input parameter. Specify one of the following:

Value Description

'INET' or a decimal '2'
Indicates the address being converted is an IPv4 address.

'INET6' or a decimal '19'
Indicates the address being converted is an IPv6 address.

AF can also indicate a fullword binary number specifying the address family.

SRCADDR Input parameter. A field containing the numeric binary form of the IPv4 or IPv6 address being converted. For an IPv4 address, this field must be a fullword. For an IPv6 address, this field must be 16 bytes. The address must be in network byte order.

DSTADDR Input parameter. A field used to receive the standard text presentation form of the IPv4 or IPv6 address being converted. For IPv4 the address will be in dotted-decimal format and for IPv6 the address will be in colon-hex format. The size of the converted IPv4 address will be a maximum of 15 bytes and the size of the converted IPv6 address will be a maximum of 45 bytes. Consult the value returned in **DSTLEN** for the actual length of the value in **DSTADDR**.

DSTLEN Initially, an input parameter. The address of a binary halfword field that is used to specify the length of the **DSTADDR** field on input and upon a successful return will contain the length of the converted IP address.

ERRNO Output parameter. A fullword binary field. If **RETCODE** is negative, **ERRNO** contains a valid error number. Otherwise, ignore the **ERRNO** field.

See Appendix B, “Socket call error return codes,” on page 885 for information about **ERRNO** return codes.

RETCODE A fullword binary field that returns one of the following:

Value	Description
0	Successful call.
–1	Check **ERRNO** for an error code.

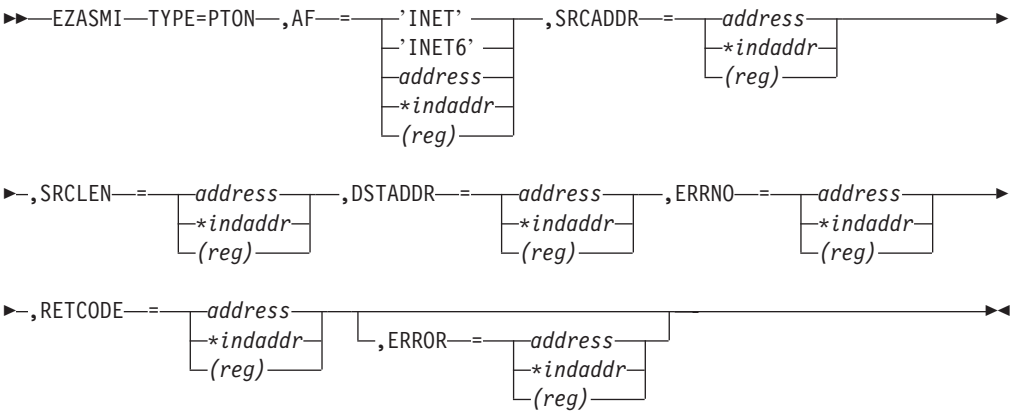
ERROR Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

PTON

The **PTON** macro converts an IP address in its standard text presentation form to its numeric binary form. On successful completion, **PTON** returns the converted IP address in the buffer provided.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See “Addressability mode (Amode) considerations” under “CALL instruction API environmental restrictions and programming requirements” on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.



Keyword	Description
AF	Input parameter. Specify one of the following:

Value	Description

'INET' or a decimal '2'
Indicates the address being converted is an IPv4 address.

'INET6' or a decimal '19'
Indicates the address being converted is an IPv6 address.

AF can also indicate a fullword binary number specifying the address family.

SRCADDR Input parameter. A field containing the standard text presentation form of the IPv4 or IPv6 address being converted. For IPv4 the address must be in dotted-decimal format and for IPv6 the address must be in colon-hex format. The size of the field for an IPv4 address must be 15 bytes and the size for an IPv6 address must be 45 bytes.

SRCLEN Input parameter. A binary halfword field that must contain the length of the IP address to be converted.

DSTADDR A field used to receive the numeric binary form of the IPv4 or IPv6 address being converted in network byte order. For an IPv4 address, this field must be a fullword. For an IPv6 address, this field must be 16 bytes.

ERRNO Output parameter. A fullword binary field. If **RETCODE** is negative, **ERRNO** contains a valid error number. Otherwise, ignore the **ERRNO** field.

See Appendix B, "Socket call error return codes," on page 885 for information about **ERRNO** return codes.

RETCODE A fullword binary field that returns one of the following:

Value	Description
0	Successful call.
–1	Check **ERRNO** for an error code.

ERROR Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

READ

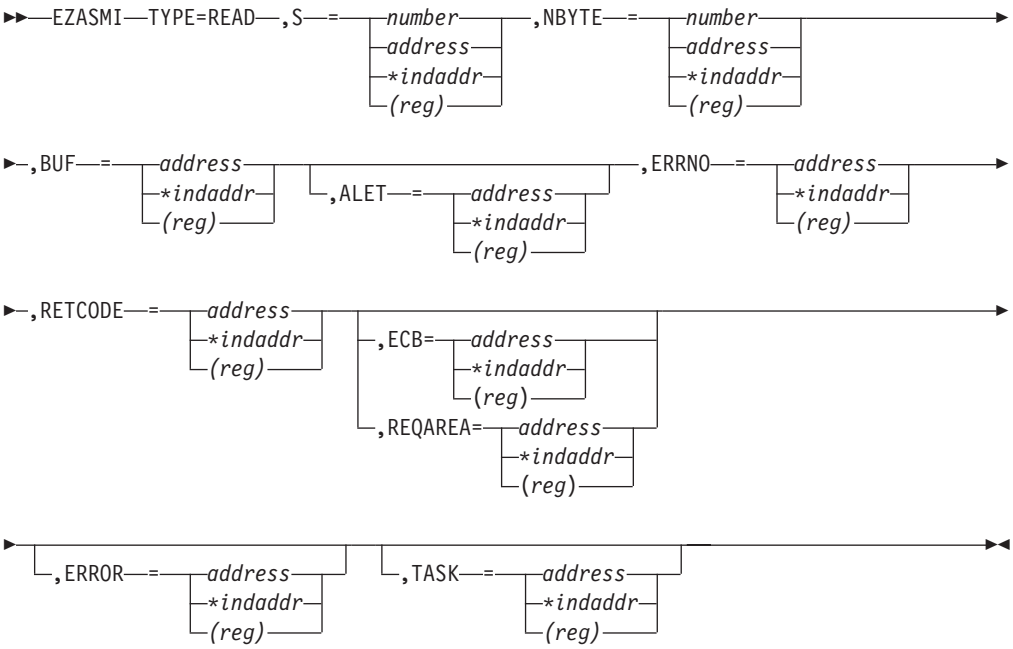
The READ macro reads data on a socket and stores it in a buffer. The READ macro applies only to connected sockets.

For datagram sockets, the READ call returns the entire datagram that was sent. If a datagram packet is too long to fit in the supplied buffer, datagram sockets discard extra bytes.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.

ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.



Keyword	Description
S	Input parameter. A value or the address of a halfword binary number specifying the socket that is going to read the data.
NBYTE	Input parameter. A fullword binary number set to the size of **BUF**. READ does not return more than the number of bytes of data in **NBYTE** even if more data is available.
BUF	On input, a buffer to be filled by completion of the call. The length of **BUF** must be at least as long as the value of **NBYTE**.
ALET	Optional input parameter. A fullword binary field containing the **ALET** or **BUF**. The default is 0 (primary address space). If a nonzero ALET is specified, the ALET must represent a valid entry in the dispatchable unit access list (DU-AL) for the task issuing this call. Note that ALETs can only be specified for synchronous socket calls (for example, ECB/REQAREA cannot be specified). An exception to this is an ALET representing a SCOPE=COMMON data space.
ERRNO	Output parameter. A fullword binary field. If **RETCODE** is negative, **ERRNO** contains a valid error number. Otherwise, ignore the **ERRNO** field. See Appendix B, "Socket call error return codes," on page 885 for information about **ERRNO** return codes.
RETCODE	A fullword binary field that returns one of the following:

Value	Description
0	A 0 return code indicates that the connection is closed and no data is available.
>0	A positive value indicates the number of bytes copied into the buffer.
–1	Check **ERRNO** for an error code.

ECB or REQAREA
Input parameter. This parameter is required if you are using APITYPE=3. It points to a 104-byte field containing the following:

For ECB
A 4-byte **ECB** posted by TCP/IP when the macro completes.

For REQAREA
A 4-byte user token (set by you) that is presented to your exit when the response to this function request is complete.

For ECB/REQAREA
The last 100 bytes is a storage field used by the interface to save the state information.

Note: This storage must not be modified until the macro function has completed and the **ECB** has been posted or the asynchronous exit has been driven.

ERROR Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

TASK Input parameter. The location of the task storage area in your program.

READ returns up to the number of bytes specified by **NBYTE**. If less than the number of bytes requested is available, the READ macro returns the number currently available.

If data is not available for the socket and the socket is in blocking mode, the READ macro blocks the caller until data arrives. If data is not available and the socket is in nonblocking mode, READ returns a -1 and sets ERRNO to 35 (EWOULDBLOCK). See “IOCTL” on page 345 or “FCNTL” on page 287 for a description of how to set the nonblocking mode.

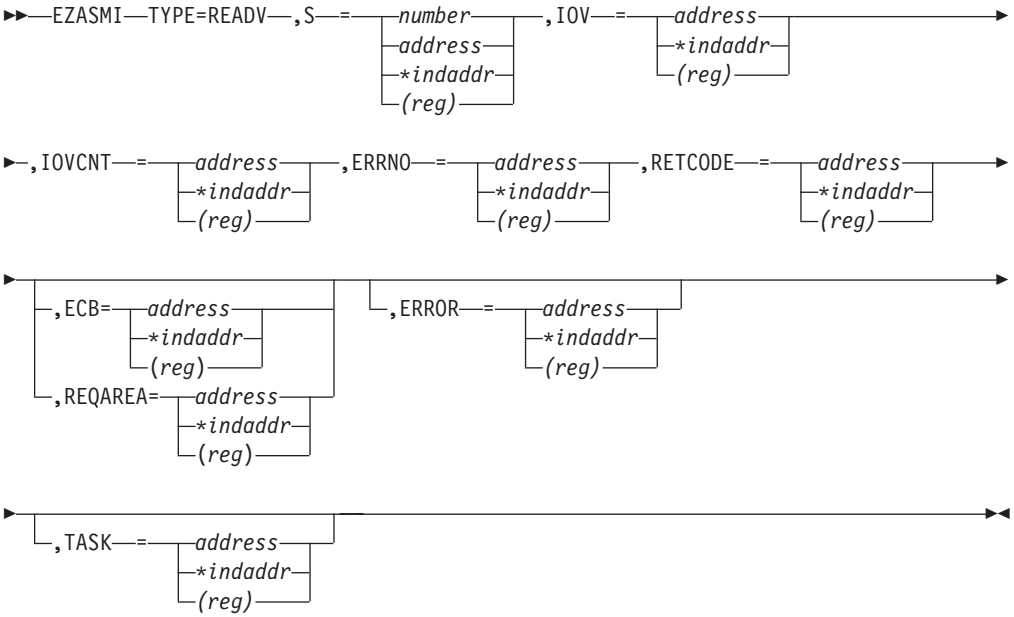
READV

The READV macro reads data on a socket and stores it in a set of buffers. If a datagram packet is too long to fit in the supplied buffer, datagram sockets discard extra bytes.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.

Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.



Keyword **Description**

S Input parameter. A value or the address of a halfword binary number specifying the descriptor of the socket into which the data is to be read.

IOV An array of three fullword structures with the number of structures equal to the value in **IOVCNT** and the format of the structures as follows:

Fullword 1
Input parameter. A buffer to be filled by the completion of the call.

Fullword 2
Input parameter. The **ALET** for this buffer. If the buffer is in the primary address space, this should be zeros.

If a nonzero *ALET* is specified, the *ALET* must represent a valid entry in the dispatchable unit access list (DU-AL) for the task issuing this call. Note that *ALET*s can only be specified for synchronous socket calls (for example, ECB/REQAREA cannot be specified). An exception to this is an *ALET* representing a SCOPE=COMMON data space.

Fullword 3
Input parameter. The length of the data buffer referred to in Fullword 1.

IOVCNT Input parameter. A fullword binary field specifying the number of data buffers provided for this call. The limit is 120.

ERRNO Output parameter. A fullword binary field. If **RETCODE** is negative, this contains an error number.

RETCODE A fullword binary field that returns one of the following:

Value	Description
0	A 0 return code indicates that the connection is closed and no data is available.
>0	A positive value indicates the number of bytes copied into the buffer.
−1	Check **ERRNO** for an error code.

ECB or REQAREA
Input parameter. This parameter is required if you are using APITYPE=3. It points to a 104-byte field containing:

For ECB
A 4-byte **ECB** posted by TCP/IP when the macro completes.

For REQAREA
A 4-byte user token (set by you) that is presented to your exit when the response to this function request is complete.

For ECB/REQAREA
The last 100 bytes is a storage field used by the interface to save the state information.

Note: This storage must not be modified until the macro function has completed and the **ECB** has been posted, or the asynchronous exit has been driven.

ERROR Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

TASK Input parameter. The location of the task storage area in your program.

RECV

The RECV macro receives data on a socket and stores it in a buffer. The RECV macro applies only to connected sockets. RECV can read the next message, but leaves the data in a buffer, and can read out-of-band data. RECV gives you the option of setting **FLAGS** with the **FLAGS** parameter.

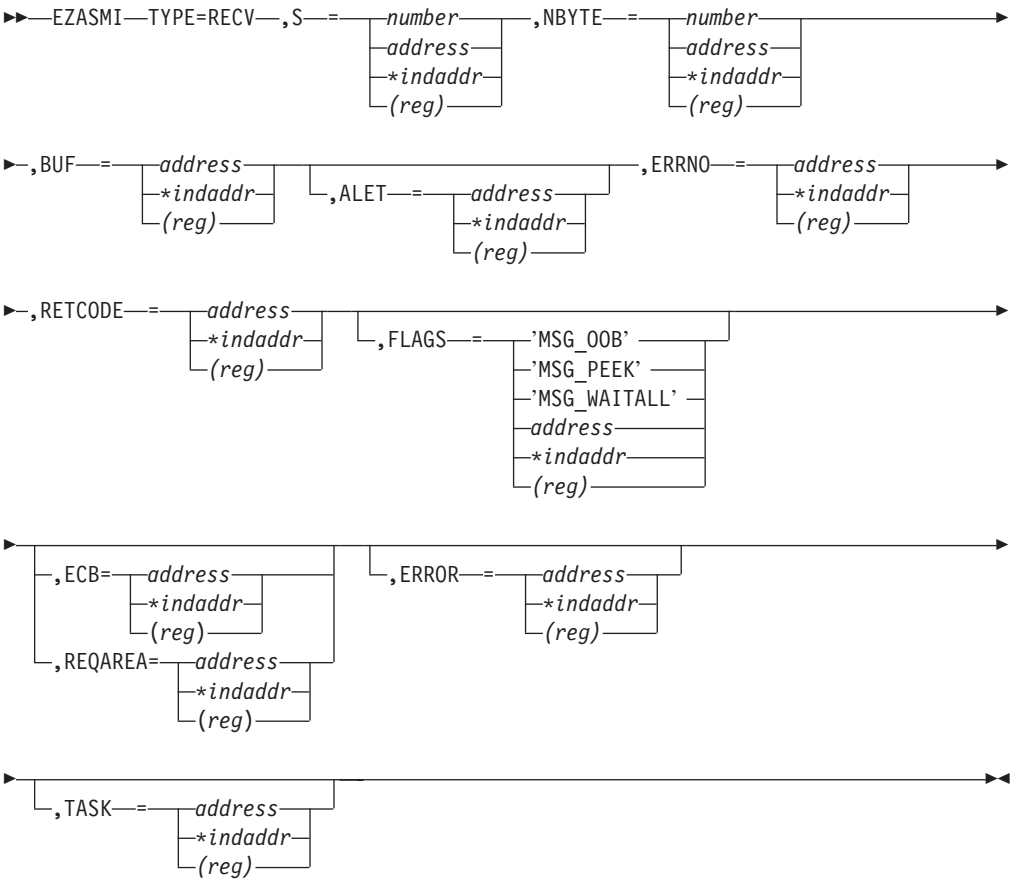
Note: Out-of-band data (called urgent data in TCP) appears to the application like a separate stream of data from the main data stream.

RECV returns the length of the incoming message or data. If a datagram packet is too long to fit in the supplied buffer, datagram sockets discard extra bytes.

For stream sockets, the data is processed like streams of information with no boundaries separating data. For example, if applications A and B are connected with a stream socket and Application A sends 1000 bytes, each call to RECV can return 1 byte, or 10 bytes, or the entire 1000 bytes. Therefore, applications using stream sockets should place RECV in a loop that repeats the call until all data has been received.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.



Keyword **Description**

S Input parameter. A value or the address of a halfword binary number specifying the socket descriptor.

NBYTE Input parameter. A fullword binary number set to the size of **BUF**. RECV does not receive more than the number of bytes of data in **NBYTE** even if more data is available.

BUF On input, a buffer to be filled by completion of the call. The length of **BUF** must be at least as long as the value of **NBYTE**.

ALET Optional input parameter. A fullword binary field containing the **ALET** of **BUF**. The default is 0 (primary address space).

If a nonzero *ALET* is specified, the *ALET* must represent a valid entry in the dispatchable unit access list (DU-AL) for the task issuing this call. Note that *ALET*s can only be specified for synchronous socket calls (for example, ECB/REQAREA cannot be specified). An exception to this is an *ALET* representing a SCOPE=COMMON data space.

ERRNO Output parameter. A fullword binary field. If **RETCODE** is negative, this field contains an error number. See Appendix B, "Socket call error return codes," on page 885 for information about **ERRNO** return codes.

RETCODE A fullword binary field that returns one of the following:

Value	Description
0	A 0 return code indicates that the connection is closed and no data is available.
>0	A positive value indicates the number of bytes copied into the buffer.
−1	Check **ERRNO** for an error code.

FLAGS Input parameter. **FLAGS** can be a literal value or a fullword binary field.

Literal Value	Binary Value	Description
'MSG_OOB'	X'00000001'	Receive out-of-band data (stream sockets only). Out-of-band data can be read if the SO_OOBINLINE option is set for the socket regardless of whether the MSG_OOB flag is set.
'MSG_PEEK'	X'00000002'	Peek at the data, but do not destroy the data. If the peek flag is set, the next receive operation reads the same data.
'MSG_WAITALL'	X'00000040'	Requests that the function block until the full amount of requested data can be returned (stream sockets only). The function might return a smaller amount of data if the connection is terminated, if an error is pending, or if the SO_RCVTIMEO field is set and the timer expired for the socket.

ECB or REQAREA
Input parameter. This parameter is required if you are using APITYPE=3. It points to a 104-byte field containing:

For ECB
A 4-byte **ECB** posted by TCP/IP when the macro completes.

For REQAREA
A 4-byte user token (set by you) that is presented to your exit when the response to this function request is complete.

For ECB/REQAREA
The last 100 bytes is a storage field used by the interface to save the state information.

Note: This storage must not be modified until the macro function has completed and the **ECB** has been posted, or the asynchronous exit has been driven.

ERROR Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

TASK Input parameter. The location of the task storage area in your program.

If data is not available for the socket and the socket is in blocking mode, the RECV macro blocks the caller until data arrives. If data is not available and the socket is in nonblocking mode, RECV returns a –1 and sets **ERRNO** to 35 (EWOULDBLOCK). See "FCNTL" on page 287 or "IOCTL" on page 345 for a description of how to set nonblocking mode.

RECVFROM

The RECVFROM macro receives data for a socket and stores it in a buffer. RECVFROM returns the length of the incoming message or data stream.

If data is not available for the socket designated by descriptor S, and socket S is in blocking mode, the RECVFROM call blocks the caller until data arrives.

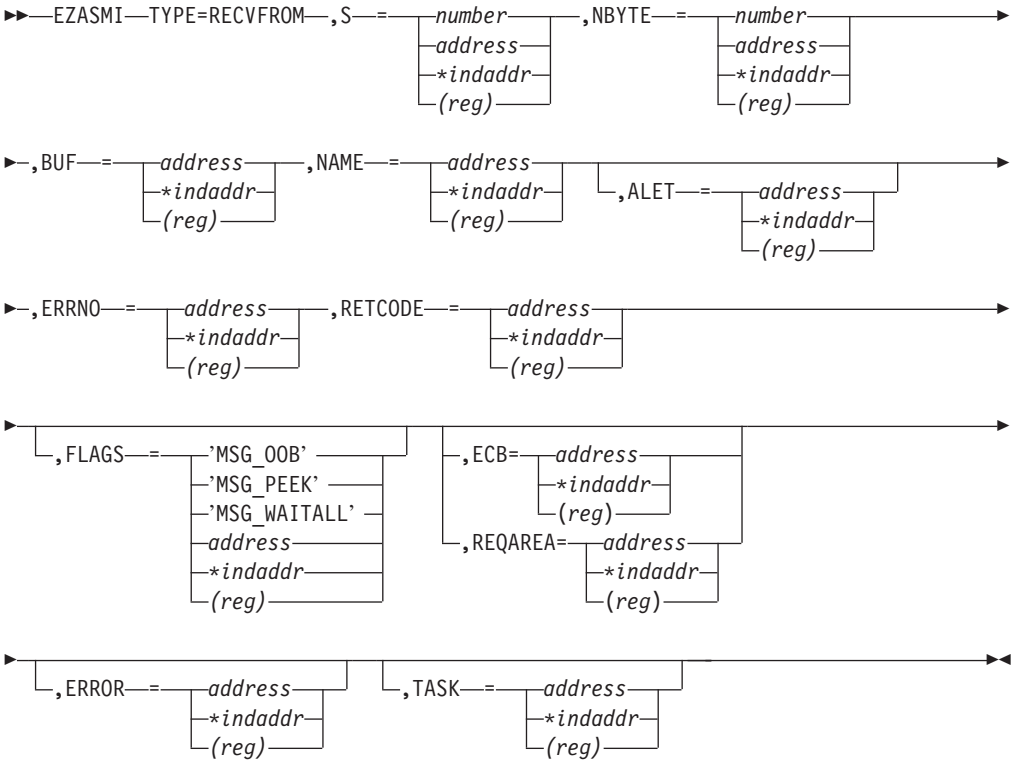
If data is not available and socket S is in nonblocking mode, RECVFROM returns a –1 and sets **ERRNO** to 35 (EWOULDBLOCK). Because RECVFROM returns the socket address in the **NAME** structure, it applies to any datagram socket, whether connected or unconnected. See "FCNTL" on page 287 or "IOCTL" on page 345 for a description of how to set nonblocking mode. If a datagram packet is too long to fit in the supplied buffer, datagram sockets discard extra bytes.

For stream sockets, the data is processed as streams of information with no boundaries separating data. For example, if applications A and B are connected with a stream socket and Application A sends 1000 bytes, each call to this function can return 1 byte, or 10 bytes, or the entire 1000 bytes. Applications using stream sockets should place RECVFROM in a loop that repeats until all of the data has been received.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.

Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.



Keyword	Description
S	Input parameter. A value or the address of a halfword binary number specifying the socket to receive the data.
NBYTE	Input parameter. A value or the address of a fullword binary number specifying the length of the input buffer. **NBYTE** must first be initialized to the size of the buffer associated with **NAME**. On return the **NBYTE** contains the number of bytes of data received.
BUF	On input, a buffer to be filled by completion of the call. The length of **BUF** must be at least as long as the value of **NBYTE**.
NAME	Initially, the IPv4 or IPv6 application provides a pointer to a structure that will contain the peer socket name on completion of the call. If the **NAME** parameter value is nonzero, the IPv4 or IPv6 source address of the message is filled in with the address of who sent the datagram. Include the SYS1.MACLIB(BPXYSOCK) macro

to get the assembler mappings for the socket address structure. The socket address structure mappings begin at the SOCKADDR label. The AF_INET socket address structure fields start at the SOCK_SIN label. The AF_INET6 socket address structure fields start at the SOCK_SIN6 label.

The IPv4 socket address structure contains the following fields:

Field Description

FAMILY
Output parameter. A halfword binary number specifying the IPv4 addressing family. The value for the IPv4 socket descriptor (S parameter) is a decimal 2, indicating AF_INET.

PORT Output parameter. A halfword binary number specifying the port number of the sending socket.

IPv4-ADDRESS
Output parameter. A fullword binary number specifying the 32-bit IPv4 Internet address of the sending socket.

RESERVED
Output parameter. An 8-byte reserved field. This field is required, but is not used.

The IPv6 socket structure contains the following fields:

Field Description

NAMELEN
Output parameter. A 1-byte binary field specifying the length of this IPv6 socket address structure. Any value specified by the use of this field is ignored when processed as input and the field is set to 0 when processed as output.

FAMILY
Output parameter. A 1-byte binary field specifying the IPv6 addressing family. The value for IPv6 socket descriptor (S parameter) is a decimal 19, indicating AF_INET6.

PORT Output parameter. A halfword binary number specifying the port number of the sending socket.

FLOW-INFO
Output parameter. A fullword binary field specifying the traffic class and flow label. This value of this field is undefined.

IPv6-ADDRESS
Output parameter. A 16-byte binary field that is set to the 128-bit IPv6 Internet address, in network byte order, of the sending socket.

SCOPE-ID
A fullword binary field which identifies a set of interfaces as appropriate for the scope of the address carried in the **IPv6-ADDRESS** field. For a link scope **IPv6-ADDRESS**, **SCOPE-ID** contains the link index for the **IPv6-ADDRESS**. For all other address scopes, **SCOPE-ID** is undefined.

ALET Optional input parameter. A fullword binary field containing the **ALET** of **BUF**. The default is 0 (primary address space).

If a nonzero *ALET* is specified, the *ALET* must represent a valid entry in the dispatchable unit access list (DU-AL) for the task issuing this call. Note that *ALET*s can only be specified for synchronous socket calls (for example, ECB/REQAREA cannot be specified). An exception to this is an *ALET* representing a SCOPE=COMMON data space.

ERRNO Output parameter. A fullword binary field. If **RETCODE** is negative, this field contains an error number. See Appendix B, "Socket call error return codes," on page 885 for information about **ERRNO** return codes.

RETCODE A fullword binary field that returns one of the following:

Value	Description
0	A 0 return code indicates that the connection is closed and no data is available.
>0	A positive value indicates the number of bytes transferred by the RECVFROM call.
–1	Check **ERRNO** for an error code.

FLAGS Input parameter. **FLAGS** can be a literal value or a fullword binary field.

Literal Value	Binary Value	Description
'MSG_OOB'	X'00000001'	Receive out-of-band data (stream sockets only). Out-of-band data can be read if the SO_OOBINLINE option is set for the socket regardless of whether the MSG_OOB flag is set.
'MSG_PEEK'	X'00000002'	Peek at the data, but do not destroy the data. If the peek flag is set, the next receive operation reads the same data.
'MSG_WAITALL'	X'00000040'	Requests that the function block until the full amount of requested data can be returned (stream sockets only). The function might return a smaller amount of data if the connection is terminated, if an error is pending, or if the SO_RCVTIMEO field is set and the timer expired for the socket.

ECB or REQAREA

Input parameter. This parameter is required if you are using APITYPE=3. It points to a 104-byte field containing:

For ECB

A 4-byte **ECB** posted by TCP/IP when the macro completes.

For REQAREA

A 4-byte user token (set by you) that is presented to your exit when the response to this function request is complete.

For ECB/REQAREA
The last 100 bytes is a storage field used by the interface to save the state information.

Note: This storage must not be modified until the macro function has completed and the **ECB** has been posted, or the asynchronous exit has been driven.

ERROR Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

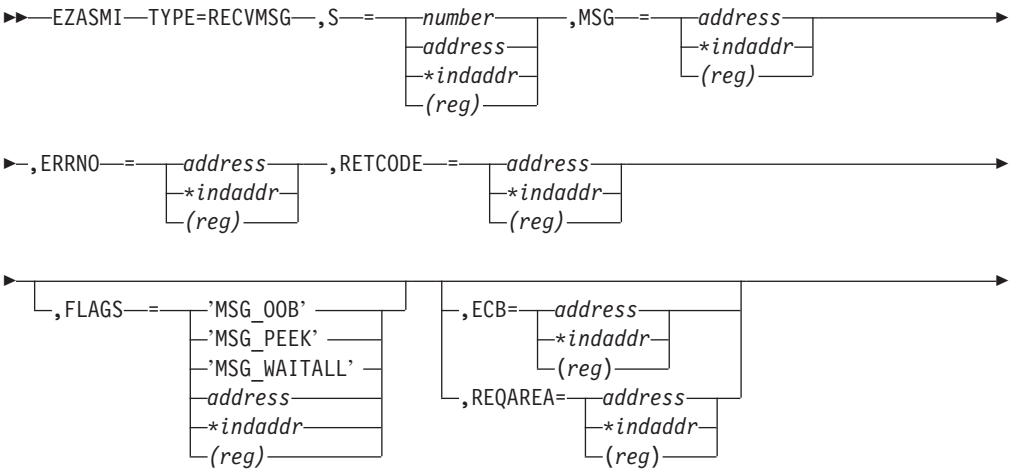
TASK Input parameter. The location of the task storage area in your program.

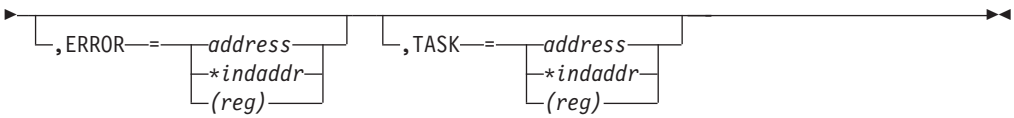
RECVMSG

The RECVMSG macro receives messages on a socket with descriptor *s* and stores them in an array of message headers. If a datagram packet is too long to fit in the supplied buffer, datagram sockets discard extra bytes.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.





Keyword	Description
S	Input parameter. A value or the address of a halfword binary number specifying the socket descriptor.
MSG	On input, this is a pointer to a message header into which the message is received on completion of the call.

NAME

On input, a pointer to a buffer where the sender's IPv4 or IPv6 address will be stored on completion of the call. The storage being pointed to should be for an IPv4 or IPv6 socket address. Include the SYS1.MACLIB(BPXYSOCK) macro to get the assembler mappings for the socket address structure. The socket address structure mappings begin at the SOCKADDR label. The AF_INET socket address structure fields start at the SOCK_SIN label. The AF_INET6 socket address structure fields start at the SOCK_SIN6 label.

The IPv4 socket address structure contains the following fields:

Field	Description
FAMILY	Output parameter. A halfword binary number specifying the IPv4 addressing family. The value for the IPv4 socket descriptor (S parameter) is a decimal 2, indicating AF_INET.
PORT	Output parameter. A halfword binary number specifying the port number of the sending socket.
IPv4-ADDRESS	Output parameter. A fullword binary number specifying the 32-bit IPv4 Internet address of the sending socket.
RESERVED	Output parameter. An 8-byte reserved field. This field is required, but is not used.

The IPv6 socket address structure contains the following fields:

Field	Description
NAMELEN	Output parameter. A 1-byte binary field specifying the length of this IPv6 socket address structure. Any value specified by the use of this field is ignored when processed as input and the field is set to 0 when processed as output.
FAMILY	Output parameter. A 1-byte binary field specifying

the IPv6 addressing family. The value for the IPv6 socket descriptor (S parameter) is a decimal 19, indicating AF_INET6.

PORT Output parameter. A halfword binary number specifying the port number of the sending socket.

FLOW-INFO
Output parameter. A fullword binary field specifying the traffic class and flow label. This value of this field is undefined.

IPv6-ADDRESS
Output parameter. A 16-byte binary field specifying the 128-bit IPv6 Internet address, in network byte order, of the sending socket.

SCOPE-ID
A fullword binary field which identifies a set of interfaces as appropriate for the scope of the address carried in the **IPv6-ADDRESS** field. For a link scope **IPv6-ADDRESS**, **SCOPE-ID** contains the link index for the **IPv6-ADDRESS**. For all other address scopes, **SCOPE-ID** is undefined.

IOV On input, a pointer to an array of three fullword structures with the number of structures equal to the value in IOVCNT and the format of the structures as follows:

Fullword 1
Input parameter. The address of a data buffer.

Fullword 2
Input parameter. The **ALET** for this buffer. If the buffer is in the primary address space, this should be zeros.

If a nonzero *ALET* is specified, the *ALET* must represent a valid entry in the dispatchable unit access list (DU-AL) for the task issuing this call. Note that *ALET*s can only be specified for synchronous socket calls (for example, ECB/REQAREA cannot be specified). An exception to this is an *ALET* representing a SCOPE=COMMON data space.

Fullword 3
Input parameter. The length of the data buffer referenced in Fullword 1.

IOVCNT
On input, a pointer to a fullword binary field specifying the number of data buffers provided for this call.

ACCRIGHTS
On input, a pointer to the access rights received. This field is ignored.

ACCRLEN
On input, a pointer to the length of the access rights received. This field is ignored.

ERRNO Output parameter. A fullword binary field. If **RETCODE** is negative, this contains an error number.

RETCODE Output parameter. A fullword binary field with the following values:

Value	Description
-1	Call returned error. See **ERRNO** field.
0	Connection partner has closed connection.
>0	Number of bytes read.

FLAGS Input parameter. **FLAGS** can be a literal value or a fullword binary field.

Literal Value	Binary Value	Description
'MSG_OOB'	X'00000001'	Receive out-of-band data (stream sockets only). Out-of-band data can be read if the SO_OOBINLINE option is set for the socket regardless of whether the MSG_OOB flag is set.
'MSG_PEEK'	X'00000002'	Peek at the data, but do not destroy the data. If the peek flag is set, the next receive operation reads the same data.
'MSG_WAITALL'	X'00000040'	Requests that the function block until the full amount of requested data can be returned (stream sockets only). The function might return a smaller amount of data if the connection is terminated, if an error is pending, or if the SO_RCVTIMEO field is set and the timer expired for the socket.

ECB or REQAREA

Input parameter. This parameter is required if you are using APITYPE=3. It points to a 104-byte field containing:

For ECB

A 4-byte **ECB** posted by TCP/IP when the macro completes.

For REQAREA

A 4-byte user token (set by you) that is presented to your exit when the response to this function request is complete.

For ECB/REQAREA

The last 100 bytes is a storage field used by the interface to save the state information.

Note: This storage must not be modified until the macro function has completed and the **ECB** has been posted, or the asynchronous exit has been driven.

ERROR Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

TASK Input parameter. The location of the task storage area in your program.

SELECT

In a process where multiple I/O operations can occur it is necessary for the program to be able to wait on one or several of the operations to complete. For example, consider a program that issues a READ to multiple sockets whose blocking mode is set. Because the socket would block on a READ macro, only one socket could be read at a time. Setting the sockets to nonblocking would solve this problem, but would require polling each socket repeatedly until data becomes available. The SELECT macro allows you to test several sockets and to process a later I/O macro only when one of the tested sockets is ready. This ensures that the I/O macro does not block.

Tip: You do not need to use the SELECT macro when you are using APITYPE=3 (asynchronous) calls. Simply issue the intended call and let the specified notification mechanism (ECB or exit routine) take effect.

To use the SELECT macro as a timer in your program, do either of the following:
- Set the read, write, and exception arrays to zeros.
- Do not specify MAXSOC.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.

Testing sockets

Read, write, and exception operations can be tested. The SELECT macro monitors activity on selected sockets to determine whether:

- A buffer for the specified sockets contains input data. If input data is available for a given socket, a read operation on that socket does not block.
- TCP/IP can accommodate additional output data. If TCP/IP can accept additional output for a socket, a write operation on the socket does not block.
- An exceptional condition occurs on a socket.
- A timeout occurs on the SELECT macro itself. A TIMEOUT period can be specified when the SELECT macro is issued.

Each socket descriptor is represented by a bit in a bit string. The length of this bit-mask array is dependent on the value in MAXSOC and must be a multiple of 4 bytes. See "Selecting requests in a concurrent server program" on page 45 for more information.

Read operations

The ACCEPT, READ, READV, RECV, RECVFROM, and RECVMSG macros are read operations. A socket is ready for reading when data is received on it, or when an exception condition occurs.

To determine if a socket is ready for the read operation, set the appropriate bit in RSNDMSK to 1 before issuing the SELECT macro. When the SELECT macro returns, the corresponding bits in the RRETMSK indicate sockets ready for reading.

Write operations

A socket is selected for writing, ready to be written, when:

- TCP/IP can accept additional outgoing data.
- A connection request is received in response to an ACCEPT macro.
- A CONNECT call for a nonblocking socket, which has previously returned ERRNO 36 (EINPROGRESS), completes the connection.

The WRITE, WRITEV, SEND, SENDMSG, or SENDTO macros block when the data to be sent exceeds the amount that TCP/IP can accept. To avoid this, you can precede the write operation with a SELECT macro to ensure that the socket is ready for writing. After a socket is selected for WRITE, your program can determine the amount of TCP/IP buffer space available by issuing the GETSOCKOPT macro with the SO_SNDBUF option.

To determine if a socket is ready for the write operation, set the appropriate bit in WSNDMSK to 1.

Exception operations

For each socket to be tested, the SELECT macro can check for an exception condition. The exception conditions are:

- The calling program (concurrent server) has issued a GIVESOCKET command and the target subtask has successfully issued the TAKESOCKET call. When this condition is selected, the calling program (concurrent server) should issue CLOSE to dissociate itself from the socket.
- A socket has received out-of-band data. For this condition, a READ macro returns the out-of-band data before the program data.

To determine if a socket has an exception condition, use the ESNDMSK character string and set the appropriate bits to 1.

Returning the results

For each event tested by a *x*SNDMSK, a bit string records the results of the check. The bit strings are RRETMSK, WRETMSK, and ERETMSK for read, write, and exceptional events. On return from the SELECT macro, each bit set to 1 in the xRETMSK is a read, write, or exceptional event for the associated socket.

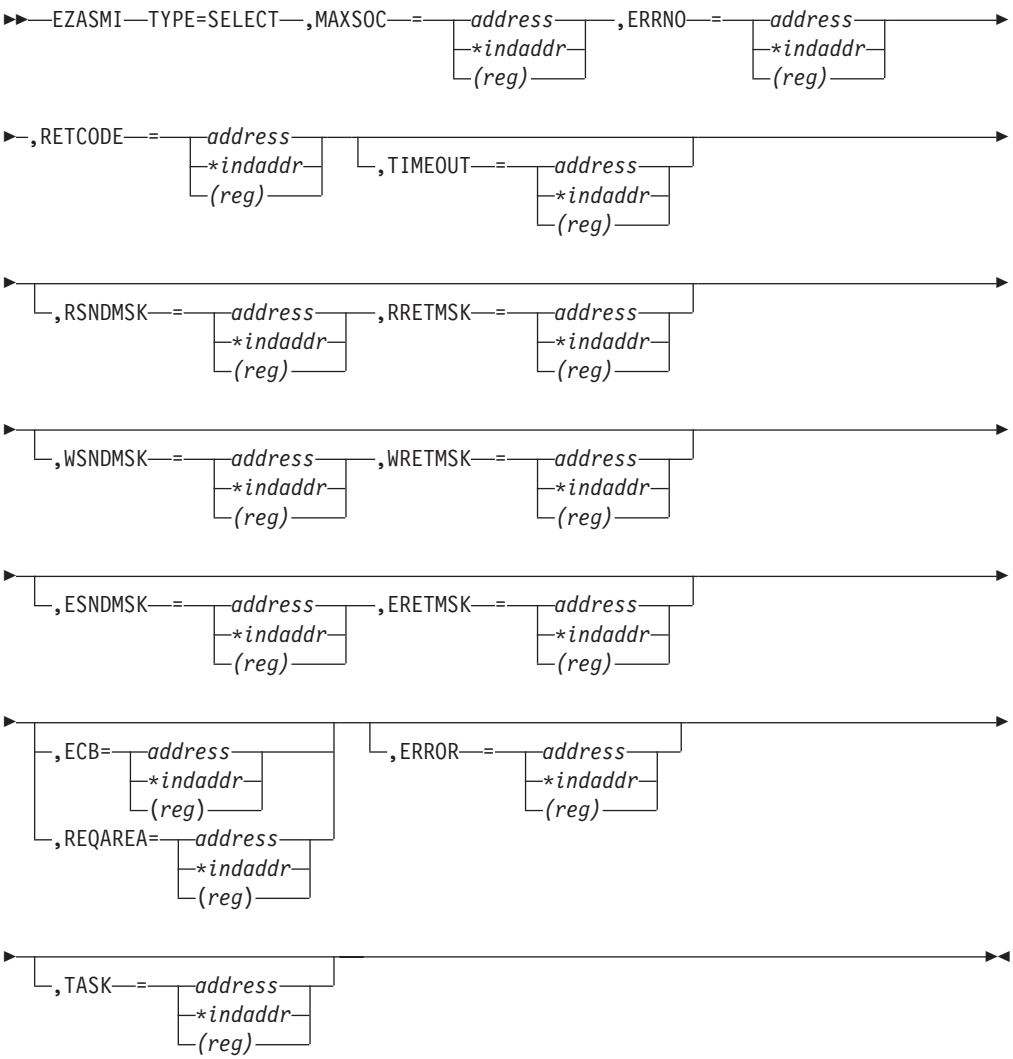
MAXSOC parameter

The SELECT call must test each bit in each string before returning results. For efficiency, the MAXSOC parameter can be used to specify the largest socket descriptor number that needs to be tested for any event type. The SELECT call tests only bits in the range 0 through the MAXSOC value minus one.

Example: If MAXSOC value is set to 50, the range would be 0 – 49.

TIMEOUT parameter

If the time in the TIMEOUT parameter elapses before an event is detected, the SELECT call returns and RETCODE is set to 0.



Keyword	Description
MAXSOC	Input parameter. A fullword binary field that specifies the largest socket descriptor value being checked. The SELECT call tests only bits that are in the range 0 through the MAXSOC value minus 1. For example, if you set the MAXSOC value to 50, the range is 0 – 49.
ERRNO	Output parameter. A fullword binary field. If **RETCODE** is negative, **ERRNO** contains a valid error number. Otherwise, ignore **ERRNO**. See Appendix B, "Socket call error return codes," on page 885 for information about **ERRNO** return codes.
RETCODE	Output parameter. A fullword binary field that returns one of the following: **Value Description**

>0 Indicates the number of ready sockets in the three return masks.

Note: If the number of ready sockets is greater than 65 535, only 65 535 is reported.

=0 Indicates that the SELECT time limit has expired.

−1 Check **ERRNO** for an error code.

TIMEOUT Input parameter.

If **TIMEOUT** is not specified, the SELECT call blocks until a socket becomes ready.

If **TIMEOUT** is specified, **TIMEOUT** is the maximum interval for the SELECT call to wait until completion of the call. If you want SELECT to poll the sockets and return immediately, **TIMEOUT** should be specified to point to a 0-valued TIMEVAL structure.

TIMEOUT is specified in the two-word **TIMEOUT** as follows:

- TIMEOUT-SECONDS, word one of **TIMEOUT**, is the seconds component of the timeout value.
- TIMEOUT-MICROSEC, word two of **TIMEOUT**, is the microseconds component of the timeout value (0–999999).

For example, if you want SELECT to timeout after 3.5 seconds, set TIMEOUT-SECONDS to 3 and TIMEOUT-MICROSEC to 500000.

For APITYPE=3 with an ECB specified, the SELECT call will return immediately because it is asynchronous; the ECB will be POSTed when the timer pops.

RSNDMSK Input parameter. The bit-mask array to control checking for read interrupts. If this parameter is not specified or the specified bit-mask is zeros, the SELECT does not check for read interrupts. The length of this bit-mask array is dependent on the value in MAXSOC and must be a multiple of 4 bytes. See “Selecting requests in a concurrent server program” on page 45 for more information.

RRETMSK Output parameter. The bit-mask array returned by the SELECT if **RSNDMSK** is specified. The length of this bit-mask array is dependent on the value in MAXSOC and must be a multiple of 4 bytes. See “Selecting requests in a concurrent server program” on page 45 for more information.

WSNDMSK Input parameter. The bit-mask array to control checking for write interrupts. If this parameter is not specified or the specified bit-mask is zeros, the SELECT does not check for write interrupts. The length of this bit-mask array is dependent on the value in MAXSOC and must be a multiple of 4 bytes. See “Selecting requests in a concurrent server program” on page 45 for more information.

WRETMSK Output parameter. The bit-mask array returned by the SELECT if **WSNDMSK** is specified. The length of this bit-mask array is dependent on the value in MAXSOC and must be a multiple of 4 bytes. See “Selecting requests in a concurrent server program” on page 45 for more information.

ESNDMSK Input parameter. The bit-mask array to control checking for exception interrupts. If this parameter is not specified or the

specified bit-mask is zeros, the SELECT does not check for exception interrupts. The length of this bit-mask array is dependent on the value in MAXSOC and must be a multiple of 4 bytes. See "Selecting requests in a concurrent server program" on page 45 for more information.

ERETMSK Output parameter. The bit-mask array returned by the SELECT if ESNDMSK is specified. The length of this bit-mask array is dependent on the value in MAXSOC and must be a multiple of 4 bytes. See "Selecting requests in a concurrent server program" on page 45 for more information.

ECB or REQAREA
Input parameter. This parameter is required if you are using APITYPE=3. It points to a 104-byte field containing:

For ECB
A 4-byte **ECB** posted by TCP/IP when the macro completes.

For REQAREA
A 4-byte user token (set by you) that is presented to your exit when the response to this function request is complete.

For ECB/REQAREA
The last 100 bytes is a storage field used by the interface to save the state information.

Note: This storage must not be modified until the macro function has completed and the **ECB** has been posted, or the asynchronous exit has been driven.

ERROR Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

TASK Input parameter. The location of the task storage area in your program.

SELECTEX

The SELECTEX macro monitors a set of sockets, a time value, and an ECB or list of ECBs. It completes when either one of the sockets has activity, the time value expires, or the ECBs are posted.

To use the SELECTEX call as a timer in your program, do either of the following:

- Set the read, write, and exception arrays to zeros.
- Do not specify MAXSOC.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.

ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.

Testing sockets

Read, write, and exception operations can be tested. The SELECTEX macro monitors activity on selected sockets to determine whether:

- A buffer for the specified sockets contains input data. If input data is available for a given socket, a read operation on that socket does not block.
- TCP/IP can accommodate additional output data. If TCP/IP can accept additional output for a socket, a write operation on the socket does not block.
- An exceptional condition occurs on a socket.
- A timeout occurs on the SELECTEX macro itself. A TIMEOUT period can be specified when the SELECTEX macro is issued.

Each socket descriptor is represented by a bit in a bit string.

Read operations

The ACCEPT, READ, READV, RECV, RECVFROM, and RECVMSG macros are read operations. A socket is ready for reading when data is received on it, or when an exception condition occurs.

To determine if a socket is ready for the read operation, set the appropriate bit in RSNDMSK to 1 before issuing the SELECTEX macro. When the SELECTEX macro returns, the corresponding bits in the RRETMSK indicate sockets ready for reading.

Write operations

A socket is selected for writing, ready to be written, when:

- TCP/IP can accept additional outgoing data.
- A connection request is received in response to an ACCEPT macro.
- A CONNECT call for a nonblocking socket, which has previously returned ERRNO 36 (EINPROGRESS), completes the connection.

The WRITE, WRITEV, SEND, SENDMSG, or SENDTO macros block when the data to be sent exceeds the amount that TCP/IP can accept. To avoid this, you can precede the write operation with a SELECTEX macro to ensure that the socket is ready for writing. After a socket is selected for WRITE, your program can determine the amount of TCP/IP buffer space available by issuing the GETSOCKOPT macro with the SO_SNDBUF option.

To determine if a socket is ready for the write operation, set the appropriate bit in WSNDMSK to 1.

Exception operations

For each socket to be tested, the SELECTEX macro can check for an exception condition. The exception conditions are:

- The calling program (concurrent server) has issued a GIVESOCKET command and the target subtask has successfully issued the TAKESOCKET call. When this condition is selected, the calling program (concurrent server) should issue CLOSE to dissociate itself from the socket.

- A socket has received out-of-band data. For this condition, a READ macro returns the out-of-band data before the program data.

To determine whether a socket has an exception condition, use the ESNDMSK character string and set the appropriate bits to 1.

Returning the results

For each event tested by a *x*SNDMSK, a bit string records the results of the check. The bit strings are RRETMSK, WRETMSK, and ERETMSK for read, write, and exceptional events. On return from the SELECTEX macro, each bit set to 1 in the xRETMSK is a read, write, or exceptional event for the associated socket.

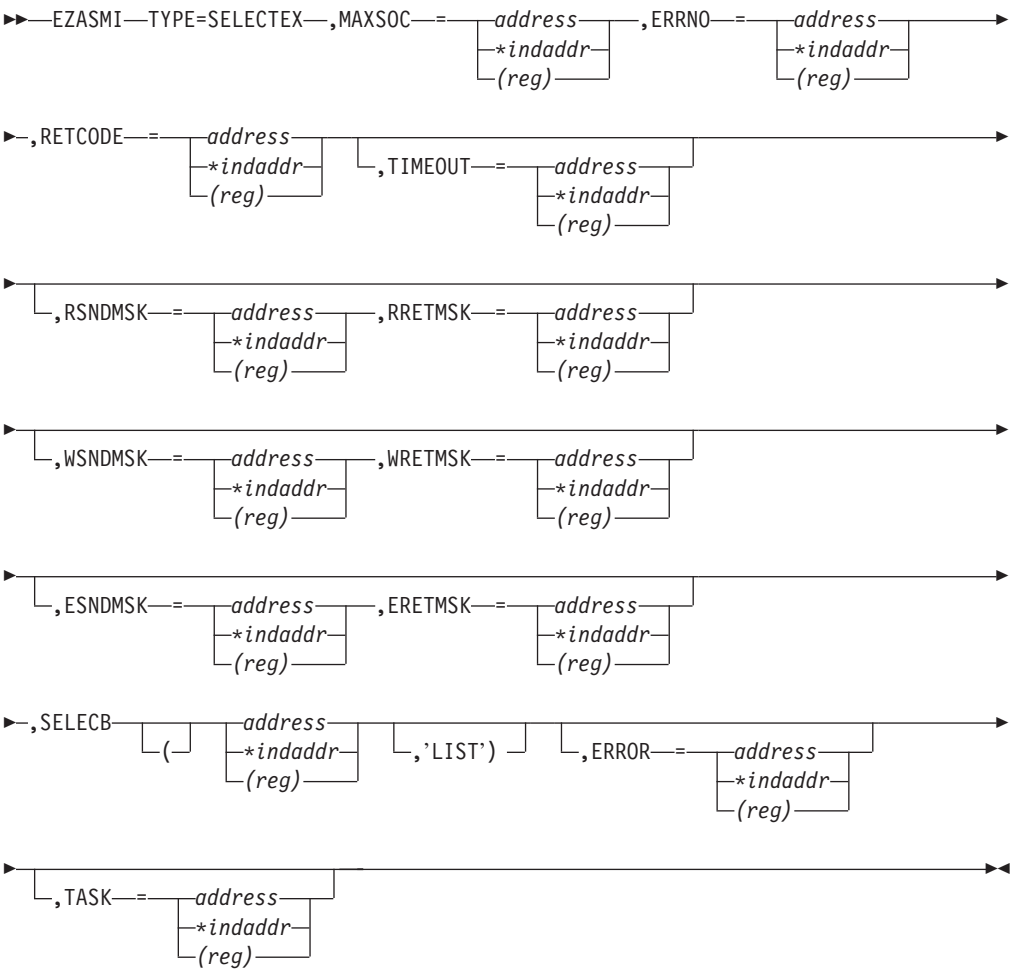
MAXSOC parameter

The SELECTEX call must test each bit in each string before returning results. For efficiency, the MAXSOC parameter can be used to specify the largest socket descriptor number that needs to be tested for any event type. The SELECTEX call tests only bits that are in the range 0 through the MAXSOC value minus 1.

Example: If MAXSOC value is set to 50, the range would be 0 – 49.

TIMEOUT parameter

If the time in the TIMEOUT parameter elapses before an event is detected, the SELECTEX macro returns and RETCODE is set to 0.



Keyword **Description**

MAXSOC Input parameter. A fullword binary field that specifies the largest socket descriptor value being checked. The SELECTEX call tests only bits that are in the range 0 through the MAXSOC value minus 1. For example, if you set the MAXSOC value to 50, the range is 0 – 49.

ERRNO Output parameter. A fullword binary field. If **RETCODE** is negative, this contains an error number.

RETCODE Output parameter. A fullword binary field.

Value	Meaning
>0	The number of ready sockets. **Note:** If the number of ready sockets is greater than 65 535, only 65 535 is reported.
0	Either the SELECTEX time limit has expired (ECB value is 0) or one of the caller's ECBs has been posted (ECB value is nonzero and the caller's descriptor sets is be set to 0). The caller must initialize the ECB values to zero before issuing the SELECTEX socket command.
-1	Check **ERRNO** for an error code.

TIMEOUT Input parameter.

If **TIMEOUT** is not specified, the SELECTEX call blocks until a socket becomes ready or until a user **ECB** is posted.

If a **TIMEOUT** value is specified, **TIMEOUT** is the maximum interval for the SELECTEX call to wait until completion of the call. If you want SELECTEX to poll the sockets and return immediately, **TIMEOUT** should be specified to point to a zero-valued TIMEVAL structure.

TIMEOUT is specified in the two-word TIMEOUT as follows:

- TIMEOUT-SECONDS, word one of **TIMEOUT**, is the seconds component of the timeout value.
- TIMEOUT-MICROSEC, word two of **TIMEOUT**, is the microseconds component of the timeout value (0—999999).

For example, if you want SELECT to timeout after 3.5 seconds, set TIMEOUT-SECONDS to 3 and TIMEOUT-MICROSEC to 500000. TIMEOUT, SELECTEX returns to the calling program.

RSNDMSK Input parameter. The bit-mask array to control checking for read interrupts. If this parameter is not specified or the specified bit-mask is zeros, the SELECT does not check for read interrupts. The length of this bit-mask array is dependent on the value in MAXSOC and must be a multiple of 4 bytes. See "Selecting requests in a concurrent server program" on page 45 for more information.

RRETMSK Output parameter. The bit-mask array returned by the SELECT if **RSNDMSK** is specified. The length of this bit-mask array is dependent on the value in MAXSOC and must be a multiple of 4 bytes. See "Selecting requests in a concurrent server program" on page 45 for more information.

WSNDMSK Input parameter. The bit-mask array to control checking for write

interrupts. If this parameter is not specified or the specified bit-mask is zeros, the SELECT does not check for write interrupts. The length of this bit-mask array is dependent on the value in MAXSOC and must be a multiple of 4 bytes. See "Selecting requests in a concurrent server program" on page 45 for more information.

WRETMSK Output parameter. The bit-mask array returned by the SELECT if **WSNDMSK** is specified. The length of this bit-mask array is dependent on the value in MAXSOC and must be a multiple of 4 bytes. See "Selecting requests in a concurrent server program" on page 45 for more information.

ESNDMSK Input parameter. The bit-mask array to control checking for exception interrupts. If this parameter is not specified or the specified bit-mask is zeros, the SELECT does not check for exception interrupts. The length of this bit-mask array is dependent on the value in MAXSOC and must be a multiple of 4 bytes. See "Selecting requests in a concurrent server program" on page 45 for more information.

ERETMSK Output parameter. The bit-mask array returned by the SELECT if ESNDMSK is specified. The length of this bit-mask array is dependent on the value in MAXSOC and must be a multiple of 4 bytes. See "Selecting requests in a concurrent server program" on page 45 for more information.

SELECB Input parameter. An **ECB** or list of **ECB** addresses which, if posted, causes completion of the SELECTEX.

If the address of an **ECB** list is specified, you must set the high-order bit of the last entry in the **ECB** list to 1 and you must also add the LIST keyword. The **ECB**s must reside in the caller's home address space.

Note: The maximum number of **ECB**s that can be specified in a list is 1013.

ERROR Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

TASK Input parameter. The location of the task storage area in your program.

SEND

The SEND macro sends datagrams on a specified connected socket.

FLAGS allows you to:

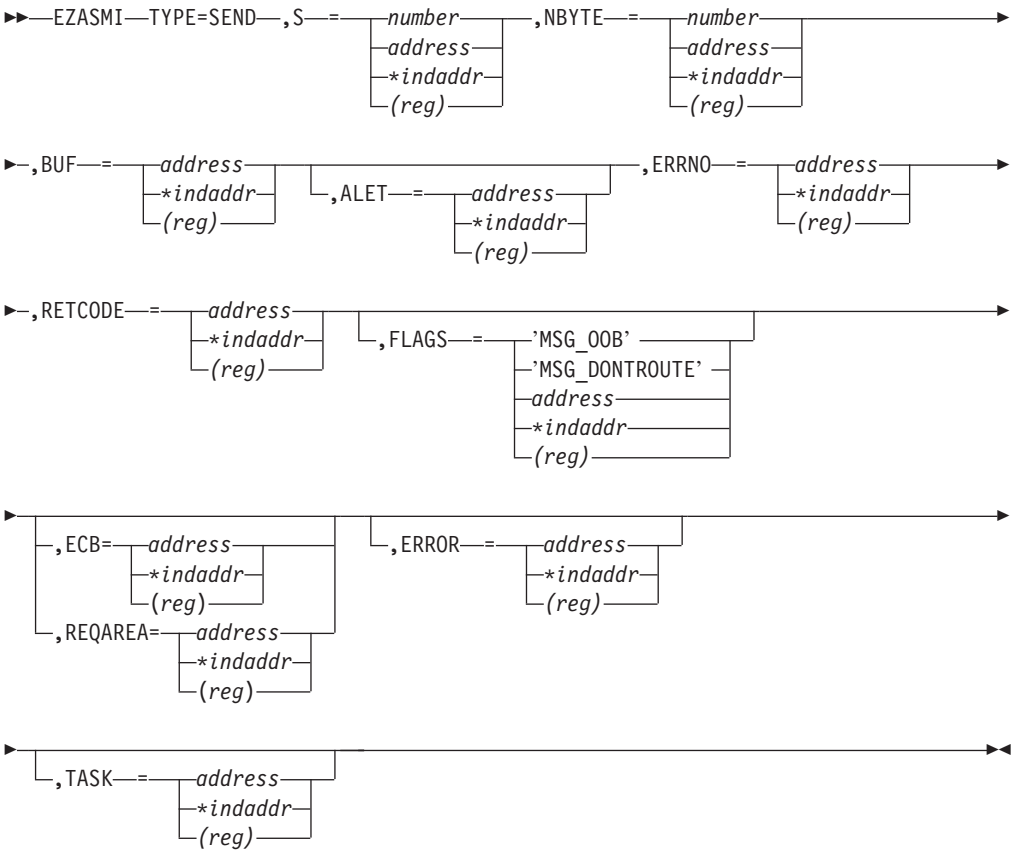
- Send out-of-band data, for example, interrupts, aborts, and data marked urgent. Only stream sockets created in the AF_INET address family support out-of-band data.
- Suppress use of local routing tables. This implies that the caller takes control of routing and writing network software.

For datagram sockets, SEND transmits the entire datagram if it fits into the receiving buffer. Extra data is discarded.

For stream sockets, data is processed as streams of information with no boundaries separating the data. For example, if a program is required to send 1000 bytes, each call to this function can send any number of bytes, up to the entire 1000 bytes, with the number of bytes sent returned in **RETCODE**. Therefore, programs using stream sockets should place this call in a loop and reissue the call until all data has been sent.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.



Keyword **Description**

S Input parameter. A value or the address of a halfword binary number specifying the socket descriptor of the socket that is sending data.

NBYTE Input parameter. A value or the address of a fullword binary number specifying the number of bytes to transmit.

BUF The address of the data being transmitted. The length of **BUF** must be at least as long as the value of **NBYTE**.

ALET Optional input parameter. A fullword binary field containing the **ALET** of **BUF**. The default is 0 (primary address space).

If a nonzero *ALET* is specified, the *ALET* must represent a valid entry in the dispatchable unit access list (DU-AL) for the task issuing this call. Note that *ALET*s can only be specified for synchronous socket calls (for example, ECB/REQAREA cannot be specified). An exception to this is an *ALET* representing a SCOPE=COMMON data space.

ERRNO Output parameter. A fullword binary field. If **RETCODE** is negative, this field contains an error number. See Appendix B, "Socket call error return codes," on page 885 for information about **ERRNO** return codes.

RETCODE Output parameter. A fullword binary field.

Value Description

0 or >0
A successful call. The value is set to the number of bytes transmitted.

–1 Check **ERRNO** for an error code.

FLAGS Input parameter. **FLAGS** can be a literal value or a fullword binary field:

Literal Value	Binary Value	Description
'MSG_OOB'	X'00000001'	Send out-of-band data. (Stream sockets only.)
'MSG_DONTROUTE'	X'00000004'	Do not route. Routing is handled by the calling program.

ECB or REQAREA
Input parameter. This parameter is required if you are using APITYPE=3. It points to a 104-byte field containing:

For ECB
A 4-byte **ECB** posted by TCP/IP when the macro completes.

For REQAREA
A 4-byte user token (set by you) that is presented to your exit when the response to this function request is complete.

For ECB/REQAREA
The last 100 bytes is a storage field used by the interface to save the state information.

Note: This storage must not be modified until the macro function has completed and the **ECB** has been posted, or the asynchronous exit has been driven.

ERROR Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

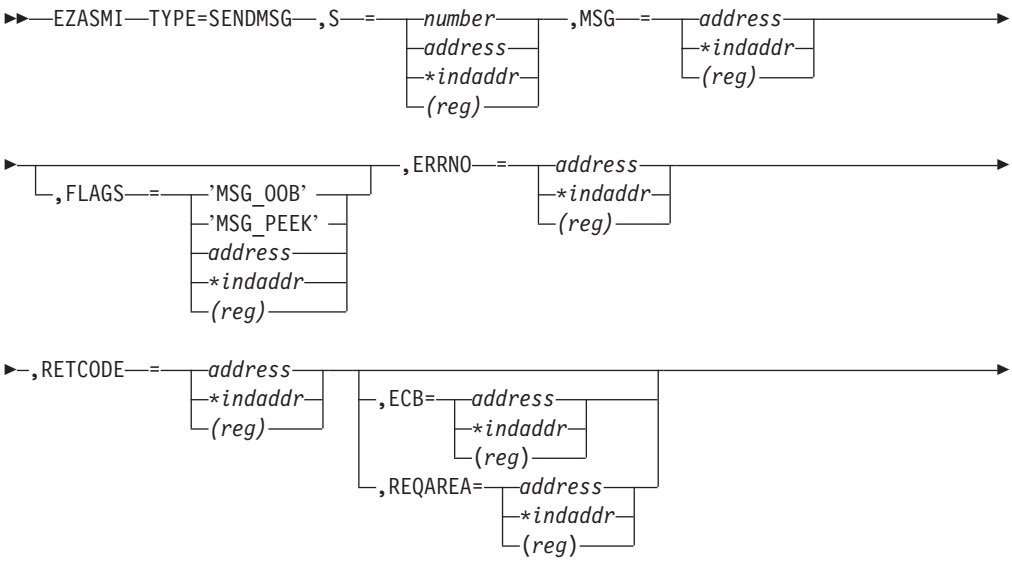
TASK Input parameter. The location of the task storage area in your program.

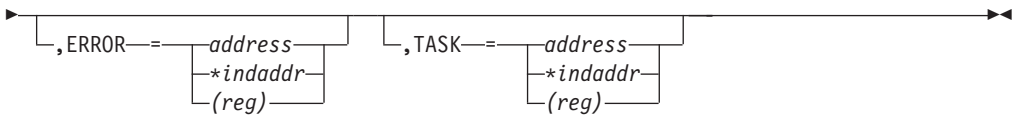
SENDMSG

The SENDMSG macro sends messages on a socket with descriptor *s* passed in an array of messages.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.





Keyword	Description
S	Input parameter. A value or the address of a halfword binary number specifying the socket descriptor.
MSG	On input, this is a pointer to a message header into which the message is received on completion of the call.

NAME

On input, a pointer to a buffer where the sender's IPv4 or IPv6 address will be stored on completion of the call. The storage being pointed to should be for an IPv4 or IPv6 socket address. Include the SYS1.MACLIB(BPXYSOCK) macro to get the assembler mappings for the socket address structure. The socket address structure mappings begin at the SOCKADDR label. The AF_INET socket address structure fields start at the SOCK_SIN label. The AF_INET6 socket address structure fields start at the SOCK_SIN6 label.

The IPv4 socket address structure contains the following fields:

Field	Description
FAMILY	A halfword binary number specifying the IPv4 addressing family. The value for the IPv4 socket descriptor (S parameter) is a decimal 2, indicating AF_INET.
PORT	A halfword binary number specifying the port number of the sending socket.
IPv4-ADDRESS	A fullword binary number specifying the 32-bit IPv4 Internet address of the sending socket.
RESERVED	An 8-byte reserved field. This field is required, but is not used.

The IPv6 socket address structure contains the following fields:

Field	Description
NAMELEN	A 1-byte binary field specifying the length of this IPv6 socket address structure. Any value specified by the use of this field is ignored when processed as input and the field is set to 0 when processed as output.
FAMILY	A 1-byte binary field specifying the IPv6

addressing family. The value for the IPv6 socket descriptor (S parameter) is a decimal 19, indicating AF_INET6.

PORT A halfword binary number specifying the port number of the sending socket.

FLOW-INFO
A fullword binary field specifying the traffic class and flow label. This field must be set to 0.

IPv6-ADDRESS
16-byte binary field specifying the 128-bit IPv6 Internet address, in network byte order, of the sending socket.

SCOPE-ID
A fullword binary field which identifies a set of interfaces as appropriate for the scope of the address carried in the **IPv6-ADDRESS** field. A value of 0 indicates the **SCOPE-ID** field does not identify the set of interfaces to be used, and can be specified for any address types and scopes. For a link scope **IPv6-ADDRESS**, **SCOPE-ID** can specify a link index which identifies a set of interfaces. For all other address scopes, **SCOPE-ID** can be set to 0.

IOV A pointer to an array of three fullword structures with the number of structures equal to the value in IOVCNT and the format of the structures as follows:

Fullword 1
Input parameter. The address of a data buffer.

Fullword 2
Input parameter. The **ALET** for this buffer. If the buffer is in the primary address space, this should be zeros.

If a nonzero *ALET* is specified, the *ALET* must represent a valid entry in the dispatchable unit access list (DU-AL) for the task issuing this call. Note that *ALET*s can only be specified for synchronous socket calls (for example, ECB/REQAREA cannot be specified). An exception to this is an *ALET* representing a SCOPE=COMMON data space.

Fullword 3
Input parameter. The length of the data buffer referenced in Fullword 1.

IOVCNT
A pointer to a fullword binary field specifying the number of data buffers provided for this call.

ACCRIGHTS
A pointer to the access rights sent. This field is ignored.

ACCRLEN
A pointer to the length of the access rights sent. This field is ignored.

FLAGS Input parameter. **FLAGS** can be a literal value or a fullword binary field:

Literal Value	Binary Value	Description
'MSG_OOB'	X'00000001'	Send out-of-band data. (Stream sockets only.)
'MSG_DONTROUTE'	X'00000004'	Do not route. Routing is handled by the calling program.

ERRNO Output parameter. A fullword binary field. If **RETCODE** is negative, this contains an error number.

RETCODE Output parameter. A fullword binary field.

Value Description

0 or >0
A successful call. The value is set to the number of bytes transmitted.

–1 Check **ERRNO** for an error code.

ECB or REQAREA
Input parameter. This parameter is required if you are using APITYPE=3. It points to a 104-byte field containing:

For ECB
A 4-byte **ECB** posted by TCP/IP when the macro completes.

For REQAREA
A 4-byte user token (set by you) that is presented to your exit when the response to this function request is complete.

For ECB/REQAREA
The last 100 bytes is a storage field used by the interface to save the state information.

Note: This storage must not be modified until the macro function has completed and the **ECB** has been posted, or the asynchronous exit has been driven.

ERROR
Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

TASK Input parameter. The location of the task storage area in your program.

SENDTO

SENDTO is similar to SEND, except that it includes the destination address parameter. You can use the destination address on the SENDTO macro to send datagrams on a UDP socket that is connected or not connected.

Use the **FLAGS** parameter to:

- Send out-of-band data, such as interrupts, aborts, and data marked as urgent.

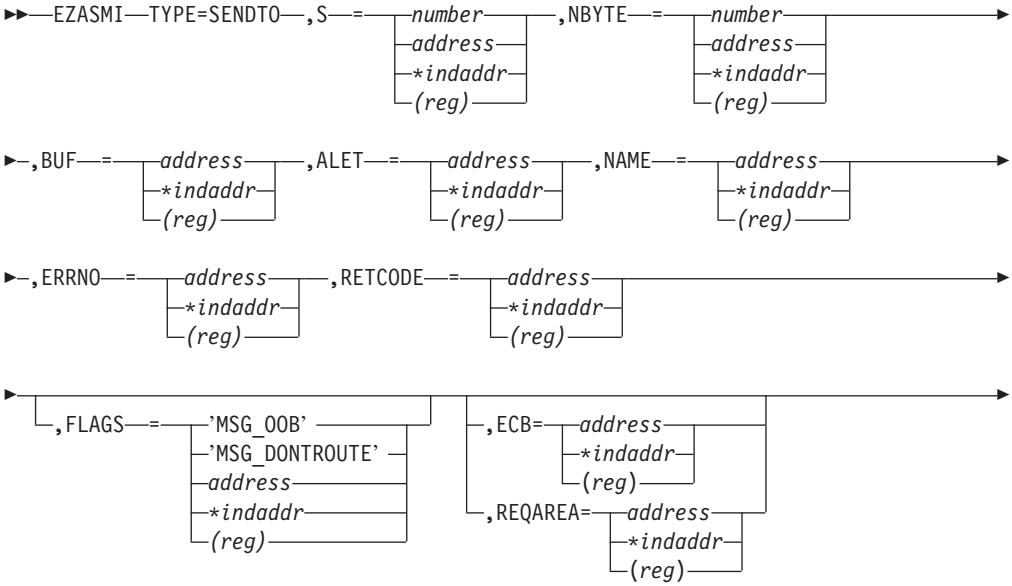
- Suppress the local routing tables. This implies that the caller takes control of routing, which requires writing network software.

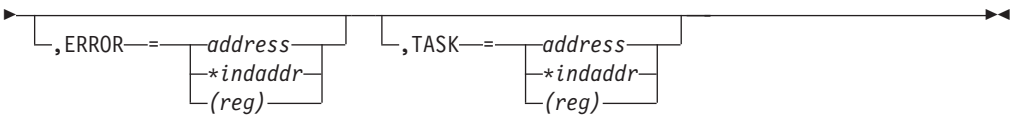
For datagram sockets, the SENDTO macro sends the entire datagram if the datagram fits into the buffer.

For stream sockets, data is processed as streams of information with no boundaries separating the data. For example, if a program is required to send 1000 bytes, each SENDTO macro call can send any number of bytes, up to the entire 1000 bytes, with the number of bytes sent returned in RETCODE. Therefore, programs using stream sockets should place SENDTO in a loop that repeats the macro until all data has been sent.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.





Keyword	Description
S	Output parameter. A value or the address of a halfword binary number specifying the socket descriptor of the socket sending the data.
NBYTE	Input parameter. A value or the address of a fullword binary number specifying the number of bytes to transmit.
BUF	Input parameter. The address of the data being transmitted. The length of **BUF** must be at least as long as the value of **NBYTE**.
ALET	Optional input parameter. A fullword binary field containing the **ALET** of **BUF**. The default is 0 (primary address space). If a nonzero *ALET* is specified, the *ALET* must represent a valid entry in the dispatchable unit access list (DU-AL) for the task issuing this call. Note that *ALET*s can only be specified for synchronous socket calls (for example, ECB/REQAREA cannot be specified). An exception to this is an *ALET* representing a SCOPE=COMMON data space.
NAME	Input parameter. The address of the IPv4 or IPv6 target. Include the SYS1.MACLIB(BPXYSOCK) macro to get the assembler mappings for the socket address structure. The socket address structure mappings begin at the SOCKADDR label. The AF_INET socket address structure fields start at the SOCK_SIN label. The AF_INET6 socket address structure fields start at the SOCK_SIN6 label. The IPv4 socket address structure must specify the following fields: **Field Description** **FAMILY** A halfword binary field containing the IPv4 addressing family. The value for the IPv4 socket descriptor (S parameter) is a decimal 2, indicating AF_INET. **PORT** A halfword binary field containing the port number bound to the socket. **IP-ADDRESS** A fullword binary field containing the 32-bit IPv4 Internet address of the socket. **RESERVED** Specifies an 8-byte reserved field. This field is required, but is not used. The IPv6 socket structure must specify the following fields: **Field Description** **NAMELEN** A 1-byte binary field specifying the length of this IPv6 socket address structure. Any value specified by the use of

this field is ignored when processed as input and the field is set to 0 when processed as output.

FAMILY
A 1-byte binary field specifying the IPv6 addressing family. The value for IPv6 socket descriptor (S parameter) is a decimal 19, indicating AF_INET6.

PORT A halfword binary field containing the port number bound to the socket.

FLOW-INFO
A fullword binary field specifying the traffic class and flow label. This field must be set to 0.

IPv6-ADDRESS
A 16-byte binary field that is set to the 128-bit IPv6 Internet address, in network byte order, of the client host machine. If 0 is specified, the application accepts connections from any network address.

SCOPE-ID
A fullword binary field which identifies a set of interfaces as appropriate for the scope of the address carried in the **IPv6-ADDRESS** field. A value of 0 indicates the **SCOPE-ID** field does not identify the set of interfaces to be used, and can be specified for any address types and scopes. For a link scope **IPv6-ADDRESS**, **SCOPE-ID** can specify a link index which identifies a set of interfaces. For all other address scopes, **SCOPE-ID** must be set to 0.

ERRNO Output parameter. A fullword binary field. If **RETCODE** is negative, **ERRNO** contains a valid error number. Otherwise, ignore **ERRNO**.

See Appendix B, "Socket call error return codes," on page 885 for information about **ERRNO** return codes.

RETCODE Output parameter. A fullword binary field that returns one of the following:

Value Description

0 or >0
A successful call. The value is set to the number of bytes transmitted.

−1 Check **ERRNO** for an error code.

FLAGS Input parameter. **FLAGS** can be a literal value or a fullword binary field:

Literal Value	Binary Value	Description
'MSG_OOB'	X'00000001'	Send out-of-band data. (Stream sockets only.)
'MSG_DONTROUTE'	X'00000004'	Do not route. Routing is handled by the calling program.

ECB or REQAREA
Input parameter. This parameter is required if you are using APITYPE=3. It points to a 104-byte field containing:

For ECB
A 4-byte **ECB** posted by TCP/IP when the macro completes.

For REQAREA
A 4-byte user token (set by you) that is presented to your exit when the response to this function request is complete.

For ECB/REQAREA
The last 100 bytes is a storage field used by the interface to save the state information.

Note: This storage must not be modified until the macro function has completed and the **ECB** has been posted, or the asynchronous exit has been driven.

ERROR Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

TASK Input parameter. The location of the task storage area in your program.

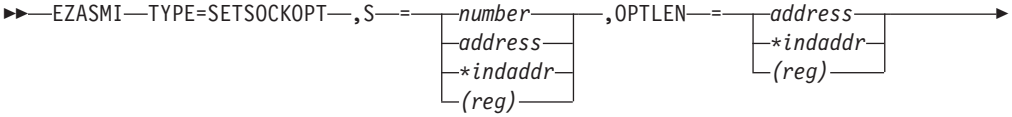
SETSOCKOPT

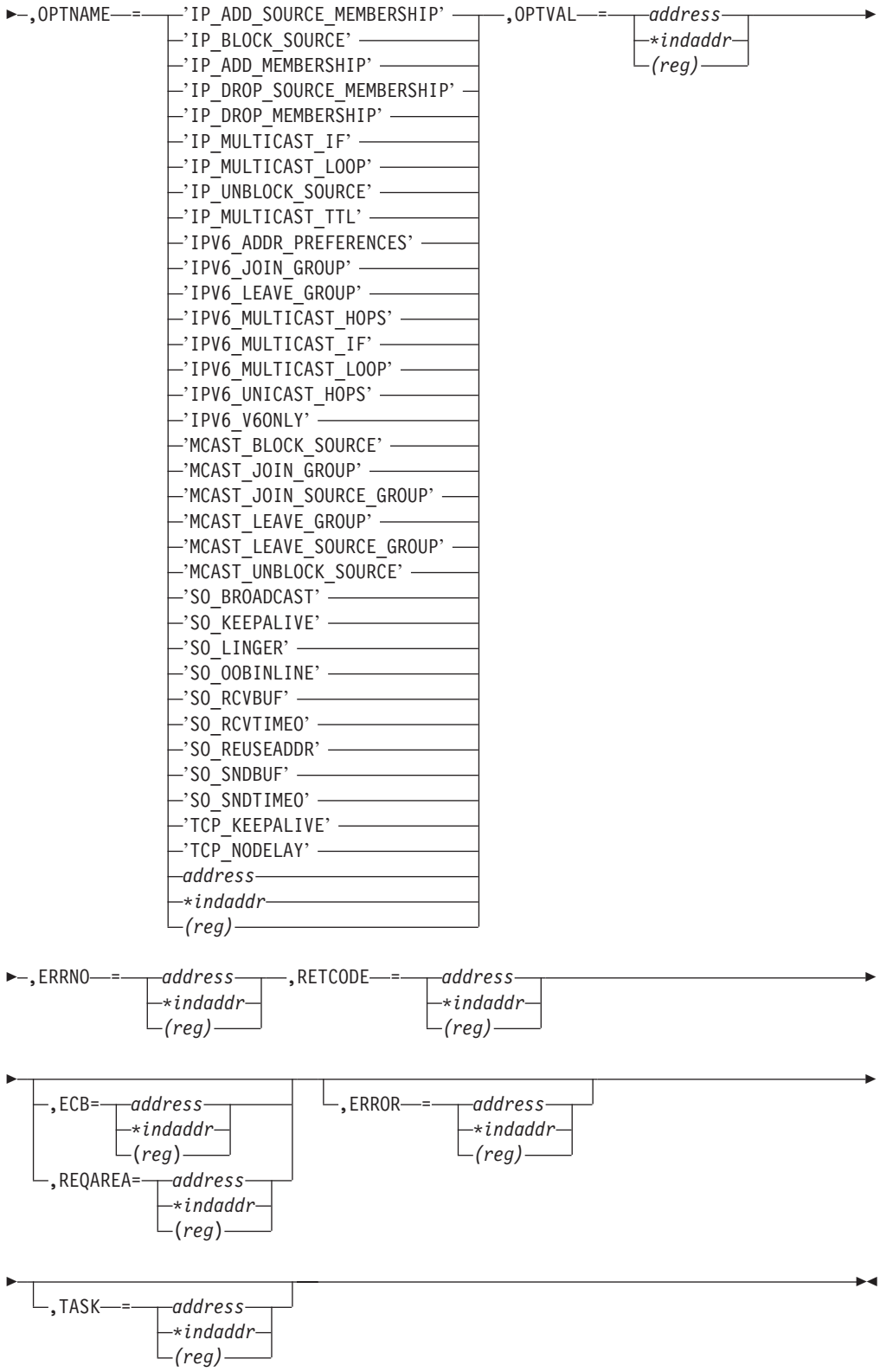
The SETSOCKOPT macro sets the options associated with a socket.

The **OPTVAL** and **OPTLEN** parameters are used to pass data used by the particular set command. The **OPTVAL** parameter points to a buffer containing the data needed by the set command. The **OPTLEN** parameter must be set to the size of the data pointed to by **OPTVAL**.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.





Keyword	Description
S	Input parameter. A value or the address of a halfword binary number specifying the socket descriptor of the socket requiring options.

OPTNAME Input parameter. See the table below for a list of the options and their unique requirements. See Appendix D, "GETSOCKOPT/SETSOCKOPT command values," on page 917 for the numeric values of **OPTNAME**.

OPTVAL Input parameter. Contains data about the option specified in **OPTNAME**. See the table below for a list of the options and their unique requirements

OPTLEN Input parameter. A fullword binary field containing the length of the data returned in **OPTVAL**. See the table below for determining on what to base the value of **OPTLEN**.

ERRNO Output parameter. A fullword binary field. If **RETCODE** is negative, this field contains an error number. See Appendix B, "Socket call error return codes," on page 885 for information about **ERRNO** return codes.

RETCODE Output parameter. A fullword binary field that returns one of the following:

Value	Description
0	Successful call.
−1	Check **ERRNO** for an error code.

ECB or REQAREA

Input parameter. This parameter is required if you are using APITYPE=3. It points to a 104-byte field containing:

For ECB
A 4-byte **ECB** posted by TCP/IP when the macro completes.

For REQAREA
A 4-byte user token (set by you) that is presented to your exit when the response to this function request is complete.

For ECB/REQAREA
The last 100 bytes is a storage field used by the interface to save the state information.

Note: This storage must not be modified until the macro function has completed and the **ECB** has been posted, or the asynchronous exit has been driven.

ERROR Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

TASK Input parameter. The location of the task storage area in your program.

Table 17. OPTNAME options for GETSOCKOPT and SETSOCKOPT

OPTNAME options (input)	SETSOCKOPT, OPTVAL (input)	GETSOCKOPT, OPTVAL (output)
IP_ADD_MEMBERSHIP Use this option to enable an application to join a multicast group on a specific interface. An interface has to be specified with this option. Only applications that want to receive multicast datagrams need to join multicast groups. This is an IPv4-only socket option.	Contains the IP_MREQ structure as defined in SYS1.MACLIB(BPXYSOCK). The IP_MREQ structure contains a 4-byte IPv4 multicast address followed by a 4-byte IPv4 interface address. See SEZAINST(CBLOCK) for the PL/I example of IP_MREQ. See SEZAINST(EZACOBOL) for the COBOL example of IP-MREQ.	N/A
IP_ADD_SOURCE_MEMBERSHIP Use this option to enable an application to join a source multicast group on a specific interface and a specific source address. You must specify an interface and a source address with this option. Applications that want to receive multicast datagrams need to join source multicast groups. This is an IPv4-only socket option.	Contains the IP_MREQ_SOURCE structure as defined in SYS1.MACLIB(BPXYSOCK). The IP_MREQ_SOURCE structure contains a 4-byte IPv4 multicast address followed by a 4-byte IPv4 source address and a 4-byte IPv4 interface address. See SEZAINST(CBLOCK) for the PL/I example of IP_MREQ_SOURCE. See SEZAINST(EZACOBOL) for the COBOL example of IP-MREQ-SOURCE.	N/A
IP_BLOCK_SOURCE Use this option to enable an application to block multicast packets that have a source address that matches the given IPv4 source address. You must specify an interface and a source address with this option. The specified multicast group must have been joined previously. This is an IPv4-only socket option.	Contains the IP_MREQ_SOURCE structure as defined in SYS1.MACLIB(BPXYSOCK). The IP_MREQ_SOURCE structure contains a 4-byte IPv4 multicast address followed by a 4-byte IPv4 source address and a 4-byte IPv4 interface address. See SEZAINST(CBLOCK) for the PL/I example of IP_MREQ_SOURCE. See SEZAINST(EZACOBOL) for the COBOL example of IP-MREQ-SOURCE.	N/A
IP_DROP_MEMBERSHIP Use this option to enable an application to exit a multicast group or to exit all sources for a multicast group. This is an IPv4-only socket option.	Contains the IP_MREQ structure as defined in SYS1.MACLIB(BPXYSOCK). The IP_MREQ structure contains a 4-byte IPv4 multicast address followed by a 4-byte IPv4 interface address. See SEZAINST(CBLOCK) for the PL/I example of IP_MREQ. See SEZAINST(EZACOBOL) for the COBOL example of IP-MREQ.	N/A

Table 17. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

OPTNAME options (input)	SETSOCKOPT, OPTVAL (input)	GETSOCKOPT, OPTVAL (output)
IP_DROP_SOURCE_MEMBERSHIP Use this option to enable an application to exit a source multicast group. This is an IPv4-only socket option.	Contains the IP_MREQ_SOURCE structure as defined in SYS1.MACLIB(BPXYSOCK). The IP_MREQ_SOURCE structure contains a 4-byte IPv4 multicast address followed by a 4-byte IPv4 source address and a 4-byte IPv4 interface address. See SEZAINST(CBLOCK) for the PL/I example of IP_MREQ_SOURCE. See SEZAINST(EZACOBOL) for the COBOL example of IP-MREQ-SOURCE.	N/A
IP_MULTICAST_IF Use this option to set or obtain the IPv4 interface address used for sending outbound multicast datagrams from the socket application. This is an IPv4-only socket option. **Note:** Multicast datagrams can be transmitted only on one interface at a time.	A 4-byte binary field containing an IPv4 interface address.	A 4-byte binary field containing an IPv4 interface address.
IP_MULTICAST_LOOP Use this option to control or determine whether a copy of multicast datagrams are looped back for multicast datagrams sent to a group to which the sending host itself belongs. The default is to loop the datagrams back. This is an IPv4-only socket option.	A 1-byte binary field. To enable, set to 1. To disable, set to 0.	A 1-byte binary field. If enabled, will contain a 1. If disabled, will contain a 0.
IP_MULTICAST_TTL Use this option to set or obtain the IP time-to-live of outgoing multicast datagrams. The default value is '01'x meaning that multicast is available only to the local subnet. This is an IPv4-only socket option.	A 1-byte binary field containing the value of '00'x to 'FF'x.	A 1-byte binary field containing the value of '00'x to 'FF'x.

Table 17. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

OPTNAME options (input)	SETSOCKOPT, OPTVAL (input)	GETSOCKOPT, OPTVAL (output)
IP_UNBLOCK_SOURCE Use this option to enable an application to unblock a previously blocked source for a given IPv4 multicast group. You must specify an interface and a source address with this option. This is an IPv4-only socket option.	Contains the IP_MREQ_SOURCE structure as defined in SYS1.MACLIB(BPXYSOCK). The IP_MREQ_SOURCE structure contains a 4-byte IPv4 multicast address followed by a 4-byte IPv4 source address and a 4-byte IPv4 interface address. See SEZAINST(CBLOCK) for the PL/I example of IP_MREQ_SOURCE. See SEZAINST(EZACOBOL) for the COBOL example of IP-MREQ-SOURCE.	

Table 17. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

OPTNAME options (input)	SETSOCKOPT, OPTVAL (input)	GETSOCKOPT, OPTVAL (output)
IPV6_ADDR_PREFERENCES Use this option to query or set IPv6 address preferences of a socket. The default source address selection algorithm considers these preferences when it selects an IP address that is appropriate to communicate with a given destination address. This is an AF_INET6-only socket option. **Result:** These flags are only preferences. The stack could assign a source IP address that does not conform to the IPV6_ADDR_PREFERENCES flags that you specify. **Guideline:** Use the INET6_IS_SRCADDR function to test whether the source IP address matches one or more IPV6_ADDR_PREFERENCES flags.	Contains the 4-byte flags field IPV6_ADDR_PREFERENCES_ FLAGS that is defined in SYS1.MACLIB(BPXYSOCK) with the following flags: **IPV6_PREFER_SRC_HOME (X'00000001')** Prefer home address **IPV6_PREFER_SRC_COA (X'00000002')** Prefer care-of address **IPV6_PREFER_SRC_TMP (X'00000004')** Prefer temporary address **IPV6_PREFER_SRC_PUBLIC (X'00000008')** Prefer public address **IPV6_PREFER_SRC_CGA (X'00000010')** Prefer cryptographically generated address **IPV6_PREFER_SRC_NONCGA (X'00000020')** Prefer non-cryptographically generated address Some of these flags are contradictory. Combining contradictory flags, such as IPV6_PREFER_SRC_CGA and IPV6_PREFER_SRC_NONCGA, results in error code EINVAL. See IPV6_ADDR_PREFERENCES and Mapping of GAI_HINTS/GAI_ADDRINFO EFLAGS in SEZAINST(CBLOCK) for the PL/I example of the OPTNAME and flag definitions. See IPV6_ADDR_PREFERENCES and AI_EFLAGS mappings in SEZAINST(EZACOBOL) for the COBOL example of the OPTNAME and flag definitions.	Contains the 4-byte flags field IPV6_ADDR_PREFERENCES_ FLAGS that is defined in SYS1.MACLIB(BPXYSOCK) with the following flags: **IPV6_PREFER_SRC_HOME (X'00000001')** Prefer home address **IPV6_PREFER_SRC_COA (X'00000002')** Prefer care-of address **IPV6_PREFER_SRC_TMP (X'00000004')** Prefer temporary address **IPV6_PREFER_SRC_PUBLIC (X'00000008')** Prefer public address **IPV6_PREFER_SRC_CGA (X'00000010')** Prefer cryptographically generated address **IPV6_PREFER_SRC_ NONCGA (X'00000020')** Prefer non-cryptographically generated address See IPV6_ADDR_ PREFERENCES and Mapping of GAI_HINTS/GAI_ADDRINFO EFLAGS in SEZAINST(CBLOCK) for the PL/I example of the OPTNAME and flag definitions. See IPV6_ADDR_PREFERENCES and AI_EFLAGS mappings in SEZAINST(EZACOBOL) for the COBOL example of the OPTNAME and flag definitions.

Table 17. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

OPTNAME options (input)	SETSOCKOPT, OPTVAL (input)	GETSOCKOPT, OPTVAL (output)
IPV6_JOIN_GROUP Use this option to control the reception of multicast packets and specify that the socket join a multicast group. This is an IPv6-only socket option.	Contains the IPV6_MREQ structure as defined in SYS1.MACLIB(BPXYSOCK). The IPV6_MREQ structure contains a 16-byte IPv6 multicast address followed by a 4-byte IPv6 interface index number. If the interface index number is 0, then the stack chooses the local interface. See the SEZAINST(CBLOCK) for the PL/I example of IPV6_MREQ. See SEZAINST(EZACOBOL) for the COBOL example of IPV6-MREQ.	N/A
IPV6_LEAVE_GROUP Use this option to control the reception of multicast packets and specify that the socket leave a multicast group. This is an IPv6-only socket option.	Contains the IPV6_MREQ structure as defined in SYS1.MACLIB(BPXYSOCK). The IPV6_MREQ structure contains a 16-byte IPv6 multicast address followed by a 4-byte IPv6 interface index number. If the interface index number is 0, then the stack chooses the local interface. See the SEZAINST(CBLOCK) for the PL/I example of IPV6_MREQ. See SEZAINST(EZACOBOL) for the COBOL example of IPV6-MREQ.	N/A
IPV6_MULTICAST_HOPS Use to set or obtain the hop limit used for outgoing multicast packets. This is an IPv6-only socket option.	Contains a 4-byte binary value specifying the multicast hops. If not specified, then the default is 1 hop. -1 indicates use stack default. 0 – 255 is the valid hop limit range. **Note:** An application must be APF authorized to enable it to set the hop limit value above the system defined hop limit value. CICS applications cannot execute as APF authorized.	Contains a 4-byte binary value in the range 0 – 255 indicating the number of multicast hops.

Table 17. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

OPTNAME options (input)	SETSOCKOPT, OPTVAL (input)	GETSOCKOPT, OPTVAL (output)
IPV6_MULTICAST_IF Use this option to set or obtain the index of the IPv6 interface used for sending outbound multicast datagrams from the socket application. This is an IPv6-only socket option.	Contains a 4-byte binary field containing an IPv6 interface index number.	Contains a 4-byte binary field containing an IPv6 interface index number.
IPV6_MULTICAST_LOOP Use this option to control or determine whether a multicast datagram is looped back on the outgoing interface by the IP layer for local delivery when datagrams are sent to a group to which the sending host itself belongs. The default is to loop multicast datagrams back. This is an IPv6-only socket option.	A 4-byte binary field. To enable, set to 1. To disable, set to 0.	A 4-byte binary field. If enabled, contains a 1. If disabled, contains a 0.
IPV6_UNICAST_HOPS Use this option to set or obtain the hop limit used for outgoing unicast IPv6 packets. This is an IPv6-only socket option.	Contains a 4-byte binary value specifying the unicast hops. If not specified, then the default is 1 hop. -1 indicates use stack default. 0 – 255 is the valid hop limit range. **Note:** APF authorized applications are permitted to set a hop limit that exceeds the system configured default. CICS applications cannot execute as APF authorized.	Contains a 4-byte binary value in the range 0 – 255 indicating the number of unicast hops.
IPV6_V6ONLY Use this option to set or determine whether the socket is restricted to send and receive only IPv6 packets. The default is to not restrict the sending and receiving of only IPv6 packets. This is an IPv6-only socket option.	A 4-byte binary field. To enable, set to 1. To disable, set to 0.	A 4-byte binary field. If enabled, contains a 1. If disabled, contains a 0.

Table 17. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

OPTNAME options (input)	SETSOCKOPT, OPTVAL (input)	GETSOCKOPT, OPTVAL (output)
MCAST_BLOCK_SOURCE Use this option to enable an application to block multicast packets that have a source address that matches the given source address. You must specify an interface index and a source address with this option. The specified multicast group must have been joined previously.	Contains the GROUP_SOURCE_REQ structure as defined in SYS1.MACLIB(BPXYSOCK). The GROUP_SOURCE_REQ structure contains a 4-byte interface index number followed by a socket address structure of the multicast address and a socket address structure of the source address. See SEZAINST(CBLOCK) for the PL/I example of GROUP_SOURCE_REQ. See SEZAINST(EZACOBOL) for the COBOL example of GROUP-SOURCE-REQ.	N/A
MCAST_JOIN_GROUP Use this option to enable an application to join a multicast group on a specific interface. You must specify an interface index. Applications that want to receive multicast datagrams must join multicast groups.	Contains the GROUP_REQ structure as defined in SYS1.MACLIB(BPXYSOCK). The GROUP_REQ structure contains a 4-byte interface index number followed by a socket address structure of the multicast address. See SEZAINST(CBLOCK) for the PL/I example of GROUP_REQ. See SEZAINST(EZACOBOL) for the COBOL example of GROUP-REQ.	N/A
MCAST_JOIN_SOURCE_GROUP Use this option to enable an application to join a source multicast group on a specific interface and a source address. You must specify an interface index and the source address. Applications that want to receive multicast datagrams only from specific source addresses need to join source multicast groups.	Contains the GROUP_SOURCE_REQ structure as defined in SYS1.MACLIB(BPXYSOCK). The GROUP_SOURCE_REQ structure contains a 4-byte interface index number followed by a socket address structure of the multicast address and a socket address structure of the source address. See SEZAINST(CBLOCK) for the PL/I example of GROUP_SOURCE_REQ. See SEZAINST(EZACOBOL) for the COBOL example of GROUP-SOURCE-REQ.	N/A

Table 17. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

OPTNAME options (input)	SETSOCKOPT, OPTVAL (input)	GETSOCKOPT, OPTVAL (output)
MCAST_LEAVE_GROUP Use this option to enable an application to exit a multicast group or exit all sources for a given multicast groups.	Contains the GROUP_REQ structure as defined in SYS1.MACLIB(BPXYSOCK). The GROUP_REQ structure contains a 4-byte interface index number followed by a socket address structure of the multicast address. See SEZAINST(CBLOCK) for the PL/I example of GROUP_REQ. See SEZAINST(EZACOBOL) for the COBOL example of GROUP-REQ.	N/A
MCAST_LEAVE_SOURCE_GROUP Use this option to enable an application to exit a source multicast group.	Contains the GROUP_SOURCE_REQ structure as defined in SYS1.MACLIB(BPXYSOCK). The GROUP_SOURCE_REQ structure contains a 4-byte interface index number followed by a socket address structure of the multicast address and a socket address structure of the source address. See SEZAINST(CBLOCK) for the PL/I example of GROUP_SOURCE_REQ. See SEZAINST(EZACOBOL) for the COBOL example of GROUP-SOURCE-REQ.	N/A
MCAST_UNBLOCK_SOURCE Use this option to enable an application to unblock a previously blocked source for a given multicast group. You must specify an interface index and a source address with this option.	Contains the GROUP_SOURCE_REQ structure as defined in SYS1.MACLIB(BPXYSOCK). The GROUP_SOURCE_REQ structure contains a 4-byte interface index number followed by a socket address structure of the multicast address and a socket address structure of the source address. See SEZAINST(CBLOCK) for the PL/I example of GROUP_SOURCE_REQ. See SEZAINST(EZACOBOL) for the COBOL example of GROUP-SOURCE-REQ.	N/A

Table 17. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

OPTNAME options (input)	SETSOCKOPT, OPTVAL (input)	GETSOCKOPT, OPTVAL (output)
SO_ASCII Use this option to set or determine the translation to ASCII data option. When SO_ASCII is set, data is translated to ASCII. When SO_ASCII is not set, data is not translated to or from ASCII. **Note:** This is a REXX-only socket option.	To enable, set to ON. To disable, set to OFF. **Note:** The *optvalue* is returned and is optionally followed by the name of the translation table that is used if translation is applied to the data.	If enabled, contains ON. If disabled, contains OFF. **Note:** The *optvalue* is returned and is optionally followed by the name of the translation table that is used if translation is applied to the data.
SO_BROADCAST Use this option to set or determine whether a program can send broadcast messages over the socket to destinations that can receive datagram messages. The default is disabled. **Note:** This option has no meaning for stream sockets.	A 4-byte binary field. To enable, set to 1 or a positive value. To disable, set to 0.	A 4-byte field. If enabled, contains a 1. If disabled, contains a 0.
SO_DEBUG Use SO_DEBUG to set or determine the status of the debug option. The default is *disabled*. The debug option controls the recording of debug information. **Notes:** 1. This is a REXX-only socket option. 2. This option has meaning only for stream sockets.	To enable, set to ON. To disable, set to OFF.	If enabled, contains ON. If disabled, contains OFF.
SO_EBCDIC Use this option to set or determine the translation to EBCDIC data option. When SO_EBCDIC is set, data is translated to EBCDIC. When SO_EBCDIC is not set, data is not translated to or from EBCDIC. This option is ignored by EBCDIC hosts. **Note:** This is a REXX-only socket option.	To enable, set to ON. To disable, set to OFF. **Note:** The *optvalue* is returned and is optionally followed by the name of the translation table that is used if translation is applied to the data.	If enabled, contains ON. If disabled, contains OFF. **Note:** The *optvalue* is returned and is optionally followed by the name of the translation table that is used if translation is applied to the data.
SO_ERROR Use this option to request pending errors on the socket or to check for asynchronous errors on connected datagram sockets or for other errors that are not explicitly returned by one of the socket calls. The error status is clear afterwards.	N/A	A 4-byte binary field containing the most recent ERRNO for the socket.

Table 17. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

OPTNAME options (input)	SETSOCKOPT, OPTVAL (input)	GETSOCKOPT, OPTVAL (output)
SO_KEEPALIVE Use this option to set or determine whether the keep alive mechanism periodically sends a packet on an otherwise idle connection for a stream socket. The default is disabled. When activated, the keep alive mechanism periodically sends a packet on an otherwise idle connection. If the remote TCP does not respond to the packet or to retransmissions of the packet, the connection is terminated with the error ETIMEDOUT.	A 4-byte binary field. To enable, set to 1 or a positive value. To disable, set to 0.	A 4-byte binary field. If enabled, contains a 1. If disabled, contains a 0.

SO_LINGER
 	
Use this option to control or determine how TCP/IP processes data that has not been transmitted when a CLOSE is issued for the socket. The default is disabled.
 	
Notes:
1. This option has meaning only for stream sockets.
2. If you set a zero linger time, the connection cannot close in an orderly manner, but stops, resulting in a RESET segment being sent to the connection partner. Also, if the aborting socket is in nonblocking mode, the close call is treated as though no linger option had been set.
 	
When SO_LINGER is set and CLOSE is called, the calling program is blocked until the data is successfully transmitted or the connection has timed out.
 	
When SO_LINGER is not set, the CLOSE returns without blocking the caller, and TCP/IP continues to attempt to send data for a specified time. This usually allows sufficient time to complete the data transfer.
 	
Use of the SO_LINGER option does not guarantee successful completion because TCP/IP only waits the amount of time specified in OPTVAL for SO_LINGER.
	Contains an 8-byte field containing two 4-byte binary fields.
	
	Assembler coding:
	`ONOFF  DS F`
	`LINGER  DS F`
	
	COBOL coding:
	`ONOFF  PIC 9(8) BINARY.`
	`LINGER PIC 9(8) BINARY.`
	
	Set ONOFF to a nonzero value to enable and set to 0 to disable this option. Set LINGER to the number of seconds that TCP/IP lingers after the CLOSE is issued.
		Contains an 8-byte field containing two 4-byte binary fields.
		
		Assembler coding:
		`ONOFF  DS F`
		`LINGER  DS F`
		
		COBOL coding:
		`ONOFF  PIC 9(8) BINARY.`
		`LINGER PIC 9(8) BINARY.`
		
		A nonzero value returned in ONOFF indicates enabled, a 0 indicates disabled. LINGER indicates the number of seconds that TCP/IP will try to send data after the CLOSE is issued.

Table 17. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

OPTNAME options (input)	SETSOCKOPT, OPTVAL (input)	GETSOCKOPT, OPTVAL (output)
SO_OOBINLINE Use this option to control or determine whether out-of-band data is received. **Note:** This option has meaning only for stream sockets. When this option is set, out-of-band data is placed in the normal data input queue as it is received and is available to a RECV or a RECVFROM even if the OOB flag is not set in the RECV or the RECVFROM. When this option is disabled, out-of-band data is placed in the priority data input queue as it is received and is available to a RECV or a RECVFROM only when the OOB flag is set in the RECV or the RECVFROM.	A 4-byte binary field. To enable, set to 1 or a positive value. To disable, set to 0.	A 4-byte binary field. If enabled, contains a 1. If disabled, contains a 0.
SO_RCVBUF Use this option to control or determine the size of the data portion of the TCP/IP receive buffer. The size of the data portion of the receive buffer is protocol-specific, based on the following values prior to any SETSOCKOPT call: • TCPRCVBufrsize keyword on the TCPCONFIG statement in the PROFILE.TCPIP data set for a TCP Socket • UDPRCVBufrsize keyword on the UDPCONFIG statement in the PROFILE.TCPIP data set for a UDP Socket • The default of 65 535 for a raw socket	A 4-byte binary field. To enable, set to a positive value specifying the size of the data portion of the TCP/IP receive buffer. To disable, set to a 0.	A 4-byte binary field. If enabled, contains a positive value indicating the size of the data portion of the TCP/IP receive buffer. If disabled, contains a 0.

Table 17. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

OPTNAME options (input)	SETSOCKOPT, OPTVAL (input)	GETSOCKOPT, OPTVAL (output)
SO_RCVTIMEO Use this option to control or determine the maximum length of time that a receive-type function can wait before it completes. If a receive-type function has blocked for the maximum length of time that was specified without receiving data, control is returned with an errno set to EWOULDBLOCK. The default value for this option is 0, which indicates that a receive-type function does not time out. When the MSG_WAITALL flag (stream sockets only) is specified, the timeout takes precedence. The receive-type function can return the partial count. See the explanation of that operation's MSG_WAITALL flag parameter. The following receive-type functions are supported: • READ • READV • RECV • RECVFROM • RECVMSG	This option requires a TIMEVAL structure, which is defined in SYS1.MACLIB(BPXYRLIM) macro. The TIMEVAL structure contains the number of seconds and microseconds specified as fullword binary numbers. The seconds can be a value in the range 0 - 2 678 400 (equal to 31 days), and the microseconds can be a value in the range 0 - 1 000 000 (equal to 1 second). Although TIMEVAL value can be specified using microsecond granularity, the internal TCP/IP timers that are used to implement this function have a granularity of approximately 100 milliseconds.	This option stores a TIMEVAL structure that is defined in the SYS1.MACLIB(BPXYRLIM) macro. The TIMEVAL structure contains the number of seconds and microseconds, which are specified as fullword binary numbers. The number of seconds value that is returned is in the range 0 - 2 678 400 (equal to 31 days). The number of microseconds value that is returned is in the range 0 - 1 000 000.

Table 17. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

OPTNAME options (input)	SETSOCKOPT, OPTVAL (input)	GETSOCKOPT, OPTVAL (output)
SO_REUSEADDR Use this option to control or determine whether local addresses are reused. The default is disabled. This alters the normal algorithm used with BIND. The normal BIND algorithm allows each Internet address and port combination to be bound only once. If the address and port have been already bound, then a subsequent BIND will fail and result error will be EADDRINUSE. When this option is enabled, the following situations are supported: • A server can BIND the same port multiple times as long as every invocation uses a different local IP address and the wildcard address INADDR_ANY is used only one time per port. • A server with active client connections can be restarted and can bind to its port without having to close all of the client connections. • For datagram sockets, multicasting is supported so multiple bind() calls can be made to the same class D address and port number. • If you require multiple servers to BIND to the same port and listen on INADDR_ANY, see the SHAREPORT option on the PORT statement in TCPIP.PROFILE.	A 4-byte binary field. To enable, set to 1 or a positive value. To disable, set to 0.	A 4-byte binary field. If enabled, contains a 1. If disabled, contains a 0.
SO_SNDBUF Use this option to control or determine the size of the data portion of the TCP/IP send buffer. The size is of the TCP/IP send buffer is protocol specific and is based on the following: • The TCPSENDBufrsize keyword on the TCPCONFIG statement in the PROFILE.TCPIP data set for a TCP socket • The UDPSENDBufrsize keyword on the UDPCONFIG statement in the PROFILE.TCPIP data set for a UDP socket • The default of 65 535 for a raw socket	A 4-byte binary field. To enable, set to a positive value specifying the size of the data portion of the TCP/IP send buffer. To disable, set to a 0.	A 4-byte binary field. If enabled, contains a positive value indicating the size of the data portion of the TCP/IP send buffer. If disabled, contains a 0.

Table 17. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

OPTNAME options (input)	SETSOCKOPT, OPTVAL (input)	GETSOCKOPT, OPTVAL (output)
SO_SNDTIMEO Use this option to control or determine the maximum length of time that a send-type function can remain blocked before it completes. If a send-type function has blocked for this length of time, it returns with a partial count or, if no data is sent, with an errno set to EWOULDBLOCK. The default value for this is 0, which indicates that a send-type function does not time out. For a SETSOCKOPT, the following send-type functions are supported: • SEND • SENDMSG • SENDTO • WRITE • WRITEV	This option requires a TIMEVAL structure, which is defined in the SYS1.MACLIB(BPXYRLIM) macro. The TIMEVAL structure contains the number of seconds and microseconds specified as fullword binary numbers. The seconds value is in the range 0 - 2 678 400 (equal to 31 days), and the microseconds value is in the range 0 - 1 000 000 (equal to 1 second). Although the TIMEVAL value can be specified using microsecond granularity, the internal TCP/IP timers that are used to implement this function have a granularity of approximately 100 milliseconds.	This option stores a TIMEVAL structure that is defined in SYS1.MACLIB(BPXYRLIM). The TIMEVAL structure contains the number of seconds and microseconds, which are specified as fullword binary numbers. The number of seconds value that is returned is in the range 0 - 2 678 400 (equal to 31 days). The microseconds value that is returned is in the range 0 - 1 000 000.
SO_TYPE Use this option to return the socket type.	N/A	A 4-byte binary field indicating the socket type: X'1' indicates SOCK_STREAM. X'2' indicates SOCK_DGRAM. X'3' indicates SOCK_RAW.
TCP_KEEPALIVE Use this option to set or determine whether a socket-specific timeout value (in seconds) is to be used in place of a configuration-specific value whenever keep alive timing is active for that socket. When activated, the socket-specified timer value remains in effect until respecified by SETSOCKOPT or until the socket is closed. See the *z/OS Communications Server: IP Programmer's Guide and Reference* for more information about the socket option parameters.	A 4-byte binary field. To enable, set to a value in the range of 1 – 2 147 460. To disable, set to a value of 0.	A 4-byte binary field. If enabled, contains the specific timer value (in seconds) that is in effect for the given socket. If disabled, contains a 0 indicating keep alive timing is not active.

Table 17. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

OPTNAME options (input)	SETSOCKOPT, OPTVAL (input)	GETSOCKOPT, OPTVAL (output)

TCP_NODELAY
 	
Use this option to set or determine whether data sent over the socket is subject to the Nagle algorithm (RFC 896).
 	
Under most circumstances, TCP sends data when it is presented. When this option is enabled, TCP will wait to send small amounts of data until the acknowledgment for the previous data sent is received. When this option is disabled, TCP will send small amounts of data even before the acknowledgment for the previous data sent is received.
Note: Use the following to set **TCP_NODELAY OPTNAME** value for COBOL programs:
`01 TCP-NODELAY-VAL PIC 9(10) COMP`
`  VALUE 2147483649.`
`01 TCP-NODELAY-REDEF REDEFINES`
`  TCP-NODELAY-VAL.`
`05 FILLER PIC 9(6) BINARY.`
`05 TCP-NODELAY PIC 9(8) BINARY.`
	A 4-byte binary field.
	
	To enable, set to a 0.
	
	To disable, set to a 1 or nonzero.
		A 4-byte binary field.
		
		If enabled, contains a 0.
		
		If disabled, contains a 1.

SHUTDOWN

One way to terminate a network connection is to issue a CLOSE macro that attempts to complete all outstanding data transmission requests prior to breaking the connection. The SHUTDOWN macro can be used to close one-way traffic while completing data transfer in the other direction. The HOW parameter determines the direction of the traffic to shutdown.

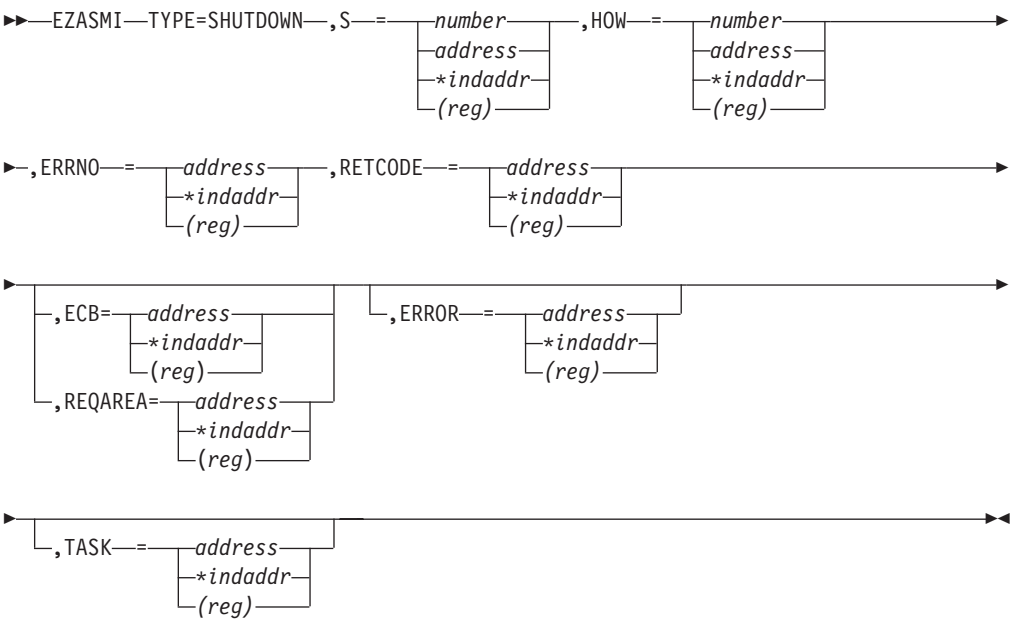
A client program can use the SHUTDOWN macro to reuse a given socket with a different connection.

If you issue SHUTDOWN for a socket that currently has outstanding socket calls pending, see Table 3 on page 37 to determine the effects of this operation on the outstanding socket calls.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.

Control parameters:	All parameters must be addressable by the caller and in the primary address space.



Keyword **Description**

S Input parameter. A value or the address of a halfword binary number specifying the socket to be shutdown.

HOW Input parameter. A fullword binary field specifying the shutdown method.

Value	Description
0	Ends further receive operations.
1	Ends further send operations.
2	Ends further send and receive operations.

ERRNO Output parameter. A fullword binary field. If **RETCODE** is negative, this field contains an error number. See Appendix B, "Socket call error return codes," on page 885 for information about **ERRNO** return codes.

RETCODE Output parameter. A fullword binary field that returns the following:

Value	Description
0	Successful call.
−1	Check **ERRNO** for an error code.

ECB or REQAREA

Input parameter. This parameter is required if you are using APITYPE=3. It points to a 104-byte field containing:

For ECB

A 4-byte **ECB** posted by TCP/IP when the macro completes.

For REQAREA
A 4-byte user token (set by you) that is presented to your exit when the response to this function request is complete.

For ECB/REQAREA
The last 100 bytes is a storage field used by the interface to save the state information.

Note: This storage must not be modified until the macro function has completed and the **ECB** has been posted, or the asynchronous exit has been driven.

ERROR Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

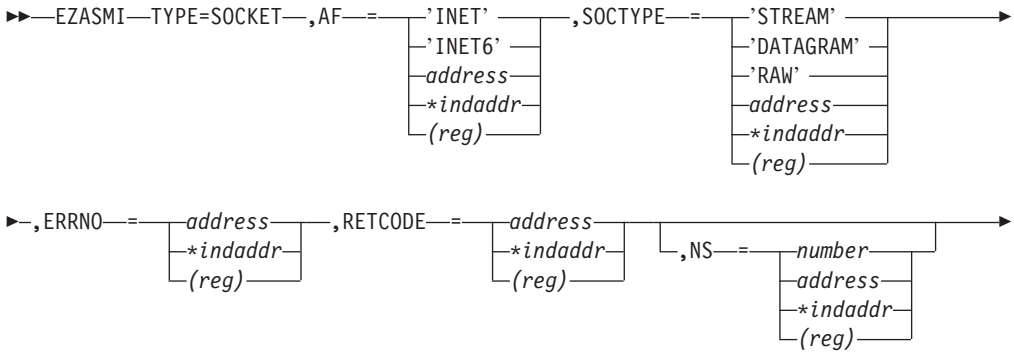
TASK Input parameter. The location of the task storage area in your program.

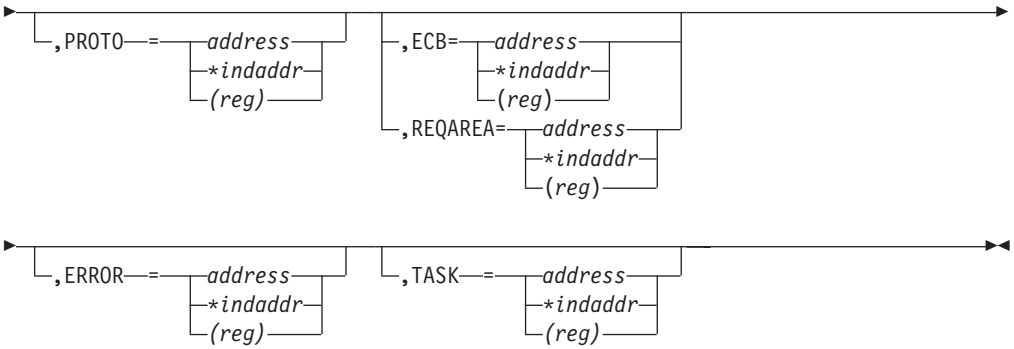
SOCKET

The SOCKET macro creates an endpoint for communication and returns a socket descriptor representing the endpoint. Different types of sockets provide different communication services.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.





Keyword **Description**

AF Input parameter. Specify one of the following:

Value **Description**

'INET' or a decimal 2
Indicates the socket being created will use the IPv4 Internet protocol.

'INET6' or decimal 19
Indicates the socket being created will use the IPv6 Internet protocol.

Note: AF can also indicate a fullword binary number specifying the address family.

SOCTYPE Input parameter. A fullword binary field set to the type of socket required. The types are:

Value **Description**

1 or 'STREAM'
Stream sockets provide sequenced, two-way byte streams that are reliable and connection-oriented. They support a mechanism for out-of-band data. This is the normal type for TCP/IP.

2 or 'DATAGRAM'
Datagram sockets provide datagrams, which are connectionless messages of a fixed maximum length whose reliability is not guaranteed. Datagrams can be corrupted, received out of order, lost, or delivered multiple times. This type is supported only in the AF_INET domain.

3 or 'RAW'
Raw sockets provide the interface to internal protocols (such as IP and ICMP).

Note: For SOCK_RAW sockets, the application must by APF-authorized.

ERRNO Output parameter. A fullword binary field. If **RETCODE** is negative, this field contains an error number. See Appendix B, "Socket call error return codes," on page 885 for information about **ERRNO** return codes.

RETCODE Output parameter. A fullword binary field that returns one of the following:

Value	Description
> or = 0	Contains the new socket descriptor.
–1	Check **ERRNO** for an error code.

NS Optional input. A value or the address of a halfword binary number specifying the socket number for the new socket. If a socket number is not specified, the interface assigns one.

PROTO Input parameter. A fullword binary number specifying the protocol supported. **PROTO** only applies to new sockets and should be set to 0 for TCP/IP. **PROTO** for IPv6 raw sockets cannot be set to the following:

Protocol name	Numeric value
IPROTO_HOPOPTS	0
IPPROTO_TCP	6
IPPROTO_UDP	17
IPPROTO_IPV6	41
IPPROTO_ROUTING	43
IPPROTO_FRAGMENT	44
IPPROTO_ESP	50
IPPROTO_AH	51
IPPROTO_NONE	59
IPPROTO_DSTOPTS	60

PROTO numbers are found in the *hlq*.etc.proto data set.

ECB or REQAREA
Input parameter. This parameter is required if you are using APITYPE=3. It points to a 104-byte field containing:

For ECB
A 4-byte **ECB** posted by TCP/IP when the macro completes.

For REQAREA
A 4-byte user token (set by you) that is presented to your exit when the response to this function request is complete.

For ECB/REQAREA
The last 100 bytes is a storage field used by the interface to save the state information.

Note: This storage must not be modified until the macro function has completed and the **ECB** has been posted, or the asynchronous exit has been driven.

ERROR Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

TASK Input parameter. The location of the task storage area in your program.

TAKESOCKET

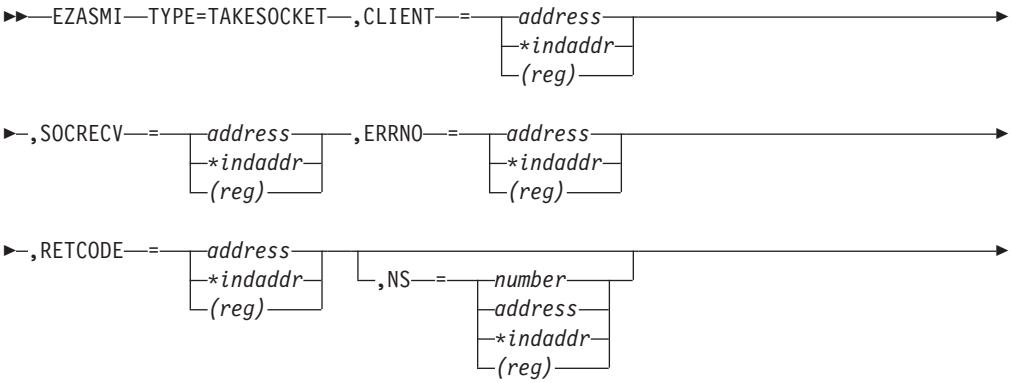
The TAKESOCKET macro acquires a socket from another program and creates a new socket. Typically, a subtask issues this macro using client ID and socket descriptor data that it obtained from the concurrent server.

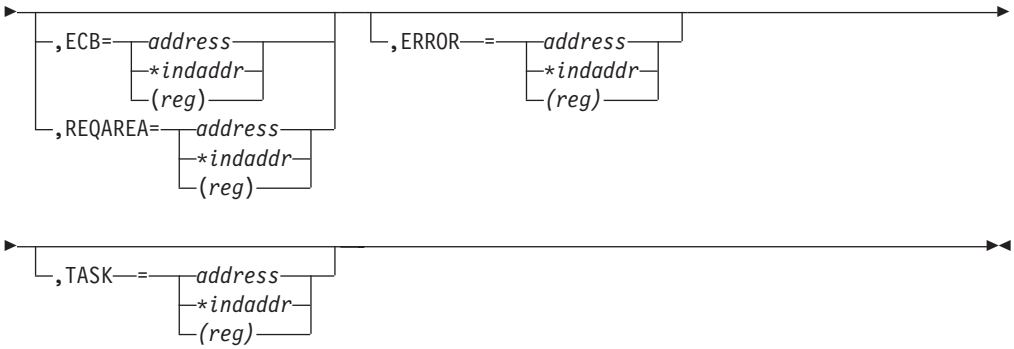
Notes:

1. When TAKESOCKET is issued, a new socket descriptor is returned in **RETCODE**. You should use this new socket descriptor in later macros such as GETSOCKOPT, which require the S (socket descriptor) parameter.
2. Both concurrent servers and iterative servers use this interface. An iterative server handles one client at a time. A concurrent server receives connection requests from multiple clients and creates subtasks that process the client requests. When a subtask is created, the concurrent server gets a new socket, passes the new socket to the subtask, and dissociates itself from the connection. The TCP/IP Listener program is an example of a concurrent server.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.





Keyword	Description
CLIENT	Input parameter. The client data returned by the GETCLIENTID macro.

Field	Description
DOMAIN	Input parameter. A fullword binary number set to the domain of the program that is giving the socket. For TCP/IP the value is a decimal 2, indicating AF_INET, or a decimal 19, indicating AF_INET6. **Note:** The TAKESOCKET can only acquire a socket of the same address family from a GIVESOCKET.
NAME	An 8-byte character field set to the MVS address space identifier of the program giving the socket.
TASK	Input parameter. Specifies an 8-byte field. This field must match the value of the SUBTASK parameter on the INITAPI for the MVS task that issued the GIVESOCKET request.
RESERVED	Input parameter. A 20-byte reserved field. This field is required, but not used.

SOCRECV	Input parameter. A halfword binary field containing the socket descriptor number assigned by the application that called GIVESOCKET.
ERRNO	Output parameter. A fullword binary field. If **RETCODE** is negative, this field contains an error number. See Appendix B, "Socket call error return codes," on page 885 for information about **ERRNO** return codes.
RETCODE	Output parameter. A fullword binary field.

Value	Description
0 or >0	Contains the new socket descriptor.
–1	Check **ERRNO** for an error code.

NS	Input parameter. A value or a halfword binary number specifying the socket descriptor number for the new socket. If a number is not specified, the interface assigns a socket number.

ECB or REQAREA

Input parameter. This parameter is required if you are using APITYPE=3. It points to a 104-byte field containing:

For ECB

A 4-byte **ECB** posted by TCP/IP when the macro completes.

For REQAREA

A 4-byte user token (set by you) that is presented to your exit when the response to this function request is complete.

For ECB/REQAREA

The last 100 bytes is a storage field used by the interface to save the state information.

Note: This storage must not be modified until the macro function has completed and the **ECB** has been posted, or the asynchronous exit has been driven.

ERROR Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

TASK Input parameter. The location of the task storage area in your program.

TASK

The TASK macro allocates a task storage area addressable to all socket users communicating across a particular connection. Most commonly this is done by assigning one connection to each MVS subtask. If more than one module is using sockets within a connection or task, it is your responsibility to provide the task storage address to each user. Each program using sockets should define task storage using the instruction EZASMI TYPE=TASK with STORAGE=DSECT.

If this macro is not named, the default name EZASMTIE is assumed.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.

Keyword	Description
STORAGE	Input parameter. Defines one of the following storage definitions:

Keyword	Description
DSECT	Generates a DSECT.
CSECT	Generates an inline storage definition that can be used within a CSECT or as a part of a larger DSECT.

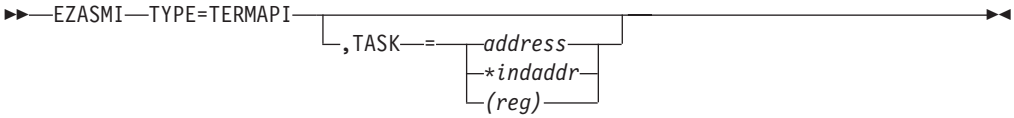
TERMAPI

The TERMAPI macro ends the session created by the INITAPI macro.

Note: The INITAPI and TERMAPI macros must be issued under the same task.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.



Keyword	Description
TASK	Input parameter. The location of the task storage area in your program.

WRITE

The WRITE macro writes data on a connected socket. The WRITE macro is similar to the SEND macro except that it does not have the control flags that can be used with SEND.

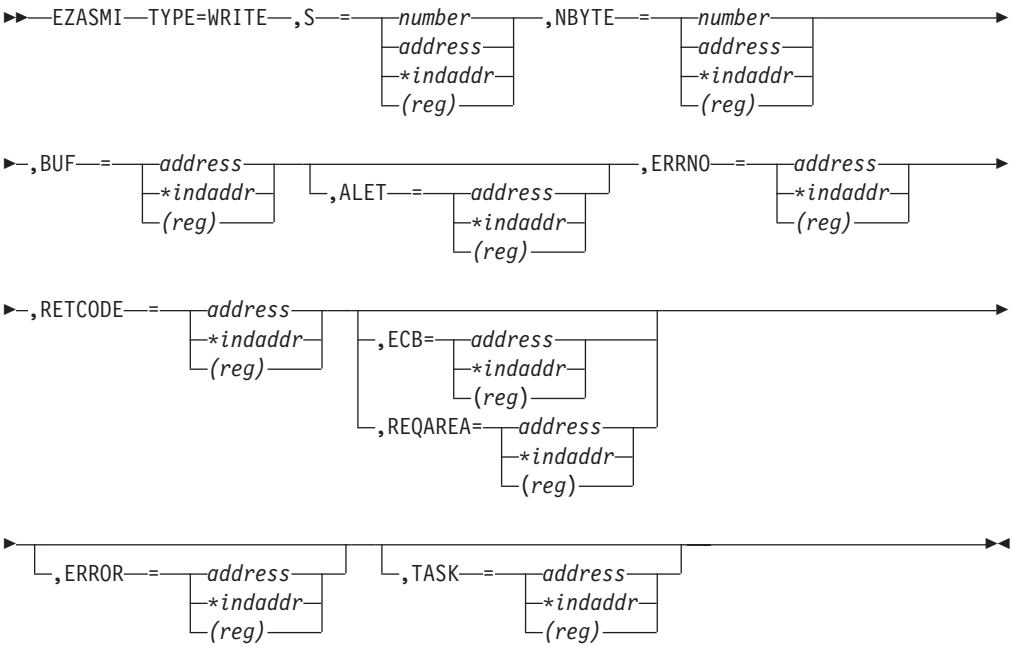
For datagram sockets, this macro writes the entire datagram, if it will fit into one TCP/IP buffer.

For stream sockets, the data is processed as streams of information with no boundaries separating the data. For example, if you want to send 1000 bytes of

data, each call to the write macro can send 1 byte, 10 bytes, or the entire 1000 bytes. You should place the WRITE macro in a loop that cycles until all of the data has been sent.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.



Keyword	Description
S	Input parameter. A value or the address of a halfword binary number specifying the socket descriptor of the socket to receive the data.
NBYTE	Input parameter. A value or the address of a fullword binary field specifying the number of bytes of data to transmit.
BUF	The address of the data being transmitted. The length of **BUF** must be at least as long as the value of **NBYTE**.
ALET	Optional input parameter. A fullword binary field containing the **ALET** of **BUF**. The default is 0 (primary address space).

If a nonzero *ALET* is specified, the *ALET* must represent a valid entry in the dispatchable unit access list (DU-AL) for the task issuing this call. Note that *ALET*s can only be specified for synchronous socket calls (for example, ECB/REQAREA cannot be specified). An exception to this is an *ALET* representing a SCOPE=COMMON data space.

ERRNO Output parameter. A fullword binary field. If RETCODE is negative, this field contains an error number. See Appendix B, "Socket call error return codes," on page 885 for information about **ERRNO** return codes.

RETCODE Output parameter. A fullword binary field.

Value	Description
>0	A successful call. The value is set to the number of bytes transmitted.
0	Connection partner has closed connection.
–1	Check **ERRNO** for an error code.

ECB or REQAREA
Input parameter. This parameter is required if you are using APITYPE=3. It points to a 104-byte field containing:

For ECB
A 4-byte **ECB** posted by TCP/IP when the macro completes.

For REQAREA
A 4-byte user token (set by you) that is presented to your exit when the response to this function request is complete.

For ECB/REQAREA
The last 100 bytes is a storage field used by the interface to save the state information.

Note: This storage must not be modified until the macro function has completed and the **ECB** has been posted, or the asynchronous exit has been driven.

ERROR Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

TASK Input parameter. The location of the task storage area in your program.

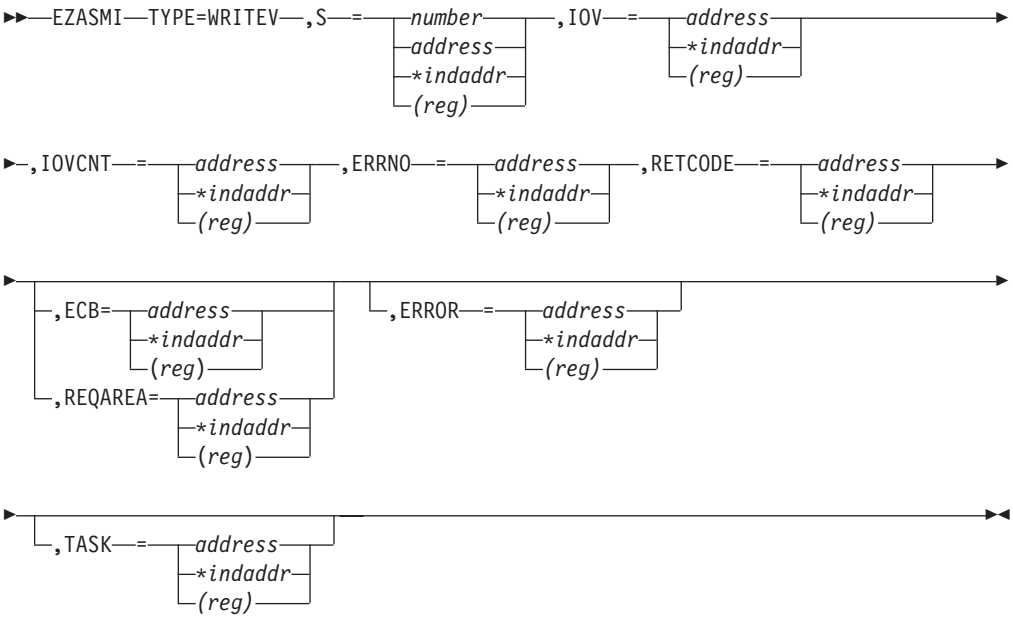
This macro writes up to **NBYTE** bytes of data. If there is not enough available buffer space for the socket data to be transmitted, and the socket is in blocking mode, WRITE blocks the caller until additional buffer space is available. If the socket is in nonblocking mode, WRITE returns a -1 and sets **ERRNO** to 35 (EWOULDBLOCK). See "FCNTL" on page 287 or "IOCTL" on page 345 for a description of how to set the nonblocking mode.

WRITEV

The WRITEV function writes data on a socket from a set of buffers.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.



Keyword	Description
S	Input parameter. A value or the address of a halfword binary number specifying the descriptor of the socket from which the data is to be written.
IOV	Input parameter. An array of three fullword structures with the number of structures equal to the value in IOVCNT and the format of the structures as follows: **Fullword 1** Input parameter. The address of a data buffer. **Fullword 2** Input parameter. The **ALET** for this buffer. If the buffer is in the primary address space, this should be zeros. If a nonzero *ALET* is specified, the *ALET* must represent a valid entry in the dispatchable unit access list (DU-AL) for

the task issuing this call. Note that *ALET*s can only be specified for synchronous socket calls (for example, ECB/REQAREA cannot be specified). An exception to this is an *ALET* representing a SCOPE=COMMON data space.

Fullword 3
Input parameter. The length of the data buffer referenced in Fullword 1.

IOVCNT Input parameter. A fullword binary field specifying the number of data buffers provided for this call.

ERRNO Output parameter. A fullword binary field. If **RETCODE** is negative, this contains an error number.

RETCODE Output parameter. A fullword binary field.

Value	Description
>0	A successful call. The value is set to the number of bytes transmitted.
0	Connection partner has closed connection.
−1	Check **ERRNO** for an error code.

ECB or REQAREA
Input parameter. This parameter is required if you are using APITYPE=3. It points to a 104-byte field containing:

For ECB
A 4-byte **ECB** posted by TCP/IP when the macro completes.

For REQAREA
A 4-byte user token (set by you) that is presented to your exit when the response to this function request is complete.

For ECB/REQAREA
The last 100 bytes is a storage field used by the interface to save the state information.

Note: This storage must not be modified until the macro function has completed and the **ECB** has been posted, or the asynchronous exit has been driven.

ERROR Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

TASK Input parameter. The location of the task storage area in your program.

Macro interface assembler language sample programs

This information provides sample programs for the macro interface that you can use for assembler language applications. The source code can be found in the SEZAINST data set.

The following sample programs are included:

Program	Description
EZASOKAS	Sample IPv4 macro interface server program

Program	Description
EZASOKAC	Sample IPv4 macro interface client program
EZASO6AS	Sample IPv6 macro interface server program
EZASO6AC	Sample IPv6 macro interface client program

EZASOKAS sample server program for IPv4

The EZASOKAS program is a server program that shows you how to use the following calls provided by the macro socket interface:

- INITAPI
- SOCKET
- GETHOSTID
- BIND
- LISTEN
- ACCEPT
- READ
- WRITE
- CLOSE
- TERMAPI

```
EZASOKAS CSECT
EZASOKAS AMODE ANY
EZASOKAS RMODE ANY
*        PRINT NOGEN
*********************************************************************
*                                                                   *
*   MODULE NAME:  EZASOKAS Sample server program                    *
*                                                                   *
* Copyright:    Licensed Materials - Property of IBM                *
*                                                                   *
*               "Restricted Materials of IBM"                       *
*                                                                   *
*               5694-A01                                            *
*                                                                   *
*               (C) Copyright IBM Corp. 1977, 2003                  *
*                                                                   *
*               US Government Users Restricted Rights -             *
*               Use, duplication or disclosure restricted by        *
*               GSA ADP Schedule Contract with IBM Corp.            *
*                                                                   *
* Status:       CSV1R5                                              *
*                                                                   *
*                                                                   *
*   LANGUAGE:  Assembler                                            *
*                                                                   *
*   ATTRIBUTES: NON-REUSABLE                                        *
*                                                                   *
*   REGISTER USAGE:                                                 *
*        R1  =                                                      *
*        R2  =                                                      *
*        R3  = BASE REG 1                                           *
*        R4  = BASE REG 2 (UNUSED)                                  *
*        R5  = FUTURE BASE REG?                                     *
*        R6  = TEMP                                                 *
*        R7  = RETURN REG                                           *
*        R8  =                                                      *
*        R9  = A(WORK AREA)                                         *
*        R10 =                                                      *
*        R11 =                                                      *
*        R12 =                                                      *
*        R13 = SAVE AREA                                            *
*        R14 =                                                      *
*        R15 =                                                      *
*                                                                   *
*   INPUT: NONE                                                     *
*   OUTPUT: WTO results of each test case                           *
*                                                                   *
*********************************************************************
         GBLB  &TRACE  ASSEMBLER VARIABLE TO CONTROL TRACE GENERATION
&TRACE   SETB  1       1=TRACE ON  0=TRACE OFF
R0       EQU   0
R1       EQU   1
R2       EQU   2
R3       EQU   3
```

Figure 67. EZASOKAS sample server program for IPv4 (Part 1 of 10)

```
R4       EQU   4
R5       EQU   5
R6       EQU   6
R7       EQU   7
R8       EQU   8
R9       EQU   9
R10      EQU   10
R11      EQU   11
R12      EQU   12
R13      EQU   13
R14      EQU   14
R15      EQU   15
*--------------------------------------------------------------------*
* START OF EXECUTABLE CODE                                           *
*--------------------------------------------------------------------*
         USING *,R3,R4            TELL ASSEMBLER OF OTHERS
         SAVE (14,12),T,*
         LR    R3,R15             COPY EP REG TO FIRST BASE
         LA    R5,2048            GET R5 HALFWAY THERE
         LA    R5,2048(R5)        GET R5 THERE
         LA    R4,0(R5,R3)        GET R4 THERE
         LA    R12,12             JUST FOR FUN!
         ST    R1,PARMADDR        SAVE ADDRESS OF PARAMETER LIST
         L     R1,0(R1)           GET POINTER
         LH    R1,0(R1)           GET LENGTH
*        STC   R1,TRACE           USE IT AS FLAG
         L     R7,=A(SOCSAVE)     GET NEW SAVE AREA
         ST    R7,8(R13)          SAVE ADDRESS OF NEW SAVE AREA
         ST    R13,4(R7)          COMPLETE SAVE AREA CHAIN
         LR    R13,R7             NOW SWAP THEM
         L     R9,=A(MYCB)        POINT TO THE CONTROL BLOCK
         USING MYCB,R9            TELL ASSEMBLER
*--------------------------------------------------------------------*
*   BUILD MESSAGE FOR CONSOLE
*--------------------------------------------------------------------*
*                                 INITIALIZE MESSAGE TEXT FIELDS
LOOP     EQU   *
         MVC   MSGNUM(8),SUBTASK  WHO I AM
         MVC   TYPE,MSGSTART      MOVE 'STARTED' TO MESSAGE
*
         MVC   MSGRSLT1,MSGSUCC   ...SUCCESSFUL TEXT
         MVC   MSGRSLT2,BLANK35
*
         STM   R14,R12,12(R13)    JUST FOR DEBUGGING
         BAL   R14,WTOSUB         --> DO STARTING WTO
**********************************************************************
*                                                                    *
*        Issue INITAPI to connect to interface                       *
*                                                                    *
**********************************************************************
         POST  ECB,1              NEXT IS ALWAYS SYNCH
         MVI   SYNFLAG,1          MOVE A 1 FOR ASYNC
         MVC   TYPE,MINITAPI      MOVE 'INITAPI' TO MESSAGE
*
         EZASMI TYPE=INITAPI,     Issue INITAPI Macro                X
```

Figure 67. EZASOKAS sample server program for IPv4 (Part 2 of 10)

```
              SUBTASK=SUBTASK,   SPECIFY SUBTASK IDENTIFIER          X
              MAXSOC=MAXSOC,     SPECIFY MAXIMUM NUMBER OF SOCKETS   X
              MAXSNO=MAXSNO,     (HIGHEST SOCKET NUMBER ASSIGNED)    X
              ERRNO=ERRNO,       (Specify ERRNO field)               X
              RETCODE=RETCODE,   (Specify RETCODE field)             X
              APITYPE=APITYPE,   (SPECIFY APITYPE FIELD)             X
              ERROR=ERROR,       ABEND IF ERROR ON MACRO             X
              ASYNC=('EXIT',MYEXIT)  (SPECIFY AN EXIT)
*             IDENT=IDENT,       TCP ADDR SPACE AND MY ADDR SPACE
*             ASYNC=('ECB')      (SPECIFY ECBS)
*
         BAL   R14,RCCHECK        --> DID IT WORK?
*********************************************************************
*                                                                   *
*        Issue SOCKET Macro to obtain a socket descriptor           *
*                 *** INET and STREAM ***                           *
*                                                                   *
*********************************************************************
         MVC   TYPE,MSOCKET       MOVE 'SOCKET' TO MESSAGE
*
         EZASMI TYPE=SOCKET,      Issue SOCKET Macro                  X
               AF='INET',         INET or IUCV                        X
               SOCTYPE='STREAM',  STREAM(TCP) DATAGRAM(UDP) or RAW    X
               ERRNO=ERRNO,       (Specify ERRNO field)               X
               RETCODE=RETCODE,   (Specify RETCODE field)             X
               REQAREA=REQAREA,   IN CASE WE ARE DOING EXITS OR ECBS  X
               ERROR=ERROR        Abend if Macro error
*
         BAL   R14,RCCHECK        CHECK FOR SUCCESSFUL CALL
*
*-------------------------------------------------------------------*
*        Get socket descriptor number
*-------------------------------------------------------------------*
         STH   R8,S               SAVE RETCODE (=SOCKET DESCRIPTOR)
*********************************************************************
*                                                                   *
*        ISSUE GETHOSTID CALL                                       *
*                                                                   *
*********************************************************************
         MVC   TYPE,=CL8'GETHOSTI'     'GETHOSTI' TO MESSAGE
         EZASMI TYPE=GETHOSTID,RETCODE=RETCODE,ERRNO=ERRNO,          X
               REQAREA=REQAREA    IN CASE WE ARE DOING EXITS OR ECBS
         BAL   R14,RCCHECK        CHECK FOR SUCCESSFUL CALL
         ST    R8,ADDR            SAVE OUR ID
*********************************************************************
*                                                                   *
*        Issue BIND socket                                          *
*                                                                   *
*********************************************************************
         MVC   TYPE,MBIND         MOVE 'BIND' TO MESSAGE
         MVC   PORT(2),PORTS      Load STREAM port #
         MVC   ADDRESS(4),ADDR    Load MVS1 internet address
*
         EZASMI TYPE=BIND,        Issue Macro                         X
               S=S,               STREAM                              X
```

Figure 67. EZASOKAS sample server program for IPv4 (Part 3 of 10)

```
               NAME=NAME,         (SOCKET NAME STRUCTURE)              X
               ERRNO=ERRNO,       (Specify ERRNO field)                X
               RETCODE=RETCODE,   (Specify RETCODE field)              X
               REQAREA=REQAREA,   IN CASE WE ARE DOING EXITS OR ECBS   X
               ERROR=ERROR        Abend if Macro error
*
         BAL   R14,RCCHECK        CHECK FOR SUCCESSFUL CALL
*********************************************************************
*                                                                   *
*        Issue LISTEN - Backlog = 5                                 *
*                                                                   *
*********************************************************************
         MVC   TYPE,MLISTEN       MOVE 'LISTEN' TO MESSAGE
*
         EZASMI TYPE=LISTEN,      Issue Macro                         X
               S=S,               STREAM                              X
               BACKLOG=BACKLOG,   BACKLOG                             X
               ERRNO=ERRNO,       (Specify ERRNO field)               X
               RETCODE=RETCODE,   (Specify RETCODE field)             X
               REQAREA=REQAREA,   IN CASE WE ARE DOING EXITS OR ECBS   X
               ERROR=ERROR        Abend if Macro error
*
         BAL   R14,RCCHECK        CHECK FOR SUCCESSFUL CALL
*********************************************************************
*                                                                   *
*        Issue ACCEPT - Block until connection from peer            *
*                                                                   *
*********************************************************************
         MVC   TYPE,MACCEPT       MOVE 'ACCEPT' TO MESSAGE
         MVC   PORT(2),PORTS      Load STREAM port #
         MVC   ADDRESS(4),ADDR    Load MVS1 internet address
*
         EZASMI TYPE=ACCEPT,      Issue Macro                         X
               S=S,               STREAM                              X
               NAME=NAME,         (SOCKET NAME STRUCTURE)             X
               ERRNO=ERRNO,       (Specify ERRNO field)               X
               RETCODE=RETCODE,   (Specify RETCODE field)             X
               REQAREA=REQAREA,   IN CASE WE ARE DOING EXITS OR ECBS   X
               ERROR=ERROR        Abend if Macro error
*
         BAL   R14,RCCHECK        CHECK FOR SUCCESSFUL CALL
* Message RESULTS text
         STH   R8,SOCDESCA        SAVE RETCODE (SOCKET DESCRIPTOR)
*********************************************************************
*                                                                   *
*        Issue READ - Read data and store in buffer                 *
*                                                                   *
*********************************************************************
         MVC   TYPE,MREAD         MOVE 'READ  ' TO MESSAGE
*
         EZASMI TYPE=READ,        Issue Macro                         X
               S=SOCDESCA,        ACCEPT SOCKET                       X
               NBYTE=NBYTE,       SIZE OF BUFFER                      X
               BUF=BUF,           (BUFFER)                            X
               ERRNO=ERRNO,       (Specify ERRNO field)               X
```

Figure 67. EZASOKAS sample server program for IPv4 (Part 4 of 10)

```
               RETCODE=RETCODE,   (Specify RETCODE field)              X
               REQAREA=REQAREA,   IN CASE WE ARE DOING EXITS OR ECBS   X
               ERROR=ERROR        Abend if Macro error
*
         BAL   R14,RCCHECK        CHECK FOR SUCCESSFUL CALL
         MVC   MSGRSLT1,MSGBUFF
         MVC   MSGRSLT2,BUF
         BAL   R14,WTOSUB         --> PRINT IT
*
*
*********************************************************************
*                                                                   *
*        Issue WRITE - Write data from buffer                       *
*                                                                   *
*********************************************************************
         MVC   TYPE,MWRITE        MOVE 'WRITE ' TO MESSAGE
*
         EZASMI TYPE=WRITE,       Issue Macro                         X
               S=SOCDESCA,        ACCEPT Socket                       X
               NBYTE=NBYTE,       SIZE OF BUFFER                      X
               BUF=BUF,           (BUFFER)                            X
               ERRNO=ERRNO,       (Specify ERRNO field)               X
               RETCODE=RETCODE,   (Specify RETCODE field)             X
               REQAREA=REQAREA,   IN CASE WE ARE DOING EXITS OR ECBS   X
               ERROR=ERROR        Abend if Macro error
*
         BAL   R14,RCCHECK        CHECK FOR SUCCESSFUL CALL
*********************************************************************
*                                                                   *
*        Issue CLOSE for ACCEPT socket                              *
*                                                                   *
*********************************************************************
         MVC   TYPE,MCLOSE        MOVE 'CLOSE' TO MESSAGE
*
         EZASMI TYPE=CLOSE,       Issue Macro                         X
               S=SOCDESCA,        ACCEPT                              X
               ERRNO=ERRNO,       (Specify ERRNO field)               X
               RETCODE=RETCODE,   (Specify RETCODE field)             X
               REQAREA=REQAREA,   IN CASE WE ARE DOING EXITS OR ECBS   X
               ERROR=ERROR        Abend if Macro error
*
         MVC   MSGRSLT2,BLANK35
         BAL   R14,RCCHECK        CHECK FOR SUCCESSFUL CALL
*
*********************************************************************
*                                                                   *
*        Terminate Connection to API                                *
*                                                                   *
*********************************************************************
         MVC   TYPE,MTERMAPI      MOVE 'TERMAPI' TO MESSAGE
*
         POST  ECB,1              FOLLOWING IS ALWAYS SYNCH
         EZASMI TYPE=TERMAPI      Issue EZASMI Macro for Termapi
*-------------------------------------------------------------------*
* Message RESULTS text
```

Figure 67. EZASOKAS sample server program for IPv4 (Part 5 of 10)

```
         MVC   MSGRSLT2,BLANK35
*
         BAL   R14,RCCHECK        --> CHECK RC
*-------------------------------------------------------------------*
*        Issue console message for task termination
*-------------------------------------------------------------------*
         MVC   TYPE,MSGEND        Move 'ENDED' to message
*
         MVC   MSGRSLT1,MSGSUCC   ...SUCCESSFUL text
         MVC   MSGRSLT2,BLANK35
*
         BAL   R14,WTOSUB
         LA    R14,1              CONSTANT
         AH    R14,APITYPE        ADD
         STH   R14,APITYPE        STORE
         CH    R14,=H'3'          COMPARE
*        BE    LOOP               --> LETS DO IT AGAIN!
*-------------------------------------------------------------------*
*        Return to Caller
*-------------------------------------------------------------------*
         L     R13,4(R13)
         RETURN (14,12),T,RC=0
WTOSUB   EQU   *
         LR    R7,R14             COPY RETURN REG
         MVC   MSGCMD(8),TYPE
         WTO   TEXT=MSG           WRITE MESSAGE TO OPERATOR
         BR    R7                 --> RETURN TO CALLER
         CNOP  2,4
*        USES R6,R7,R8         RETCODE RETURNED IN R8
RCCHECK  EQU   *
         LR    R7,R14             COPY TO REAL RETURN REG
         MVC   MSGRSLT1,MSGSUCC   ...SUCCESS TEXT
         L     R6,RETCODE
         LTR   R6,R6
         BM    NOWAIT
         CLI   SYNFLAG,0          PLAIN CASE?
         BE    NOWAIT             --> SKIP IT
         MVC   KEY+14(8),SUBTASK
         MVC   KEY+23(8),TYPE
KEY      WTO   'WAIT: XXXXXXXX XXXXXXXX'
         WAIT  ECB=ECB
NOWAIT   EQU   *
*        LA    R15,ECB
*        ST    R15,ECB
         ST    R9,ECB             MAKE THIS THE TOKEN AGAIN
         L     R6,RETCODE         CHECK FOR SUCCESSFUL CALL
         CLC   TYPE,=CL8'GETHOSTI'
         BE    HOSTIDRC           HANDLE PRINTING HOST ID
         LTR   R8,R6              SAVE A COPY
*
         BNL   CONT00
FAILMSG  EQU   *
         MVC   MSGRSLT1,MSGFAIL   ...FAIL TEXT
CONT00   EQU   *
*
```

Figure 67. EZASOKAS sample server program for IPv4 (Part 6 of 10)

```
*--------------------------------------------------------------------*
*        FORMAT THE RETCODE= -XXXXXXX ERRNO= XXXXXXX MSG RESULTS
*        ***> R6 = RETCODE VALUE ON ENTRY
*--------------------------------------------------------------------*
         MVC   MSGRTCT,MSGRETC    ' RETCODE= '
         MVI   MSGRTCS,C'+'
         LTR   R6,R6
         BNM   NOTM               -->
         MVI   MSGRTCS,C'-'       MOVE SIGN WHICH IS ALWAYS MINUS
NOTM     EQU   *
         MVC   MSGERRT,MSGERRN    ' ERRNO= '
*
         CVD   R6,DWORK           CONVERT IT TO DECIMAL
         UNPK  MSGRTCV,DWORK+4(4) UNPACK IT
         OI    MSGRTCV+6,X'F0'    CORRECT THE SIGN
ERRNOFMT EQU   *
         L     R6,ERRNO           GET ERRNO VALUE
         CVD   R6,DWORK           CONVERT IT TO DECIMAL
         UNPK  MSGERRV,DWORK+4(4) UNPACK IT
         OI    MSGERRV+6,X'F0'    CORRECT THE SIGN
*
         MVC   MSGRSLT2(35),MSGRTCD
*
         MVI   MSGRTHX,X'40'      CLEAR HEX INDICATOR
         SR    R6,R6              CLEAR OUT...
         ST    R6,RETCODE            RETCODE AND...
         ST    R6,ERRNO                 ERRNO
*
*
         CLI   TRACE,0
         BNE   NOTRACE
         LR    R14,R7             GIVE HIM RETURN REG
         B     WTOSUB             --> DO WTO
NOTRACE  EQU   *
         BR    R7                 --> RETURN TO CALLER
*
HOSTIDRC EQU   *               VALID HOSTID MAY LOOK LIKE NEG. RC
         C     R6,=F'-1'        ONLY -1 RC INDICATES FAILURE
         BE    FAILMSG             ...BAD RC, USE STANDARD MSG
         LR    R8,R6               ...NEXT CALL EXPECTS ADDR IN R8
         MVC   MSGRSLT1,MSGSUCC    ...SUCCESS TEXT
         UNPK  HEXRC(9),RETCODE(5)   PLUS ONE FOR FAKE SIGN
         TR    HEXRC(8),HEXTAB     ...CONVERT UNPK TO PRINTABLE HEX
         MVI   HEXRC+8,X'40'       ...SPACE OUT FAKED SIGN BYTE
         MVI   MSGRTHX,C'X'        ...INDICATE INFO IS HEX
         B     ERRNOFMT
*
SYNFLAG  DC    H'0'               DEFAULT TO SYN
TRACE    DC    H'0'               DEFAULT TO TRACE
MYEXIT   DC   A(MYEXIT1,SUBTASK)
MYEXIT1  SAVE (14,12),T,*
         LR   R2,R15
         USING MYEXIT1,R2
         LM   R8,R9,0(R1)            GET TWO TOKENS
         MVC  EXKEY+14(8),0(R8)      TELL WHO
```

Figure 67. EZASOKAS sample server program for IPv4 (Part 7 of 10)

```
         MVC  EXKEY+23(8),TYPE       TELL WHAT
EXKEY    WTO 'EXIT: XXXXXXXX XXXXXXXX'
         POST ECB,1
         RETURN (14,12),T,RC=0
         DROP  R2
*-------------------------------------------------------------------*
*        ABEND PROGRAM AND GET DUMP
*-------------------------------------------------------------------*
ERROR    ABEND 1,DUMP
*-------------------------------------------------------------------*
* CONSTANTS USED TO RUN PROGRAM                                     *
*-------------------------------------------------------------------*
EZASMGW  EZASMI TYPE=GLOBAL,      Storage definition for GWA           X
               STORAGE=CSECT
*--------------------*
* INITAPI macro parms *
*--------------------*
SUBTASK  DC    CL8'EZASOKAS'      SUBTASK PARM VALUE
MAXSOC   DC    AL2(50)            MAXSOC PARM VALUE
APITYPE  DC    H'2'               OR A 3
MAXSNO   DC    F'0'               (HIGHEST SOCKET DESCRIPTOR AVAILABLE)
IDENT    DC    0CL16' '
         DC    CL8'       '       NAME OF TCP TO WHICH CONNECTING
         DC    CL8'SOC401CB'      MY ADDR SPACE NAME
*-------------------------------------------------------------------*
* SOCKET macro parms *
*--------------------*
S        DC    H'0'               SOCKET DESCRIPTOR FOR STREAM
*-------------------------------------------------------------------*
* BIND MACRO PARMS   *
*--------------------*
         CNOP  0,4
NAME     DC    0CL16' '           SOCKET NAME STRUCTURE
         DC    AL2(2)             FAMILY
PORT     DC    H'0'
ADDRESS  DC    F'0'
         DC    XL8'00'            RESERVED
ADDR     DC    AL1(14),AL1(0),AL1(0),AL1(0) Internet Address
PORTS    DC    H'11007'
*-------------------------------------------------------------------*
* LISTEN PARMS       *
*--------------------*
BACKLOG  DC    F'5'               BACKLOG
*-------------------------------------------------------------------*
* READ MACRO PARMS   *
*--------------------*
NBYTE    DC    F'50'              SIZE OF BUFFER
SOCDESCA DC    H'0'               SOCKET DESCRIPTOR FROM ACCEPT
BUF      DC    CL50' THIS SHOULD NEVER APPEAR!!! :-('
*-------------------------------------------------------------------*
* WTO FRAGMENTS *
*---------------*
MINITAPI DC    CL8'INITAPI'
MSOCKET  DC    CL8'SOCKET'
MBIND    DC    CL8'BIND'
```

Figure 67. EZASOKAS sample server program for IPv4 (Part 8 of 10)

```
MACCEPT  DC    CL8'ACCEPT'
MLISTEN  DC    CL8'LISTEN'
MREAD    DC    CL8'READ'
MWRITE   DC    CL8'WRITE'
MCLOSE   DC    CL8'CLOSE'
MTERMAPI DC    CL8'TERMAPI'
MSGSTART DC    CL8' STARTED'
MSGEND   DC    CL8' ENDED  '
MSGBUFF  DC    CL10' BUFFER:  '                    ...
MSGSUCC  DC    CL10' SUCCESS  '     Command results...
MSGFAIL  DC    CL10' FAIL: ( '                    ...
MSGRETC  DC    CL10' RETCODE= '                    ...
MSGERRN  DC    CL10' ERRNO=   '                    ...
BLANK35  DC    CL35' '
*-------------------------------------------------------------------*
* ERROR NUMBER / RETURN CODE FIELDS *
*-----------------------------------*
*-------------------------------------------------------------------*
* MESSAGE AREA *
*--------------*
MSG      DC    0F'0'              MESSAGE AREA
         DC    AL2(MSGE-MSGNUM)   LENGTH OF MESSAGE
MSGNUM   DC    CL10'EZASOKAS:'    'EZASOKASXX:'
MSGCMD   DC    CL8' '             COMMAND ISSUED
MSGRSLT1 DC    CL10' '            COMMAND RESULTS (SUCC, PASS, FAIL)
MSGRSLT2 DC    CL35' '            RETURNED VALUES
MSGE     EQU   *                  End of message
*-------------------------------------------------------------------*
* MESSAGE RESULTS AREAS (fill in and move to MSGRSLT2) *
*------------------------------------------------------*
MSGRTCD  DC    0CL35' '           GENERAL RETURNED VALUE
MSGRTCT  DC    CL9' RETCODE='     ' RETCODE= '
MSGRTHX  DC    CL1' '             'X' X FOR GETHOSTID
MSGRTCS  DC    CL1' '             '-' (NEGATIVE SIGN)
HEXRC    EQU   MSGRTCS            HEX RC WILL START AT SIGN LOCATION
MSGRTCV  DC    CL7' '             RETURNED VALUE (RETCODE)
MSGERRT  DC    CL10' ERRNO='      ' ERRNO=   '
MSGERRV  DC    CL7' '             RETURNED VALUE (ERRNO)
*-------------------------------------------------------------------*
PARMADDR DC    A(0)               PARM ADDRESS SAVE AREA
DWORK    DC    D'0'               WORK AREA
HEXTAB   EQU   *-240              TAB TO CONVERT TO PRINTABLE HEX
*                                 FIRST 240 BYTES NOT REFERENCED
         DC    CL16'0123456789ABCDEF'
         LTORG ,
*-------------------------------------------------------------------*
*-------------------------------------------------------------------*
* REG/SAVEAREA *
*--------------*
SOCSAVE  DC    9D'0'              SAVE AREA
         CNOP  0,8
MYCB     EQU   *                  MY CONTROL BLOCK
REQAREA  EQU   *
ECB      DC    A(ECB)             SELF POINTER
         DC    CL100'WORK AREA'
```

Figure 67. EZASOKAS sample server program for IPv4 (Part 9 of 10)

```
MYTIE    EZASMI TYPE=TASK,STORAGE=CSECT     TIE
TYPE     DC    CL8'TYPE'
ERRNO    DC    F'0'
RETCODE  DC    F'0'
MYNEXT   DC    A(MYCB)            NEXT IN CHAIN FOR MULTIPLES
         CNOP  0,8
MYLEN    EQU   *-MYCB
MYCB2    EQU   *
         ORG   *+MYLEN
         CNOP  0,8
         DC    CL8'&SYSDATE'
         DC    CL8'&SYSTIME'
         END
```

Figure 67. EZASOKAS sample server program for IPv4 (Part 10 of 10)

EZASOKAC sample client program for IPv4

The EZASOKAC program is a client module that shows you how to use the following calls provided by the macro socket interface:

- INITAPI
- SOCKET
- CONNECT
- GETPEERNAME
- WRITE
- SHUTDOWN
- WRITE
- READ
- TERMAPI

```
EZASOKAC CSECT
EZASOKAC AMODE ANY
EZASOKAC RMODE ANY
         PRINT NOGEN
*********************************************************************
*                                                                   *
*   MODULE NAME:  EZASOKAC - THIS IS A VERY SIMPLE CLIENT           *
*                                                                   *
* Copyright:    Licensed Materials - Property of IBM                *
*                                                                   *
*               "Restricted Materials of IBM"                       *
*                                                                   *
*               5694-A01                                            *
*                                                                   *
*               (C) Copyright IBM Corp. 1977, 2003                  *
*                                                                   *
*               US Government Users Restricted Rights -             *
*               Use, duplication or disclosure restricted by        *
*               GSA ADP Schedule Contract with IBM Corp.            *
*                                                                   *
* Status:       CSV1R5                                              *
*                                                                   *
*                                                                   *
*   LANGUAGE:  ASSEMBLER                                            *
*                                                                   *
*   ATTRIBUTES: NON-REUSEABLE                                       *
*                                                                   *
*   REGISTER USAGE:                                                 *
*        R1  =                                                      *
*        R2  =                                                      *
*        R3  = BASE REG 1                                           *
*        R4  = BASE REG 2 (UNUSED)                                  *
*        R5  = FUTURE BASE?                                         *
*        R6  = TEMP                                                 *
*        R7  = RETURN REG                                           *
*        R8  =                                                      *
*        R9  = A(WORK AREA)                                         *
*        R10 =                                                      *
*        R11 =                                                      *
*        R12 =                                                      *
*        R13 = SAVE AREA                                            *
*        R14 =                                                      *
*        R15 =                                                      *
*                                                                   *
*   INPUT: ANY PARM TURNS TRACE OFF, NO PARM IS NOISY MODE          *
*   OUTPUT: WTO RESULTS OF EACH TEST CASE IF TRACING                *
*           RETURN CODE IS 0 WHETHER IT CONNECTS OR NOT!            *
*                                                                   *
*********************************************************************
         GBLB  &TRACE  ASSEMBLER VARIABLE TO CONTROL TRACE GENERATION
&TRACE   SETB  1       1=TRACE ON  0=TRACE OFF
R0       EQU   0
R1       EQU   1
R2       EQU   2
```

Figure 68. EZASOKAC sample client program for IPv4 (Part 1 of 10)

```
R3       EQU   3
R4       EQU   4
R5       EQU   5
R6       EQU   6
R7       EQU   7
R8       EQU   8
R9       EQU   9
R10      EQU   10
R11      EQU   11
R12      EQU   12
R13      EQU   13
R14      EQU   14
R15      EQU   15
*--------------------------------------------------------------------*
* START OF EXECUTABLE CODE                                           *
*--------------------------------------------------------------------*
         USING *,R3,R4            TELL ASSEMBLER OF OTHERS
         SAVE (14,12),T,*
         LR    R3,R15             COPY EP REG TO FIRST BASE
         LA    R5,2048            GET R5 HALFWAY THERE
         LA    R5,2048(R5)        GET R5 THERE
         LA    R4,0(R5,R3)        GET R4 THERE
         LA    R12,12             JUST FOR FUN!
         ST    R1,PARMADDR        SAVE ADDRESS OF PARAMETER LIST
         L     R1,0(R1)           GET POINTER
         LH    R1,0(R1)           GET LENGTH
*        STC   R1,TRACE           USE IT AS FLAG
         L     R7,=A(SOCSAVE)     GET NEW SAVE AREA
         ST    R7,8(R13)          SAVE ADDRESS OF NEW SAVE AREA
         ST    R13,4(R7)          COMPLETE SAVE AREA CHAIN
         LR    R13,R7             NOW SWAP THEM
         L     R9,=A(MYCB)        POINT TO THE CONTROL BLOCK
         USING MYCB,R9            TELL ASSEMBLER
*--------------------------------------------------------------------*
*   BUILD MESSAGE FOR CONSOLE
*--------------------------------------------------------------------*
*                                 INITIALIZE MESSAGE TEXT FIELDS
LOOP     EQU   *
         MVC   MSGNUM(8),SUBTASK  WHO I AM
         MVC   TYPE,MSGSTART      MOVE 'STARTED' TO MESSAGE
*
         MVC   MSGRSLT1,MSGSUCC   ...SUCCESSFUL TEXT
         MVC   MSGRSLT2,BLANK35
*
         STM   R14,R12,12(R13)    JUST FOR DEBUGGING
         BAL   R14,WTOSUB         --> DO STARTING WTO
**********************************************************************
*                                                                    *
*        Issue INITAPI to connect to interface                       *
*                                                                    *
**********************************************************************
         MVC   TYPE,MINITAPI      MOVE 'INITAPI' TO MESSAGE
*
         POST  ECB,1              FOLLOWING IS SYNC ONLY
         MVI   SYNFLAG,0          MOVE A 1 FOR ASYNCH
```

Figure 68. EZASOKAC sample client program for IPv4 (Part 2 of 10)

```
         EZASMI TYPE=INITAPI,     ISSUE INITAPI MACRO                  X
               SUBTASK=SUBTASK,   SPECIFY SUBTASK IDENTIFIER           X
               MAXSOC=MAXSOC,     SPECIFY MAXIMUM NUMBER OF SOCKETS    X
               MAXSNO=MAXSNO,     (HIGHEST SOCKET NUMBER ASSIGNED)     X
               ERRNO=ERRNO,       (Specify ERRNO field)                X
               RETCODE=RETCODE,   (Specify RETCODE field)              X
               APITYPE=APITYPE,   (SPECIFY APITYPE FIELD)              X
               ERROR=ERROR        Abend if error on macro
*              IDENT=IDENT,       TCP ADDR SPACE AND MY ADDR SPACE
*
*              ASYNC=('ECB'),     (SPECIFY TO USE ECBS)
*              ASYNC=('EXIT',MYEXIT)  (SPECIFY TO USE EXITS)
         BAL   R14,RCCHECK        --> CHECK RESULTS
*********************************************************************
*                                                                   *
*        Issue SOCKET Macro to obtain a socket descriptor           *
*                 *** INET and STREAM ***                           *
*                                                                   *
*********************************************************************
         MVC   TYPE,MSOCKET       MOVE 'SOCKET' TO MESSAGE
*
         EZASMI TYPE=SOCKET,      Issue SOCKET Macro                  X
               AF='INET',         INET or IUCV                        X
               SOCTYPE='STREAM',  STREAM(TCP) DATAGRAM(UDP) or RAW    X
               ERRNO=ERRNO,       (Specify ERRNO field)               X
               RETCODE=RETCODE,   (Specify RETCODE field)             X
               REQAREA=REQAREA,   FOR EXITS (AND ECBS)                X
               ERROR=ERROR        Abend if Macro error
*
         BAL   R14,RCCHECK        --> CHECK RESULTS
         STH   R8,S               SAVE RETCODE (=SOCKET DESCRIPTOR)
         LTR   R8,R8              CHECK IT
         BM    DOSHUTDO           --> WE ARE DONE!
*********************************************************************
*                                                                   *
*        ISSUE GETHOSTID CALL                                       *
*                                                                   *
*********************************************************************
         MVC    TYPE,=CL8'GETHOSTI'
         POST   ECB,1             FOLLOWING IS SYNC ONLY
         EZASMI TYPE=GETHOSTID,RETCODE=RETCODE,ERRNO=ERRNO
         BAL   R14,RCCHECK        --> CHECK RESULTS
         ST    R8,ADDR
*********************************************************************
*                                                                   *
*        Issue CONNECT Socket                                       *
*                                                                   *
*********************************************************************
         MVC   TYPE,MCONNECT      MOVE 'CONNECT' TO MESSAGE
         MVC   PORT(2),PORTS      Load STREAM port #
*
*
         MVC   ADDRESS(4),ADDR    LOAD OUR INTERNET ADDRESS
*
         EZASMI TYPE=CONNECT,     Issue Macro                         X
```

Figure 68. EZASOKAC sample client program for IPv4 (Part 3 of 10)

```
               S=S,               STREAM                              X
               NAME=NAME,         SOCKET NAME STRUCTURE               X
               ERRNO=ERRNO,       (Specify ERRNO field)               X
               RETCODE=RETCODE,   (Specify RETCODE field)             X
               REQAREA=REQAREA,   FOR EXITS (AND ECBS)                X
               ERROR=ERROR        Abend if Macro error
*
         BAL   R14,RCCHECK        --> CHECK RC
         LTR   R8,R8              RECHECK IT
         BM    DOSHUTDO           --> WE ARE DONE
*********************************************************************
*                                                                   *
*        Issue GETPEERNAME                                          *
*                                                                   *
*********************************************************************
         MVC   TYPE,MGETPEER      MOVE 'GTPEERN' TO MESSAGE
*
         EZASMI TYPE=GETPEERNAME, Issue Macro                        X
               S=S,               STREAM                              X
               NAME=NAME,         (SOCKET NAME STRUCTURE)             X
               ERRNO=ERRNO,       (Specify ERRNO field)               X
               RETCODE=RETCODE,   (Specify RETCODE field)             X
               REQAREA=REQAREA,   FOR EXITS (AND ECBS)                X
               ERROR=ERROR        Abend if Macro error
*
         BAL   R14,RCCHECK        --> CHECK RC
*********************************************************************
*                                                                   *
*        Issue WRITE - Write data from buffer                       *
*                                                                   *
*********************************************************************
         MVC   TYPE,MWRITE        MOVE 'WRITE ' TO MESSAGE
*
         EZASMI TYPE=WRITE,       Issue Macro                        X
               S=S,               STREAM SOCKET                       X
               NBYTE=NBYTE,       SIZE OF BUFFER                      X
               BUF=BUF,           BUFFER                              X
               ERRNO=ERRNO,       (Specify ERRNO field)               X
               RETCODE=RETCODE,   (Specify RETCODE field)             X
               REQAREA=REQAREA,   FOR EXITS (AND ECBS)                X
               ERROR=ERROR        Abend if Macro error
*
         BAL   R14,RCCHECK        --> CHECK RC
*********************************************************************
*                                                                   *
*        Issue SHUTDOWN - HOW = 1 (end communication TO socket)     *
*                                                                   *
*********************************************************************
DOSHUTDO EQU   *
         MVC   HOW(4),=F'1'
*
         BAL   R14,SHUTSUB        --> SHUTDOWN
*
         BAL   R14,RCCHECK        --> CHECK RC
*********************************************************************
```

Figure 68. EZASOKAC sample client program for IPv4 (Part 4 of 10)

```
*                                                                     *
*        Issue READ - Read data and store in buffer                   *
*                                                                     *
***********************************************************************
         MVC   TYPE,MREAD         MOVE 'READ  ' TO MESSAGE
*
         EZASMI TYPE=READ,        Issue Macro                          X
               S=S,               STREAM SOCKET                        X
               NBYTE=NBYTE,       SIZE OF BUFFER                       X
               BUF=BUF2,          (BUFFER)                             X
               ERRNO=ERRNO,       (Specify ERRNO field)                X
               RETCODE=RETCODE,   (Specify RETCODE field)              X
               REQAREA=REQAREA,   FOR EXITS (AND ECBS)                 X
               ERROR=ERROR        Abend if Macro error
*
         BAL   R14,RCCHECK        --> CHECK RC
         MVC   MSGRSLT1,MSGBUFF   TITLE
         MVC   MSGRSLT2,BUF2      MOVE THE DATA
         BAL   R14,WTOSUB         --> PRINT IT
***********************************************************************
*                                                                     *
*        Issue SHUTDOWN - HOW = 0 (end communication FROM socket)     *
*                                                                     *
***********************************************************************
         MVC   HOW(4),=F'0'
*
         BAL   R14,SHUTSUB        --> SHUTDOWN
*
         BAL   R14,RCCHECK        --> CHECK RC
***********************************************************************
*                                                                     *
*        Terminate Connection to API                                  *
*                                                                     *
***********************************************************************
         MVC   TYPE,MTERMAPI      MOVE 'TERMAPI' TO MESSAGE
*
         POST  ECB,1              FOLLOWING IS SYNC ONLY
         EZASMI TYPE=TERMAPI      Issue EZASMI Macro for Termapi
*
         BAL   R14,RCCHECK        --> CHECK RC
*---------------------------------------------------------------------*
*        Issue console message for task termination
*---------------------------------------------------------------------*
         MVC   TYPE,MSGEND        Move 'ENDED' to message
*
         MVC   MSGRSLT1,MSGSUCC   ...SUCCESSFUL text
         MVC   MSGRSLT2,BLANK35
         BAL   R14,WTOSUB         --> DO WTO
         LA    R14,1              CONSTANT
         AH    R14,APITYPE        ADD
         STH   R14,APITYPE        STORE
         CH    R14,=H'3'          COMPARE
*        BE    LOOP               --> LETS DO IT AGAIN!
*
*---------------------------------------------------------------------*
```

Figure 68. EZASOKAC sample client program for IPv4 (Part 5 of 10)

```
*        Return to Caller
*-------------------------------------------------------------------*
         L     R13,4(R13)
         RETURN (14,12),T,RC=0
WTOSUB   EQU   *
         LR    R7,R14             SAVE RETURN REG
         MVC   MSGCMD,TYPE        COPY COMMAND
         WTO   TEXT=MSG
         BR    R7                 --> RETURN
*
SHUTSUB  EQU   *
         LR    R7,R14
         MVC   TYPE,MSHUTDOW      MOVE 'SHUTDOW' TO MESSAGE
*
         EZASMI TYPE=SHUTDOWN,    Issue Macro                          X
               S=S,               STREAM                               X
               HOW=HOW,           End communication in both directions X
               ERRNO=ERRNO,       (Specify ERRNO field)                X
               RETCODE=RETCODE,   (Specify RETCODE field)              X
               REQAREA=REQAREA,   FOR EXITS (AND ECBS)                 X
               ERROR=ERROR        Abend if Macro error
*
         BR    R7                 --> RETURN TO CALLER
*-------------------------------------------------------------------*
*        ABEND PROGRAM AND GET DUMP TO DEBUG!
ERROR    ABEND 1,DUMP
         CNOP  2,4
*        USES R6,R7,R8         RETCODE RETURNED IN R8
RCCHECK  EQU   *
         LR    R7,R14             COPY TO REAL RETURN REG
         MVC   MSGRSLT1,MSGSUCC   ...SUCCESS TEXT
         L     R6,RETCODE
         LTR   R6,R6
         BM    NOWAIT
         CLI   SYNFLAG,0          PLAIN CASE?
         BE    NOWAIT             --> SKIP IT
         MVC   KEY+14(8),SUBTASK
         MVC   KEY+23(8),TYPE
KEY      WTO   'WAIT: XXXXXXXX XXXXXXXX'
         WAIT  ECB=ECB
NOWAIT   EQU   *
*        LA    R15,ECB
*        ST    R15,ECB
         ST    R9,ECB             MAKE THIS THE TOKEN AGAIN
         L     R6,RETCODE         CHECK FOR SUCCESSFUL CALL
         CLC   TYPE,=CL8'GETHOSTI'
         BE    HOSTIDRC           HANDLE PRINTING HOST ID
         LTR   R8,R6              SAVE A COPY
*
         BNL   CONT00
FAILMSG  EQU   *
         MVC   MSGRSLT1,MSGFAIL   ...FAIL TEXT
CONT00   EQU   *
*
*-------------------------------------------------------------------*
```

Figure 68. EZASOKAC sample client program for IPv4 (Part 6 of 10)

```
*        FORMAT THE RETCODE= -XXXXXXX ERRNO= XXXXXXX MSG RESULTS
*        ***> R6 = RETCODE VALUE ON ENTRY
*-------------------------------------------------------------------*
         MVC   MSGRTCT,MSGRETC    ' RETCODE= '
         MVI   MSGRTCS,C'+'
         LTR   R6,R6
         BNM   NOTM               -->
         MVI   MSGRTCS,C'-'       MOVE SIGN WHICH IS ALWAYS MINUS
NOTM     EQU   *
         MVC   MSGERRT,MSGERRN    ' ERRNO= '
*
         CVD   R6,DWORK           CONVERT IT TO DECIMAL
         UNPK  MSGRTCV,DWORK+4(4) UNPACK IT
         OI    MSGRTCV+6,X'F0'    CORRECT THE SIGN
*
ERRNOFMT EQU   *
         L     R6,ERRNO           GET ERRNO VALUE
         CVD   R6,DWORK           CONVERT IT TO DECIMAL
         UNPK  MSGERRV,DWORK+4(4) UNPACK IT
         OI    MSGERRV+6,X'F0'    CORRECT THE SIGN
*
         MVC   MSGRSLT2(35),MSGRTCD
*
         MVI   MSGRTHX,X'40'      CLEAR HEX INDICATOR
         SR    R6,R6              CLEAR OUT...
         ST    R6,RETCODE            RETCODE AND...
         ST    R6,ERRNO                 ERRNO
*
*
         CLI   TRACE,0
         BNE   NOTRACE
         LR    R14,R7             GIVE HIM RETURN REG
         B     WTOSUB             --> DO WTO
NOTRACE  EQU   *
         BR    R7                 --> RETURN TO CALLER
*
HOSTIDRC EQU   *               VALID HOSTID MAY LOOK LIKE NEG. RC
         C     R6,=F'-1'          ONLY -1 RC INDICATES FAILURE
         BE    FAILMSG               ...BAD RC, USE STANDARD MSG
         LR    R8,R6              ...NEXT CALL EXPECTS ADDR IN R8
         MVC   MSGRSLT1,MSGSUCC   ...SUCCESS TEXT
         UNPK  HEXRC(9),RETCODE(5)   PLUS ONE FOR FAKE SIGN
         TR    HEXRC(8),HEXTAB    ...CONVERT UNPK TO PRINTABLE HEX
         MVI   HEXRC+8,X'40'      ...SPACE OUT FAKED SIGN BYTE
         MVI   MSGRTHX,C'X'       ...INDICATE INFO IS HEX
         B     ERRNOFMT
*
SYNFLAG  DC    H'0'               DEFAULT TO SYN
TRACE    DC    H'0'               DEFAULT TO TRACE
MYEXIT   DC   A(MYEXIT1,SUBTASK)
MYEXIT1  SAVE (14,12),T,*
         LR   R2,R15
         USING MYEXIT1,R2
         LM   R8,R9,0(R1)            GET TWO TOKENS
         MVC  EXKEY+14(8),0(R8)      TELL WHO
```

Figure 68. EZASOKAC sample client program for IPv4 (Part 7 of 10)

```
         MVC  EXKEY+23(8),TYPE       TELL WHAT
EXKEY    WTO 'EXIT: XXXXXXXX XXXXXXXX'
         POST ECB,1
         RETURN (14,12),T,RC=0
         DROP  R2
*-------------------------------------------------------------------*
* ELEMENTS USED TO RUN PROGRAM                                      *
*-------------------------------------------------------------------*
EZASMGW  EZASMI TYPE=GLOBAL,      STORAGE DEFINITION FOR GWA           X
               STORAGE=CSECT
*--------------------*
* INITAPI macro parms *
*--------------------*
SUBTASK  DC    CL8'EZASOKAC'      SUBTASK PARM VALUE
IDENT    DC    0CL16' '
         DC    CL8'TCPV32'        DEFAULT TO FIRST ONE AVAILABLE
         DC    CL8'EZASOKAC'      MY ADDR SPACE NAME OR JOBNAME
MAXSNO   DC    F'0'               (HIGHEST SOCKET DESCRIPTOR AVAILABLE)
MAXSOC   DC    AL2(50)            MAXSOC PARM VALUE
APITYPE  DC    H'2'               OR PUT A 3 HERE
*-------------------------------------------------------------------*
* SOCKET macro parms *
*--------------------*
S        DC    H'0'               SOCKET DESCRIPTOR FOR STREAM
*--------------------*
* CONNECT MACRO PARMS *
*--------------------*
         CNOP  0,4
NAME     DC    0CL16' '           SOCKET NAME STRUCTURE
         DC    AL2(2)             FAMILY
PORT     DC    H'0'
ADDRESS  DC    F'0'
         DC    XL8'0'             RESERVED
ADDR     DC    AL1(14),AL1(0),AL1(0),AL1(0) Internet Address
PORTS    DC    H'11007'
*ORTS    DC    H'43'
*--------------------*
* WRITE MACRO PARMS   *
*--------------------*
NBYTE    DC    F'50'              SIZE OF BUFFER
BUF      DC    CL50' THIS IS FROM EZASOKAC!' BUFFER FOR WRITE
*-----------------------*
* SHUTDOWN MACRO PARMS   *
*-----------------------*
HOW      DC    F'2'               END COMMUNICATION TO- AND FROM-SOCKET
*--------------------*
* READ MACRO PARMS    *
*--------------------*
BUF2     DC    CL50'BUF2'         BUFFER FOR READ
*---------------*
*---------------*
MINITAPI DC    CL8'INITAPI'
MSOCKET  DC    CL8'SOCKET'
MCONNECT DC    CL8'CONNECT'
MGETPEER DC    CL8'GETPEERN'
```

Figure 68. EZASOKAC sample client program for IPv4 (Part 8 of 10)

```
MREAD    DC    CL8'READ'
MWRITE   DC    CL8'WRITE'
MSHUTDOW DC    CL8'SHUTDOWN'
MTERMAPI DC    CL8'TERMAPI'
MSGSTART DC    CL8' STARTED'
MSGEND   DC    CL8' ENDED  '
MSGSUCC  DC    CL10' SUCCESS  '     Command results...
MSGFAIL  DC    CL10' FAIL: ( '                   ...
MSGRETC  DC    CL10' RETCODE= '                   ...
MSGERRN  DC    CL10' ERRNO=   '                   ...
MSGBUFF  DC    CL10' BUFFER:  '                   ...
BLANK35  DC    CL35' '
*-------------------------------------------------------------------*
* MESSAGE AREA *
*--------------*
MSG      DC    0F'0'              MESSAGE AREA
         DC    AL2(MSGE-MSGNUM)   LENGTH OF MESSAGE
MSGNUM   DC    CL10'EZASOKAC:'    'EZASOKAC: '
MSGCMD   DC    CL8' '             COMMAND ISSUED
MSGRSLT1 DC    CL10' '            COMMAND RESULTS (SUCC, PASS, FAIL)
MSGRSLT2 DC    CL35' '            RETURNED VALUES
MSGE     EQU   *                  End of message
*-------------------------------------------------------------------*
* MESSAGE RESULTS AREAS (fill in and move to MSGRSLT2) *
*-----------------------------------------------------*
*
MSGRTCD  DC    0CL35' '           GENERAL RETURNED VALUE
MSGRTCT  DC    CL9' RETCODE='     ' RETCODE= '
MSGRTHX  DC    CL1' '             'X' X FOR GETHOSTID
MSGRTCS  DC    CL1' '             '-' (NEGATIVE SIGN)
HEXRC    EQU   MSGRTCS            HEX RC WILL START AT SIGN LOCATION
MSGRTCV  DC    CL7' '             RETURNED VALUE (RETCODE)
MSGERRT  DC    CL10' ERRNO='      ' ERRNO=   '
MSGERRV  DC    CL7' '             RETURNED VALUE (ERRNO)
DWORK    DC    D'0'               WORK AREA
HEXTAB   EQU   *-240              TAB TO CONVERT TO PRINTABLE HEX
*                                 FIRST 240 BYTES NOT REFERENCED
         DC    CL16'0123456789ABCDEF'
PARMADDR DC    A(0)               PARM ADDRESS SAVE AREA
         LTORG
*-------------------------------------------------------------------*
* REG/SAVEAREA *
*--------------*
SOCSAVE  DC    9D'0'              SAVE AREA
*-------------------------------------------------------------------*
         CNOP  0,8
MYCB     EQU   *                  MY CONTROL BLOCK
REQAREA  EQU   *
ECB      DC    A(ECB)             SELF POINTER
         DC    CL100'WORK AREA'
MYTIE    EZASMI TYPE=TASK,STORAGE=CSECT     TIE
TYPE     DC    CL8'TYPE'
ERRNO    DC    F'0'
RETCODE  DC    F'0'
MYNEXT   DC    A(MYCB)            NEXT IN CHAIN FOR MULTIPLES
```

Figure 68. EZASOKAC sample client program for IPv4 (Part 9 of 10)

```
        CNOP  0,8
MYLEN   EQU   *-MYCB
MYCB2   EQU   *
        ORG   *+MYLEN
        CNOP  0,8
        DC    CL8'&SYSDATE'
        DC    CL8'&SYSTIME'
        END
```

Figure 68. EZASOKAC sample client program for IPv4 (Part 10 of 10)

EZASO6AS sample server program for IPv6

The EZASO6AS program is a server program that shows you how to use the following calls provided by the macro socket interface:

- ACCEPT
- BIND
- CLOSE
- GETADDRINFO
- GETHOSTNAME
- FREEADDRINFO
- INITAPI
- LISTEN
- PTON
- READ
- SOCKET
- TERMAPI
- WRITE

```
EZASO6AS CSECT
EZASO6AS AMODE ANY
EZASO6AS RMODE ANY
*        PRINT NOGEN
*********************************************************************
*                                                                   *
*   MODULE NAME:  EZASO6AS Sample IPV6 server program               *
*                                                                   *
* Copyright:    Licensed Materials - Property of IBM                *
*                                                                   *
*               "Restricted Materials of IBM"                       *
*                                                                   *
*               5694-A01                                            *
*                                                                   *
*               (C) Copyright IBM Corp. 2002, 2003                  *
*                                                                   *
*               US Government Users Restricted Rights -             *
*               Use, duplication or disclosure restricted by        *
*               GSA ADP Schedule Contract with IBM Corp.            *
*                                                                   *
* Status:       CSV1R5                                              *
*                                                                   *
*                                                                   *
*   LANGUAGE:  Assembler                                            *
*                                                                   *
*   ATTRIBUTES: NON-REUSABLE                                        *
*                                                                   *
*   REGISTER USAGE:                                                 *
*        R1  =                                                      *
*        R2  =                                                      *
*        R3  = BASE REG 1                                           *
*        R4  = BASE REG 2 (UNUSED)                                  *
*        R5  = FUTURE BASE REG?                                     *
*        R6  = TEMP                                                 *
*        R7  = RETURN REG                                           *
*        R8  =                                                      *
*        R9  = A(WORK AREA)                                         *
*        R10 =                                                      *
*        R11 =                                                      *
*        R12 =                                                      *
*        R13 = SAVE AREA                                            *
*        R14 =                                                      *
*        R15 =                                                      *
*                                                                   *
*   INPUT: NONE                                                     *
*   OUTPUT: WTO results of each test case                           *
*                                                                   *
*********************************************************************
         GBLB  &TRACE  ASSEMBLER VARIABLE TO CONTROL TRACE GENERATION
&TRACE   SETB  1       1=TRACE ON  0=TRACE OFF
R0       EQU   0
R1       EQU   1
R2       EQU   2
R3       EQU   3
```

Figure 69. EZASO6AS sample server program for IPv6 (Part 1 of 13)

```
R4       EQU   4
R5       EQU   5
R6       EQU   6
R7       EQU   7
R8       EQU   8
R9       EQU   9
R10      EQU   10
R11      EQU   11
R12      EQU   12
R13      EQU   13
R14      EQU   14
R15      EQU   15
*--------------------------------------------------------------------*
* START OF EXECUTABLE CODE                                           *
*--------------------------------------------------------------------*
         USING *,R3,R4            TELL ASSEMBLER OF OTHERS
         SAVE (14,12),T,*
         LR    R3,R15             COPY EP REG TO FIRST BASE
         LA    R5,2048            GET R5 HALFWAY THERE
         LA    R5,2048(R5)        GET R5 THERE
         LA    R4,0(R5,R3)        GET R4 THERE
         LA    R12,12             JUST FOR FUN!
         ST    R1,PARMADDR        SAVE ADDRESS OF PARAMETER LIST
         L     R1,0(R1)           GET POINTER
         LH    R1,0(R1)           GET LENGTH
*        STC   R1,TRACE           USE IT AS FLAG
         L     R7,=A(SOCSAVE)     GET NEW SAVE AREA
         ST    R7,8(R13)          SAVE ADDRESS OF NEW SAVE AREA
         ST    R13,4(R7)          COMPLETE SAVE AREA CHAIN
         LR    R13,R7             NOW SWAP THEM
         L     R9,=A(MYCB)        POINT TO THE CONTROL BLOCK
         USING MYCB,R9            TELL ASSEMBLER
*--------------------------------------------------------------------*
*   BUILD MESSAGE FOR CONSOLE
*--------------------------------------------------------------------*
*                                 INITIALIZE MESSAGE TEXT FIELDS
LOOP     EQU   *
         MVC   MSGNUM(8),SUBTASK  WHO I AM
         MVC   TYPE,MSGSTART      MOVE 'STARTED' TO MESSAGE
*
         MVC   MSGRSLT1,MSGSUCC   ...SUCCESSFUL TEXT
         MVC   MSGRSLT2,BLANK35
*
         STM   R14,R12,12(R13)    JUST FOR DEBUGGING
         BAL   R14,WTOSUB         --> DO STARTING WTO
**********************************************************************
*                                                                    *
*        Issue INITAPI to connect to interface                       *
*                                                                    *
**********************************************************************
         POST  ECB,1              NEXT IS ALWAYS SYNCH
         MVI   SYNFLAG,0          MOVE A 1 FOR ASYNC
         MVC   TYPE,MINITAPI      MOVE 'INITAPI' TO MESSAGE
*
         EZASMI TYPE=INITAPI,     Issue INITAPI Macro                X
```

Figure 69. EZASO6AS sample server program for IPv6 (Part 2 of 13)

```
              SUBTASK=SUBTASK,   SPECIFY SUBTASK IDENTIFIER          X
              MAXSOC=MAXSOC,     SPECIFY MAXIMUM NUMBER OF SOCKETS   X
              MAXSNO=MAXSNO,     (HIGHEST SOCKET NUMBER ASSIGNED)    X
              ERRNO=ERRNO,       (Specify ERRNO field)               X
              RETCODE=RETCODE,   (Specify RETCODE field)             X
              APITYPE=APITYPE,   (SPECIFY APITYPE FIELD)             X
              ERROR=ERROR        ABEND IF ERROR ON MACRO
*            ASYNC=('EXIT',MYEXIT), (SPECIFY AN EXIT)               X
*             IDENT=IDENT,       TCP ADDR SPACE AND MY ADDR SPACE
*             ASYNC=('ECB')      (SPECIFY ECBS)
*
         BAL   R14,RCCHECK        --> DID IT WORK?
*********************************************************************
*                                                                   *
*        Issue SOCKET Macro to obtain a socket descriptor           *
*                 *** INET and STREAM ***                           *
*                                                                   *
*********************************************************************
         MVC   TYPE,MSOCKET       MOVE 'SOCKET' TO MESSAGE
*
         EZASMI TYPE=SOCKET,      Issue SOCKET Macro                  X
               AF='INET6',        INET, IUCV, INET6                   X
               SOCTYPE='STREAM',  STREAM(TCP) DATAGRAM(UDP) or RAW    X
               ERRNO=ERRNO,       (Specify ERRNO field)               X
               RETCODE=RETCODE,   (Specify RETCODE field)             X
               ERROR=ERROR        Abend if Macro error
*             REQAREA=REQAREA,   IN CASE WE ARE DOING EXITS OR ECBS   X
*
         BAL   R14,RCCHECK        CHECK FOR SUCCESSFUL CALL
*
*-------------------------------------------------------------------*
*        Get socket descriptor number
*-------------------------------------------------------------------*
         STH   R8,S               SAVE RETCODE (=SOCKET DESCRIPTOR)
*********************************************************************
*                                                                   *
*        ISSUE PTON MACRO                                           *
*                                                                   *
*********************************************************************
         MVC   PRESENTABLE_ADDR,LOOPIPV6 IP ADDRESS TO CONVERT
*
* DISPLAY THE RETURNED ADDRESS IN PRESENTABLE FORMAT
*
         MVC   TYPE,MPTON         MOVE 'PTON  ' TO MESSAGE
*
         EZASMI TYPE=PTON,        ISSUE PTON MACRO                    X
               AF='INET6',                                           X
               SRCADDR=PRESENTABLE_ADDR,                             X
               SRCLEN=PRESENTABLE_ADDR_LEN,                          X
               DSTADDR=NUMERIC_ADDR,                                 X
               ERRNO=ERRNO,       (SPECIFY ERRNO FIELD)               X
               RETCODE=RETCODE,   (SPECIFY RETCODE FIELD)             X
               ERROR=ERROR        ABEND IF MACRO ERROR
*
         BAL   R14,RCCHECK        CHECK FOR SUCCESSFUL CALL
```

Figure 69. EZASO6AS sample server program for IPv6 (Part 3 of 13)

```
         MVC   ADDRESS,NUMERIC_ADDR
*********************************************************************
*                                                                   *
*        ISSUE GETHOSTNAME CALL                                     *
*                                                                   *
*********************************************************************
         MVC   TYPE,MGHOSTN            'GETHOSTN' TO MESSAGE
         EZASMI TYPE=GETHOSTNAME,                                   X
               NAMELEN=HOSTNAMEL, LENGTH OF HOST NAME FIELD         X
               NAME=HOSTNAME,     HOST NAME                         X
               ERRNO=ERRNO,       (Specify ERRNO field)             X
               RETCODE=RETCODE,   (Specify RETCODE field)           X
               ERROR=ERROR        Abend if Macro error
*              REQAREA=REQAREA,   IN CASE WE ARE DOING EXITS OR ECBS   X
*
         BAL   R14,RCCHECK        CHECK FOR SUCCESSFUL CALL
*
         MVC   MSGRSLT1,=C'HOST NAME ' INDICATE WHAT WE'RE PROCESSING
         XC    MSGRSLT2,MSGRSLT2
         MVC   MSGRSLT2,HOSTNAME
         STM   R14,R12,12(R13)    JUST FOR DEBUGGING
         BAL   R14,WTOSUB         SEND TO THE CONSOLE
         MVC   NODENAME(24),HOSTNAME
*********************************************************************
*                                                                   *
*        ISSUE GETADDRINFO MACRO                                    *
*                                                                   *
*********************************************************************
         MVC   TYPE,MGADDRI       MOVE 'GETADDRINFO' TO MESSAGE
         XC    ADDR_INFO(addrinfo_len),ADDR_INFO CLEAR OUT ALL HINTS
         LA    R6,ai_CANONNAMEOK  REQUEST THE CANONICAL NAME
         ST    R6,ai_flags        SAVE THE HINT FLAGS
         LA    R6,ADDR_INFO       POINT TO THE HINTS ADDRINFO
         ST    R6,HINTS           SAVE THE ADDRESS OF THE HINTS
         LA    R6,0               LENGTH OF SERVICE NAME
         ST    R6,SERVNAMEL       SAVE THE SERVICE NAME LENGTH
*
         EZASMI TYPE=GETADDRINFO, ISSUE GETADDRINFO MACRO            X
               NODE=NODENAME,     NODE GETTING INFORMATION FOR      X
               NODELEN=NODENAMEL, LENGTH OF NODE NAME               X
               SERVICE=SERVNAME,  SERVICE GETTING INFORMATION FOR   X
               SERVLEN=SERVNAMEL, LENGTH OF SERVICE NAME            X
               HINTS=HINTS,       HINTS FOR FILTERING               X
               RES=RESULT_ADDRINFO, RETURNED ADDRESS INFORMATION    X
               CANNLEN=CANNAMEL,  LENGTH OF CANONICAL NAME          X
               ERRNO=ERRNO,       (SPECIFY ERRNO FIELD)             X
               RETCODE=RETCODE,   (SPECIFY RETCODE FIELD)           X
               ERROR=ERROR        ABEND IF MACRO ERROR
*
         BAL   R14,RCCHECK        CHECK FOR SUCCESSFUL CALL
*
* IF RETURNED SUCCESSFULLY, THEN PROCESS THE ADDRINFO STRUCTORE AND
* THEN CHECK TO SEE IF THERE IS ANOTHER TO PROCESS.  CONTINUE UNTIL
* AI_NEXT IS NULL.
*
```

Figure 69. EZASO6AS sample server program for IPv6 (Part 4 of 13)

```
         ICM   R10,B'1111',RESULT_ADDRINFO EXAMINE RETURNED ADDRINFO
         BZ    NOAIS       IF NOT RETURNED THEN HOST NOT FOUND?
SEEAIS   DS    0H
         MVC   ADDR_INFO(addrinfo_len),0(R10) LOAD ADDRINFO STRUCTURE
         XC    OPNAMELEN,OPNAMELEN CLEAR NAME LENGTH OUTPUT FIELD
         XC    OPCANON,OPCANON   CLEAR CANONICAL NAME OUTPUT FIELD
         XC    OPNAME,OPNAME     CLEAR NAME OUTPUT FIELD
         XC    OPNEXT,OPNEXT     CLEAR NEXT ADDRINFO OUTPUT FIELD
*
         CALL  EZACIC09,(RESULT_ADDRINFO,                            X
               OPNAMELEN,        OUTPUT NAME LENGTH                  X
               OPCANON,          OUTPUT CANONICAL NAME               X
               OPNAME,           OUTPUT NAME                         X
               OPNEXT,           OUTPUT NEXT RESULT ADDRESS INFO     X
               RETCODE),VL
*
* FORMAT CANONNAME.
*
         MVC   MSGRSLT1,=C'CANON NAME' INDICATE WHAT WE'RE PROCESSING
         XC    MSGRSLT2,MSGRSLT2
         MVC   MSGRSLT2(21),=C' - NO CANON NAME     '
         XC    MSGRSLT2,MSGRSLT2
         MVC   MSGRSLT2,OPCANON
FMTAISNC DS    0H
         STM   R14,R12,12(R13)    JUST FOR DEBUGGING
         BAL   R14,WTOSUB         SEND TO THE CONSOLE
FMTAISNCE DS    0H
*
* IF AI_NEXT IS NULL THEN THIS IS THE LAST STRUCTURE ON THE LIST.
* TO PROCESS ALL STRUCTURES:
* 1.  GET THE FIRST ONE AND PROCESS THE FIELDS RETURNED.
* 2.  USE THE ADDRESS IN AI_NEXT TO GET THE NEXT ADDRESS IF NOT NULL.
* 3.  PROCESS THE NEW FIELDS IN THE SUBSEQUENT STRUCTURE.
* 4.  GOTO 2.
*
         ICM   R10,B'1111',ai_next SEE IF NEXT ADDRESS IS NULL...
         BP    SEEAIS            NOPE...PARSE IT.
*
*********************************************************************
*                                                                   *
*        ISSUE FREEADDRINFO MACRO.  MUST BE DRIVEN AFTER A          *
*        SUCCESSFUL GETADDRINFO; OTHERWISE, RESOLVER STORAGE WILL   *
*        BE CONSUMED.                                               *
*                                                                   *
*********************************************************************
         MVC   TYPE,MFADDRI       MOVE 'FREEADDRINFO' TO MESSAGE
*
         EZASMI TYPE=FREEADDRINFO, ISSUE FREEADDRINFO MACRO           X
               ADDRINFO=RESULT_ADDRINFO,                              X
               ERRNO=ERRNO,       (SPECIFY ERRNO FIELD)               X
               RETCODE=RETCODE,   (SPECIFY RETCODE FIELD)             X
               ERROR=ERROR        ABEND IF MACRO ERROR
*
         BAL   R14,RCCHECK        CHECK FOR SUCCESSFUL CALL
*
```

Figure 69. EZASO6AS sample server program for IPv6 (Part 5 of 13)

```
         B     ENDAIS
NOAIS    DS    0H
         XC    MSGRSLT2,MSGRSLT2
         MVC   MSGRSLT2(21),=C'Result not returned. '
         BAL   R14,WTOSUB         SEND TO THE CONSOLE
ENDAIS   DS    0H
*
*********************************************************************
*                                                                   *
*        Issue BIND socket                                          *
*                                                                   *
*********************************************************************
         MVC   TYPE,MBIND         MOVE 'BIND' TO MESSAGE
         MVC   PORT(2),PORTS      Load STREAM port #
*
         EZASMI TYPE=BIND,        Issue Macro                        X
               S=S,               STREAM                             X
               NAME=NAME,         (SOCKET NAME STRUCTURE)            X
               ERRNO=ERRNO,       (Specify ERRNO field)              X
               RETCODE=RETCODE,   (Specify RETCODE field)            X
               ERROR=ERROR        Abend if Macro error
*             REQAREA=REQAREA,   IN CASE WE ARE DOING EXITS OR ECBS   X
*
         BAL   R14,RCCHECK        CHECK FOR SUCCESSFUL CALL
*********************************************************************
*                                                                   *
*        Issue LISTEN - Backlog = 5                                 *
*                                                                   *
*********************************************************************
         MVC   TYPE,MLISTEN       MOVE 'LISTEN' TO MESSAGE
*
         EZASMI TYPE=LISTEN,      Issue Macro                        X
               S=S,               STREAM                             X
               BACKLOG=BACKLOG,   BACKLOG                            X
               ERRNO=ERRNO,       (Specify ERRNO field)              X
               RETCODE=RETCODE,   (Specify RETCODE field)            X
               ERROR=ERROR        Abend if Macro error
*             REQAREA=REQAREA,   IN CASE WE ARE DOING EXITS OR ECBS   X
*
         BAL   R14,RCCHECK        CHECK FOR SUCCESSFUL CALL
*********************************************************************
*                                                                   *
*        Issue ACCEPT - Block until connection from peer            *
*                                                                   *
*********************************************************************
         MVC   TYPE,MACCEPT       MOVE 'ACCEPT' TO MESSAGE
         MVC   PORT(2),PORTS      Load STREAM port #
*
         EZASMI TYPE=ACCEPT,      Issue Macro                        X
               S=S,               STREAM                             X
               NAME=NAME,         (SOCKET NAME STRUCTURE)            X
               ERRNO=ERRNO,       (Specify ERRNO field)              X
               RETCODE=RETCODE,   (Specify RETCODE field)            X
               ERROR=ERROR        Abend if Macro error
*             REQAREA=REQAREA,   IN CASE WE ARE DOING EXITS OR ECBS   X
```

Figure 69. EZASO6AS sample server program for IPv6 (Part 6 of 13)

```
*
         BAL   R14,RCCHECK        CHECK FOR SUCCESSFUL CALL
* Message RESULTS text
         STH   R8,SOCDESCA        SAVE RETCODE (SOCKET DESCRIPTOR)
*********************************************************************
*                                                                   *
*        ISSUE NTOP MACRO                                           *
*                                                                   *
*********************************************************************
         MVC   NUMERIC_ADDR,ADDRESS       IP ADDRESS FROM ACCEPT
*
* DISPLAY THE NUMERIC ADDRESS FIRST
*
         MVC   TYPE,MNTOP         MOVE 'NTOP  ' TO MESSAGE
*
* TRANSLATE IT TO PRESENTABLE FORM
*
         EZASMI TYPE=NTOP,        ISSUE PTON MACRO                    X
               AF='INET6',                                           X
               SRCADDR=NUMERIC_ADDR,                                 X
               DSTADDR=PRESENTABLE_ADDR,                             X
               DSTLEN=PRESENTABLE_ADDR_LEN,                          X
               ERRNO=ERRNO,       (SPECIFY ERRNO FIELD)              X
               RETCODE=RETCODE,   (SPECIFY RETCODE FIELD)            X
               ERROR=ERROR        ABEND IF MACRO ERROR
*
         BAL   R14,RCCHECK        CHECK FOR SUCCESSFUL CALL
*
* DISPLAY THE RETURNED ADDRESS IN PRESENTABLE FORMAT
*
         MVC   MSGRSLT1,=C'DSTADDR   ' INDICATE WHAT WE'RE PROCESSING
         XC    MSGRSLT2,MSGRSLT2
         MVC   MSGRSLT2(L'PRESENTABLE_ADDR),PRESENTABLE_ADDR
         STM   R14,R12,12(R13)    JUST FOR DEBUGGING
         BAL   R14,WTOSUB         SEND TO THE CONSOLE
*********************************************************************
*                                                                   *
*        Issue READ - Read data and store in buffer                 *
*                                                                   *
*********************************************************************
         MVC   TYPE,MREAD         MOVE 'READ  ' TO MESSAGE
*
         EZASMI TYPE=READ,        Issue Macro                         X
               S=SOCDESCA,        ACCEPT SOCKET                       X
               NBYTE=NBYTE,       SIZE OF BUFFER                      X
               BUF=BUF,           (BUFFER)                            X
               ERRNO=ERRNO,       (Specify ERRNO field)               X
               RETCODE=RETCODE,   (Specify RETCODE field)             X
               ERROR=ERROR        Abend if Macro error
*             REQAREA=REQAREA,   IN CASE WE ARE DOING EXITS OR ECBS   X
*
         BAL   R14,RCCHECK        CHECK FOR SUCCESSFUL CALL
         MVC   MSGRSLT1,MSGBUFF
         MVC   MSGRSLT2,BUF
         BAL   R14,WTOSUB         --> PRINT IT
```

Figure 69. EZASO6AS sample server program for IPv6 (Part 7 of 13)

```
*
*
*********************************************************************
*                                                                   *
*        Issue WRITE - Write data from buffer                       *
*                                                                   *
*********************************************************************
         MVC   TYPE,MWRITE        MOVE 'WRITE ' TO MESSAGE
*
         EZASMI TYPE=WRITE,       Issue Macro                        X
               S=SOCDESCA,        ACCEPT Socket                      X
               NBYTE=NBYTE,       SIZE OF BUFFER                     X
               BUF=BUF,           (BUFFER)                           X
               ERRNO=ERRNO,       (Specify ERRNO field)              X
               RETCODE=RETCODE,   (Specify RETCODE field)            X
               ERROR=ERROR        Abend if Macro error
*              REQAREA=REQAREA,   IN CASE WE ARE DOING EXITS OR ECBS   X
*
         BAL   R14,RCCHECK        CHECK FOR SUCCESSFUL CALL
*********************************************************************
*                                                                   *
*        Issue CLOSE for ACCEPT socket                              *
*                                                                   *
*********************************************************************
         MVC   TYPE,MCLOSE        MOVE 'CLOSE' TO MESSAGE
*
         EZASMI TYPE=CLOSE,       Issue Macro                        X
               S=SOCDESCA,        ACCEPT                             X
               ERRNO=ERRNO,       (Specify ERRNO field)              X
               RETCODE=RETCODE,   (Specify RETCODE field)            X
               ERROR=ERROR        Abend if Macro error
*              REQAREA=REQAREA,   IN CASE WE ARE DOING EXITS OR ECBS   X
*
         MVC   MSGRSLT2,BLANK35
         BAL   R14,RCCHECK        CHECK FOR SUCCESSFUL CALL
*
*********************************************************************
*                                                                   *
*        Terminate Connection to API                                *
*                                                                   *
*********************************************************************
         MVC   TYPE,MTERMAPI      MOVE 'TERMAPI' TO MESSAGE
*
         POST  ECB,1              FOLLOWING IS ALWAYS SYNCH
         EZASMI TYPE=TERMAPI      Issue EZASMI Macro for Termapi
*-------------------------------------------------------------------*
* Message RESULTS text
         MVC   MSGRSLT2,BLANK35
*
         BAL   R14,RCCHECK        --> CHECK RC
*-------------------------------------------------------------------*
*        Issue console message for task termination
*-------------------------------------------------------------------*
         MVC   TYPE,MSGEND        Move 'ENDED' to message
*
```

Figure 69. EZASO6AS sample server program for IPv6 (Part 8 of 13)

```
         MVC   MSGRSLT1,MSGSUCC   ...SUCCESSFUL text
         MVC   MSGRSLT2,BLANK35
*
         BAL   R14,WTOSUB
         LA    R14,1              CONSTANT
         AH    R14,APITYPE        ADD
         STH   R14,APITYPE        STORE
         CH    R14,=H'3'          COMPARE
*        BE    LOOP               --> LETS DO IT AGAIN!
*-------------------------------------------------------------------*
*        Return to Caller
*-------------------------------------------------------------------*
         L     R13,4(R13)
         RETURN (14,12),T,RC=0
WTOSUB   EQU   *
         LR    R7,R14             COPY RETURN REG
         MVC   MSGCMD(8),TYPE
         WTO   TEXT=MSG           WRITE MESSAGE TO OPERATOR
         BR    R7                 --> RETURN TO CALLER
         CNOP  2,4
*        USES R6,R7,R8         RETCODE RETURNED IN R8
RCCHECK  EQU   *
         LR    R7,R14             COPY TO REAL RETURN REG
         MVC   MSGRSLT1,MSGSUCC   ...SUCCESS TEXT
         L     R6,RETCODE
         LTR   R6,R6
         BM    NOWAIT
         CLI   SYNFLAG,0          PLAIN CASE?
         BE    NOWAIT             --> SKIP IT
         MVC   KEY+14(8),SUBTASK
         MVC   KEY+23(8),TYPE
KEY      WTO   'WAIT: XXXXXXXX XXXXXXXX'
         WAIT  ECB=ECB
NOWAIT   EQU   *
*        LA    R15,ECB
*        ST    R15,ECB
         ST    R9,ECB             MAKE THIS THE TOKEN AGAIN
         L     R6,RETCODE         CHECK FOR SUCCESSFUL CALL
         CLC   TYPE,=CL8'GETHOSTI'
         BE    HOSTIDRC           HANDLE PRINTING HOST ID
         LTR   R8,R6              SAVE A COPY
*
         BNL   CONT00
FAILMSG  EQU   *
         MVC   MSGRSLT1,MSGFAIL   ...FAIL TEXT
CONT00   EQU   *
*
*-------------------------------------------------------------------*
*        FORMAT THE RETCODE= -XXXXXXX ERRNO= XXXXXXX MSG RESULTS
*        ***> R6 = RETCODE VALUE ON ENTRY
*-------------------------------------------------------------------*
         MVC   MSGRTCT,MSGRETC    ' RETCODE= '
         MVI   MSGRTCS,C'+'
         LTR   R6,R6
         BNM   NOTM               -->
```

Figure 69. EZASO6AS sample server program for IPv6 (Part 9 of 13)

```
         MVI   MSGRTCS,C'-'       MOVE SIGN WHICH IS ALWAYS MINUS
NOTM     EQU   *
         MVC   MSGERRT,MSGERRN    ' ERRNO= '
*
         CVD   R6,DWORK           CONVERT IT TO DECIMAL
         UNPK  MSGRTCV,DWORK+4(4) UNPACK IT
         OI    MSGRTCV+6,X'F0'    CORRECT THE SIGN
ERRNOFMT EQU   *
         L     R6,ERRNO           GET ERRNO VALUE
         CVD   R6,DWORK           CONVERT IT TO DECIMAL
         UNPK  MSGERRV,DWORK+4(4) UNPACK IT
         OI    MSGERRV+6,X'F0'    CORRECT THE SIGN
*
         MVC   MSGRSLT2(35),MSGRTCD
*
         MVI   MSGRTHX,X'40'      CLEAR HEX INDICATOR
         SR    R6,R6              CLEAR OUT...
         ST    R6,RETCODE            RETCODE AND...
         ST    R6,ERRNO                 ERRNO
*
*
         CLI   TRACE,0
         BNE   NOTRACE
         LR    R14,R7             GIVE HIM RETURN REG
         B     WTOSUB             --> DO WTO
NOTRACE  EQU   *
         BR    R7                 --> RETURN TO CALLER
*
HOSTIDRC EQU   *               VALID HOSTID MAY LOOK LIKE NEG. RC
         C     R6,=F'-1'       ONLY -1 RC INDICATES FAILURE
         BE    FAILMSG            ...BAD RC, USE STANDARD MSG
         LR    R8,R6              ...NEXT CALL EXPECTS ADDR IN R8
         MVC   MSGRSLT1,MSGSUCC   ...SUCCESS TEXT
         UNPK  HEXRC(9),RETCODE(5)   PLUS ONE FOR FAKE SIGN
         TR    HEXRC(8),HEXTAB    ...CONVERT UNPK TO PRINTABLE HEX
         MVI   HEXRC+8,X'40'      ...SPACE OUT FAKED SIGN BYTE
         MVI   MSGRTHX,C'X'       ...INDICATE INFO IS HEX
         B     ERRNOFMT
*
SYNFLAG  DC    H'0'               DEFAULT TO SYN
TRACE    DC    H'0'               DEFAULT TO TRACE
MYEXIT   DC   A(MYEXIT1,SUBTASK)
MYEXIT1  SAVE (14,12),T,*
         LR   R2,R15
         USING MYEXIT1,R2
         LM   R8,R9,0(R1)            GET TWO TOKENS
         MVC  EXKEY+14(8),0(R8)      TELL WHO
         MVC  EXKEY+23(8),TYPE       TELL WHAT
EXKEY    WTO 'EXIT: XXXXXXXX XXXXXXXX'
         POST ECB,1
         RETURN (14,12),T,RC=0
         DROP  R2
*-------------------------------------------------------------------*
*        ABEND PROGRAM AND GET DUMP
*-------------------------------------------------------------------*
```

Figure 69. EZASO6AS sample server program for IPv6 (Part 10 of 13)

```
ERROR    ABEND 1,DUMP
*-------------------------------------------------------------------*
* CONSTANTS USED TO RUN PROGRAM                                     *
*-------------------------------------------------------------------*
EZASMGW  EZASMI TYPE=GLOBAL,      Storage definition for GWA           X
               STORAGE=CSECT
*--------------------*
* INITAPI macro parms *
*--------------------*
SUBTASK  DC    CL8'EZASO6AS'      SUBTASK PARM VALUE
MAXSOC   DC    AL2(50)            MAXSOC PARM VALUE
APITYPE  DC    H'2'               OR A 3
MAXSNO   DC    F'0'               (HIGHEST SOCKET DESCRIPTOR AVAILABLE)
IDENT    DC    0CL16' '
         DC    CL8'        '      NAME OF TCP TO WHICH CONNECTING
         DC    CL8'SOC401CB'      MY ADDR SPACE NAME
*-------------------------------------------------------------------*
* SOCKET macro parms *
*--------------------*
S        DC    H'0'               SOCKET DESCRIPTOR FOR STREAM
*-------------------------------------------------------------------*
* BIND MACRO PARMS   *
*--------------------*
         CNOP  0,4
NAME     DC    0CL28' '           SOCKET IPV6 NAME STRUCTURE
         DC    AL1(16)            Address Length
         DC    AL1(19)            Family
PORT     DC    H'0'
FLOWINFO DC    XL4'00'
ADDRESS  DC    XL16'FF'
         DC    XL4'00'            SCOPEID
ADDR     DC    XL16'00000000000000000000000000000001' Internet Address
PORTS    DC    H'11007'
*-------------------------------------------------------------------*
* LISTEN PARMS       *
*--------------------*
BACKLOG  DC    F'5'               BACKLOG
*-------------------------------------------------------------------*
* READ MACRO PARMS   *
*--------------------*
NBYTE    DC    F'50'              SIZE OF BUFFER
SOCDESCA DC    H'0'               SOCKET DESCRIPTOR FROM ACCEPT
BUF      DC    CL50' THIS SHOULD NEVER APPEAR!!! : ('
*-------------------------------------------------------------------*
* WTO FRAGMENTS *
*---------------*
MNTOP    DC    CL8'NTOP   '
MPTON    DC    CL8'PTON   '
MFADDRI  DC    CL8'FADDRI '
MGADDRI  DC    CL8'GADDRI '
MGHOSTN  DC    CL8'GETHOSTN'
MGNAMEI  DC    CL8'GNAMEI '
MINITAPI DC    CL8'INITAPI'
MSOCKET  DC    CL8'SOCKET'
MBIND    DC    CL8'BIND'
```

Figure 69. EZASO6AS sample server program for IPv6 (Part 11 of 13)

```
MACCEPT  DC    CL8'ACCEPT'
MLISTEN  DC    CL8'LISTEN'
MREAD    DC    CL8'READ'
MWRITE   DC    CL8'WRITE'
MCLOSE   DC    CL8'CLOSE'
MTERMAPI DC    CL8'TERMAPI'
MSGSTART DC    CL8' STARTED'
MSGEND   DC    CL8' ENDED  '
MSGBUFF  DC    CL10' BUFFER:  '                    ...
MSGSUCC  DC    CL10' SUCCESS  '     Command results...
MSGFAIL  DC    CL10' FAIL: ( '                    ...
MSGRETC  DC    CL10' RETCODE= '                    ...
MSGERRN  DC    CL10' ERRNO=   '                    ...
BLANK35  DC    CL35' '
*-------------------------------------------------------------------*
* ERROR NUMBER / RETURN CODE FIELDS *
*-----------------------------------*
*-------------------------------------------------------------------*
* MESSAGE AREA *
*--------------*
MSG      DC    0F'0'              MESSAGE AREA
         DC    AL2(MSGE-MSGNUM)   LENGTH OF MESSAGE
MSGNUM   DC    CL10'EZASO6AS:'    'EZASO6ASXX:'
MSGCMD   DC    CL8' '             COMMAND ISSUED
MSGRSLT1 DC    CL10' '            COMMAND RESULTS (SUCC, PASS, FAIL)
MSGRSLT2 DC    CL35' '            RETURNED VALUES
MSGE     EQU   *                  End of message
*-------------------------------------------------------------------*
* MESSAGE RESULTS AREAS (fill in and move to MSGRSLT2) *
*------------------------------------------------------*
MSGRTCD  DC    0CL35' '           GENERAL RETURNED VALUE
MSGRTCT  DC    CL9' RETCODE='     ' RETCODE= '
MSGRTHX  DC    CL1' '             'X' X FOR GETHOSTID
MSGRTCS  DC    CL1' '             '-' (NEGATIVE SIGN)
HEXRC    EQU   MSGRTCS            HEX RC WILL START AT SIGN LOCATION
MSGRTCV  DC    CL7' '             RETURNED VALUE (RETCODE)
MSGERRT  DC    CL10' ERRNO='      ' ERRNO=   '
MSGERRV  DC    CL7' '             RETURNED VALUE (ERRNO)
*-------------------------------------------------------------------*
PARMADDR DC    A(0)               PARM ADDRESS SAVE AREA
DWORK    DC    D'0'               WORK AREA
HEXTAB   EQU   *-240              TAB TO CONVERT TO PRINTABLE HEX
*                                 FIRST 240 BYTES NOT REFERENCED
         DC    CL16'0123456789ABCDEF'
         EZBREHST DSECT=NO,LIST=YES,HOSTENT=NO,ADRINFO=YES
         LTORG ,
*-------------------------------------------------------------------*
*-------------------------------------------------------------------*
* REG/SAVEAREA *
*--------------*
SOCSAVE  DC    9D'0'              SAVE AREA
         CNOP  0,8
MYCB     EQU   *                  MY CONTROL BLOCK
REQAREA  EQU   *
ECB      DC    A(ECB)             SELF POINTER
```

Figure 69. EZASO6AS sample server program for IPv6 (Part 12 of 13)

```
         DC    CL100'WORK AREA'
MYTIE    EZASMI TYPE=TASK,STORAGE=CSECT     TIE
TYPE     DC    CL8'TYPE'
ERRNO    DC    F'0'
RETCODE  DC    F'0'
*
REQARG   DC    F'1'
RETARG   DS    0H
*
* FOR NTOP AND PTON
*
NUMERIC_ADDR DS CL16              IP ADDRESS IN NUMERIC FORM
PRESENTABLE_ADDR DS CL45          IP ADDRESS IN PRESENTABLE FORM
PRESENTABLE_ADDR_LEN DC AL2(L'PRESENTABLE_ADDR) LENGTH OF PRESENTABLE  X
                                  IP ADDRESS
LOOPIPV6 DC  CL45'::1'            IPV6 LOOPBACK ADDRESS
*
* FOR GETHOSTNAME, GETADDRINFO, and FREEADDRINFO
*
HOSTNAME DC    CL24' '
NODENAME DC    CL255' '           FOR THE RETURNED HOST NAME
SERVNAME DC    C' '               SERVICE BEING RESOLVED
         CNOP  0,4
HOSTNAMEL DC   AL4(L'HOSTNAME)    LENGTH OF THE HOST NAME
NODENAMEL DC   AL4(L'NODENAME)    LENGTH OF THE NODE NAME
SERVNAMEL DC   F'0'               LENGTH OF THE SERVICE NAME
RESULT_ADDRINFO DC F'0'           RETURNED ADDRINFO
CANNAMEL DC    F'0'               CANNONICAL NAME LENGTH IN ADDRINFO
HINTS    DC    F'0'               ADDRESS OF HINTS ADDRINFO
*
* For EZACIC09 processing
*
OPNAMELEN DS   F                  SOCKET ADDRESS STRUCTURE LENGTH
OPCANON   DS   CL256              CANONICAL NAME
OPNAME    DS   CL28               SOCKET ADDRESS STRUCTURE
OPNEXT    DS   F                  NEXT RESULT ADDRESS INFO IN CHAIN
*
MYNEXT   DC    A(MYCB)            NEXT IN CHAIN FOR MULTIPLES
         CNOP  0,8
MYLEN    EQU   *-MYCB
MYCB2    EQU   *
         ORG   *+MYLEN
         CNOP  0,8
         DC    CL8'&SYSDATE'
         DC    CL8'&SYSTIME'
         BPXYSOCK DSECT=NO,LIST=YES
         END
```

Figure 69. EZASO6AS sample server program for IPv6 (Part 13 of 13)

EZASO6AC sample client program for IPv6

The EZASO6AC program is a client module that shows you how to use the following calls provided by the macro socket interface:

- INITAPI
- SOCKET
- CONNECT
- GETPEERNAME
- GETNAMEINFO
- GLOBAL
- WRITE
- READ
- TASK

- TERMAPI
- SHUTDOWN

```
EZASO6AC CSECT
EZASO6AC AMODE ANY
EZASO6AC RMODE ANY
         PRINT NOGEN
*********************************************************************
*                                                                   *
*   MODULE NAME:  EZASO6AC - THIS IS A VERY SIMPLE IPV6 CLIENT      *
*                                                                   *
* Copyright:    Licensed Materials - Property of IBM                *
*                                                                   *
*               "Restricted Materials of IBM"                       *
*                                                                   *
*               5694-A01                                            *
*                                                                   *
*               (C) Copyright IBM Corp. 2002, 2003                  *
*                                                                   *
*               US Government Users Restricted Rights -             *
*               Use, duplication or disclosure restricted by        *
*               GSA ADP Schedule Contract with IBM Corp.            *
*                                                                   *
* Status:       CSV1R5                                              *
*                                                                   *
*                                                                   *
*   LANGUAGE:  ASSEMBLER                                            *
*                                                                   *
*   ATTRIBUTES: NON-REUSEABLE                                       *
*                                                                   *
*   REGISTER USAGE:                                                 *
*        R1  =                                                      *
*        R2  =                                                      *
*        R3  = BASE REG 1                                           *
*        R4  = BASE REG 2 (UNUSED)                                  *
*        R5  = FUTURE BASE?                                         *
*        R6  = TEMP                                                 *
*        R7  = RETURN REG                                           *
*        R8  =                                                      *
*        R9  = A(WORK AREA)                                         *
*        R10 =                                                      *
*        R11 =                                                      *
*        R12 =                                                      *
*        R13 = SAVE AREA                                            *
*        R14 =                                                      *
*        R15 =                                                      *
*                                                                   *
*   INPUT: ANY PARM TURNS TRACE OFF, NO PARM IS NOISY MODE          *
*   OUTPUT: WTO RESULTS OF EACH TEST CASE IF TRACING                *
*           RETURN CODE IS 0 WHETHER IT CONNECTS OR NOT!            *
*                                                                   *
*********************************************************************
         GBLB  &TRACE  ASSEMBLER VARIABLE TO CONTROL TRACE GENERATION
&TRACE   SETB  1       1=TRACE ON  0=TRACE OFF
R0       EQU   0
R1       EQU   1
R2       EQU   2
```

Figure 70. EZASO6AC sample client program for IPv6 (Part 1 of 10)

```
R3       EQU   3
R4       EQU   4
R5       EQU   5
R6       EQU   6
R7       EQU   7
R8       EQU   8
R9       EQU   9
R10      EQU   10
R11      EQU   11
R12      EQU   12
R13      EQU   13
R14      EQU   14
R15      EQU   15
*---------------------------------------------------------------------*
* START OF EXECUTABLE CODE                                            *
*---------------------------------------------------------------------*
         USING *,R3,R4            TELL ASSEMBLER OF OTHERS
         SAVE (14,12),T,*
         LR    R3,R15             COPY EP REG TO FIRST BASE
         LA    R5,2048            GET R5 HALFWAY THERE
         LA    R5,2048(R5)        GET R5 THERE
         LA    R4,0(R5,R3)        GET R4 THERE
         LA    R12,12             JUST FOR FUN!
         ST    R1,PARMADDR        SAVE ADDRESS OF PARAMETER LIST
         L     R1,0(R1)           GET POINTER
         LH    R1,0(R1)           GET LENGTH
*        STC   R1,TRACE           USE IT AS FLAG
         L     R7,=A(SOCSAVE)     GET NEW SAVE AREA
         ST    R7,8(R13)          SAVE ADDRESS OF NEW SAVE AREA
         ST    R13,4(R7)          COMPLETE SAVE AREA CHAIN
         LR    R13,R7             NOW SWAP THEM
         L     R9,=A(MYCB)        POINT TO THE CONTROL BLOCK
         USING MYCB,R9            TELL ASSEMBLER
*---------------------------------------------------------------------*
*   BUILD MESSAGE FOR CONSOLE
*---------------------------------------------------------------------*
*                                  INITIALIZE MESSAGE TEXT FIELDS
LOOP     EQU   *
         MVC   MSGNUM(8),SUBTASK  WHO I AM
         MVC   TYPE,MSGSTART      MOVE 'STARTED' TO MESSAGE
*
         MVC   MSGRSLT1,MSGSUCC   ...SUCCESSFUL TEXT
         MVC   MSGRSLT2,BLANK35
*
         STM   R14,R12,12(R13)    JUST FOR DEBUGGING
         BAL   R14,WTOSUB         --> DO STARTING WTO
**********************************************************************
*                                                                    *
*        Issue INITAPI to connect to interface                       *
*                                                                    *
**********************************************************************
         MVC   TYPE,MINITAPI      MOVE 'INITAPI' TO MESSAGE
*
         POST  ECB,1              FOLLOWING IS SYNC ONLY
         MVI   SYNFLAG,0          MOVE A 1 FOR ASYNCH
```

Figure 70. EZASO6AC sample client program for IPv6 (Part 2 of 10)

```
         EZASMI TYPE=INITAPI,     ISSUE INITAPI MACRO                  X
               SUBTASK=SUBTASK,   SPECIFY SUBTASK IDENTIFIER           X
               MAXSOC=MAXSOC,     SPECIFY MAXIMUM NUMBER OF SOCKETS    X
               MAXSNO=MAXSNO,     (HIGHEST SOCKET NUMBER ASSIGNED)     X
               ERRNO=ERRNO,       (Specify ERRNO field)                X
               RETCODE=RETCODE,   (Specify RETCODE field)              X
               APITYPE=APITYPE,   (SPECIFY APITYPE FIELD)              X
               ERROR=ERROR        Abend if error on macro
*              IDENT=IDENT,       TCP ADDR SPACE AND MY ADDR SPACE
*
*              ASYNC=('ECB'),     (SPECIFY TO USE ECBS)
*              ASYNC=('EXIT',MYEXIT)  (SPECIFY TO USE EXITS)
         BAL   R14,RCCHECK        --> CHECK RESULTS
*********************************************************************
*                                                                   *
*        Issue SOCKET Macro to obtain a socket descriptor           *
*                  *** INET and STREAM ***                          *
*                                                                   *
*********************************************************************
         MVC   TYPE,MSOCKET       MOVE 'SOCKET' TO MESSAGE
*
         EZASMI TYPE=SOCKET,      Issue SOCKET Macro                   X
               AF='INET6',        INET, IUCV, or INET6                 X
               SOCTYPE='STREAM',  STREAM(TCP) DATAGRAM(UDP) or RAW     X
               ERRNO=ERRNO,       (Specify ERRNO field)                X
               RETCODE=RETCODE,   (Specify RETCODE field)              X
               REQAREA=REQAREA,   FOR EXITS (AND ECBS)                 X
               ERROR=ERROR        Abend if Macro error
*
         BAL   R14,RCCHECK        --> CHECK RESULTS
         STH   R8,S               SAVE RETCODE (=SOCKET DESCRIPTOR)
         LTR   R8,R8              CHECK IT
         BM    DOSHUTDO           --> WE ARE DONE!
*********************************************************************
*                                                                   *
*        Issue CONNECT Socket                                       *
*                                                                   *
*********************************************************************
         MVC   TYPE,MCONNECT      MOVE 'CONNECT' TO MESSAGE
         MVC   PORT(2),PORTS      Load STREAM port #
         MVC   ADDRESS(16),ADDR   LOAD THE INTERNET ADDRESS
*
         EZASMI TYPE=CONNECT,     Issue Macro                          X
               S=S,               STREAM                               X
               NAME=NAME,         SOCKET NAME STRUCTURE                X
               ERRNO=ERRNO,       (Specify ERRNO field)                X
               RETCODE=RETCODE,   (Specify RETCODE field)              X
               REQAREA=REQAREA,   FOR EXITS (AND ECBS)                 X
               ERROR=ERROR        Abend if Macro error
*
         BAL   R14,RCCHECK        --> CHECK RC
         LTR   R8,R8              RECHECK IT
         BM    DOSHUTDO           --> WE ARE DONE
*********************************************************************
*                                                                   *
```

Figure 70. EZASO6AC sample client program for IPv6 (Part 3 of 10)

```
*        Issue GETPEERNAME                                             *
*                                                                      *
************************************************************************
         MVC   TYPE,MGETPEER      MOVE 'GTPEERN' TO MESSAGE
*
         EZASMI TYPE=GETPEERNAME, Issue Macro                          X
               S=S,               STREAM                              X
               NAME=NAME,         (SOCKET NAME STRUCTURE)             X
               ERRNO=ERRNO,       (Specify ERRNO field)               X
               RETCODE=RETCODE,   (Specify RETCODE field)             X
               REQAREA=REQAREA,   FOR EXITS (AND ECBS)                X
               ERROR=ERROR        Abend if Macro error
*
         BAL   R14,RCCHECK        --> CHECK RC
************************************************************************
*                                                                      *
*        ISSUE GETNAMEINFO MACRO                                       *
*                                                                      *
************************************************************************
         MVC   TYPE,MGNAMEI       MOVE 'GETNAMEINFO' TO MESSAGE
         LA    R6,NI_NAMEREQD
         ST    R6,FLAGS
*
         EZASMI TYPE=GETNAMEINFO, ISSUE GETNAMEINFO MACRO              X
               NAME=NAME,                                              X
               NAMELEN=NAMELEN,                                        X
               HOST=HOSTNAME,                                          X
               HOSTLEN=HOSTNAMEL,                                      X
               SERVICE=SERVNAME,                                       X
               SERVLEN=SERVNAMEL,                                      X
               FLAGS=FLAGS,                                            X
               ERRNO=ERRNO,       (SPECIFY ERRNO FIELD)               X
               RETCODE=RETCODE,   (SPECIFY RETCODE FIELD)             X
               ERROR=ERROR        ABEND IF MACRO ERROR
*
         BAL   R14,RCCHECK        CHECK FOR SUCCESSFUL CALL
*
* DISPLAY HOSTNAME
*
         MVC   MSGRSLT1,=C'HOST NAME ' INDICATE WHAT WERE PROCESSING
         XC    MSGRSLT2,MSGRSLT2
         MVC   MSGRSLT2,HOSTNAME  LOAD UP THE DATA
         STM   R14,R12,12(R13)    JUST FOR DEBUGGING
         BAL   R14,WTOSUB         SEND TO THE CONSOLE
*
* DISPLAY SERVNAME
*
         MVC   MSGRSLT1,=C'SERV NAME ' INDICATE WHAT WERE PROCESSING
         XC    MSGRSLT2,MSGRSLT2
         MVC   MSGRSLT2,SERVNAME  LOAD UP THE DATA
         STM   R14,R12,12(R13)    JUST FOR DEBUGGING
         BAL   R14,WTOSUB         SEND TO THE CONSOLE
************************************************************************
*                                                                      *
*        Issue WRITE - Write data from buffer                          *
```

Figure 70. EZASO6AC sample client program for IPv6 (Part 4 of 10)

```
*                                                                     *
***********************************************************************
         MVC   TYPE,MWRITE        MOVE 'WRITE ' TO MESSAGE
*
         EZASMI TYPE=WRITE,       Issue Macro                          X
               S=S,               STREAM SOCKET                        X
               NBYTE=NBYTE,       SIZE OF BUFFER                       X
               BUF=BUF,           BUFFER                               X
               ERRNO=ERRNO,       (Specify ERRNO field)                X
               RETCODE=RETCODE,   (Specify RETCODE field)              X
               REQAREA=REQAREA,   FOR EXITS (AND ECBS)                 X
               ERROR=ERROR        Abend if Macro error
*
         BAL   R14,RCCHECK        --> CHECK RC
***********************************************************************
*                                                                     *
*        Issue SHUTDOWN - HOW = 1 (end communication TO socket)       *
*                                                                     *
***********************************************************************
DOSHUTDO EQU   *
         MVC   HOW(4),=F'1'
*
         BAL   R14,SHUTSUB        --> SHUTDOWN
*
         BAL   R14,RCCHECK        --> CHECK RC
***********************************************************************
*                                                                     *
*        Issue READ - Read data and store in buffer                   *
*                                                                     *
***********************************************************************
         MVC   TYPE,MREAD         MOVE 'READ  ' TO MESSAGE
*
         EZASMI TYPE=READ,        Issue Macro                          X
               S=S,               STREAM SOCKET                        X
               NBYTE=NBYTE,       SIZE OF BUFFER                       X
               BUF=BUF2,          (BUFFER)                             X
               ERRNO=ERRNO,       (Specify ERRNO field)                X
               RETCODE=RETCODE,   (Specify RETCODE field)              X
               REQAREA=REQAREA,   FOR EXITS (AND ECBS)                 X
               ERROR=ERROR        Abend if Macro error
*
         BAL   R14,RCCHECK        --> CHECK RC
         MVC   MSGRSLT1,MSGBUFF   TITLE
         MVC   MSGRSLT2,BUF2      MOVE THE DATA
         BAL   R14,WTOSUB         --> PRINT IT
***********************************************************************
*                                                                     *
*        Issue SHUTDOWN - HOW = 0 (end communication FROM socket)     *
*                                                                     *
***********************************************************************
         MVC   HOW(4),=F'0'
*
         BAL   R14,SHUTSUB        --> SHUTDOWN
*
         BAL   R14,RCCHECK        --> CHECK RC
```

Figure 70. EZASO6AC sample client program for IPv6 (Part 5 of 10)

```
*********************************************************************
*                                                                   *
*        Terminate Connection to API                                *
*                                                                   *
*********************************************************************
         MVC   TYPE,MTERMAPI      MOVE 'TERMAPI' TO MESSAGE
*
         POST  ECB,1              FOLLOWING IS SYNC ONLY
         EZASMI TYPE=TERMAPI      Issue EZASMI Macro for Termapi
*
         BAL   R14,RCCHECK        --> CHECK RC
*-------------------------------------------------------------------*
*        Issue console message for task termination
*-------------------------------------------------------------------*
         MVC   TYPE,MSGEND        Move 'ENDED' to message
*
         MVC   MSGRSLT1,MSGSUCC   ...SUCCESSFUL text
         MVC   MSGRSLT2,BLANK35
         BAL   R14,WTOSUB         --> DO WTO
         LA    R14,1              CONSTANT
         AH    R14,APITYPE        ADD
         STH   R14,APITYPE        STORE
         CH    R14,=H'3'          COMPARE
*        BE    LOOP               --> LETS DO IT AGAIN!
*
*-------------------------------------------------------------------*
*        Return to Caller
*-------------------------------------------------------------------*
         L     R13,4(R13)
         RETURN (14,12),T,RC=0
WTOSUB   EQU   *
         LR    R7,R14             SAVE RETURN REG
         MVC   MSGCMD,TYPE        COPY COMMAND
         WTO   TEXT=MSG
         BR    R7                 --> RETURN
*
SHUTSUB  EQU   *
         LR    R7,R14
         MVC   TYPE,MSHUTDOW      MOVE 'SHUTDOW' TO MESSAGE
*
         EZASMI TYPE=SHUTDOWN,    Issue Macro                          X
               S=S,               STREAM                               X
               HOW=HOW,           End communication in both directions X
               ERRNO=ERRNO,       (Specify ERRNO field)                X
               RETCODE=RETCODE,   (Specify RETCODE field)              X
               REQAREA=REQAREA,   FOR EXITS (AND ECBS)                 X
               ERROR=ERROR        Abend if Macro error
*
         BR    R7                 --> RETURN TO CALLER
*-------------------------------------------------------------------*
*        ABEND PROGRAM AND GET DUMP TO DEBUG!
ERROR    ABEND 1,DUMP
         CNOP  2,4
*        USES R6,R7,R8         RETCODE RETURNED IN R8
RCCHECK  EQU   *
```

Figure 70. EZASO6AC sample client program for IPv6 (Part 6 of 10)

```
         LR    R7,R14             COPY TO REAL RETURN REG
         MVC   MSGRSLT1,MSGSUCC   ...SUCCESS TEXT
         L     R6,RETCODE
         LTR   R6,R6
         BM    NOWAIT
         CLI   SYNFLAG,0          PLAIN CASE?
         BE    NOWAIT             --> SKIP IT
         MVC   KEY+14(8),SUBTASK
         MVC   KEY+23(8),TYPE
KEY      WTO   'WAIT: XXXXXXXX XXXXXXXX'
         WAIT  ECB=ECB
NOWAIT   EQU   *
*        LA    R15,ECB
*        ST    R15,ECB
         ST    R9,ECB             MAKE THIS THE TOKEN AGAIN
         L     R6,RETCODE         CHECK FOR SUCCESSFUL CALL
         CLC   TYPE,=CL8'GETHOSTI'
         BE    HOSTIDRC           HANDLE PRINTING HOST ID
         LTR   R8,R6              SAVE A COPY
*
         BNL   CONT00
FAILMSG  EQU   *
         MVC   MSGRSLT1,MSGFAIL   ...FAIL TEXT
CONT00   EQU   *
*
*-------------------------------------------------------------------*
*        FORMAT THE RETCODE= -XXXXXXX ERRNO= XXXXXXX MSG RESULTS
*        ***> R6 = RETCODE VALUE ON ENTRY
*-------------------------------------------------------------------*
         MVC   MSGRTCT,MSGRETC    ' RETCODE= '
         MVI   MSGRTCS,C'+'
         LTR   R6,R6
         BNM   NOTM               -->
         MVI   MSGRTCS,C'-'       MOVE SIGN WHICH IS ALWAYS MINUS
NOTM     EQU   *
         MVC   MSGERRT,MSGERRN    ' ERRNO= '
*
         CVD   R6,DWORK           CONVERT IT TO DECIMAL
         UNPK  MSGRTCV,DWORK+4(4) UNPACK IT
         OI    MSGRTCV+6,X'F0'    CORRECT THE SIGN
*
ERRNOFMT EQU   *
         L     R6,ERRNO           GET ERRNO VALUE
         CVD   R6,DWORK           CONVERT IT TO DECIMAL
         UNPK  MSGERRV,DWORK+4(4) UNPACK IT
         OI    MSGERRV+6,X'F0'    CORRECT THE SIGN
*
         MVC   MSGRSLT2(35),MSGRTCD
*
         MVI   MSGRTHX,X'40'      CLEAR HEX INDICATOR
         SR    R6,R6              CLEAR OUT...
         ST    R6,RETCODE            RETCODE AND...
         ST    R6,ERRNO                 ERRNO
*
*
```

Figure 70. EZASO6AC sample client program for IPv6 (Part 7 of 10)

```
         CLI   TRACE,0
         BNE   NOTRACE
         LR    R14,R7             GIVE HIM RETURN REG
         B     WTOSUB             --> DO WTO
NOTRACE  EQU   *
         BR    R7                 --> RETURN TO CALLER
*
HOSTIDRC EQU   *               VALID HOSTID MAY LOOK LIKE NEG. RC
         C     R6,=F'-1'       ONLY -1 RC INDICATES FAILURE
         BE    FAILMSG            ...BAD RC, USE STANDARD MSG
         LR    R8,R6              ...NEXT CALL EXPECTS ADDR IN R8
         MVC   MSGRSLT1,MSGSUCC   ...SUCCESS TEXT
         UNPK  HEXRC(9),RETCODE(5)   PLUS ONE FOR FAKE SIGN
         TR    HEXRC(8),HEXTAB    ...CONVERT UNPK TO PRINTABLE HEX
         MVI   HEXRC+8,X'40'      ...SPACE OUT FAKED SIGN BYTE
         MVI   MSGRTHX,C'X'       ...INDICATE INFO IS HEX
         B     ERRNOFMT
*
SYNFLAG  DC    H'0'               DEFAULT TO SYN
TRACE    DC    H'0'               DEFAULT TO TRACE
MYEXIT   DC   A(MYEXIT1,SUBTASK)
MYEXIT1  SAVE (14,12),T,*
         LR   R2,R15
         USING MYEXIT1,R2
         LM   R8,R9,0(R1)            GET TWO TOKENS
         MVC  EXKEY+14(8),0(R8)      TELL WHO
         MVC  EXKEY+23(8),TYPE       TELL WHAT
EXKEY    WTO 'EXIT: XXXXXXXX XXXXXXXX'
         POST ECB,1
         RETURN (14,12),T,RC=0
         DROP  R2
*-------------------------------------------------------------------*
* ELEMENTS USED TO RUN PROGRAM                                      *
*-------------------------------------------------------------------*
EZASMGW  EZASMI TYPE=GLOBAL,      STORAGE DEFINITION FOR GWA           X
               STORAGE=CSECT
*---------------------*
* INITAPI macro parms *
*---------------------*
SUBTASK  DC    CL8'EZASO6AC'      SUBTASK PARM VALUE
IDENT    DC    0CL16' '
         DC    CL8'TCPV32'        DEFAULT TO FIRST ONE AVAILABLE
         DC    CL8'EZASO6AC'      MY ADDR SPACE NAME OR JOBNAME
MAXSNO   DC    F'0'               (HIGHEST SOCKET DESCRIPTOR AVAILABLE)
MAXSOC   DC    AL2(50)            MAXSOC PARM VALUE
APITYPE  DC    H'2'               OR PUT A 3 HERE
*-------------------------------------------------------------------*
* SOCKET macro parms *
*--------------------*
S        DC    H'0'               SOCKET DESCRIPTOR FOR STREAM
*--------------------*
* CONNECT MACRO PARMS *
*--------------------*
         CNOP  0,4
NAME     DC    0CL28' '           SOCKET IPV6 NAME STRUCTURE
```

Figure 70. EZASO6AC sample client program for IPv6 (Part 8 of 10)

```
         DC    AL1(16)            Address Length
         DC    AL1(19)            Family
PORT     DC    H'0'
FLOWINFO DC    XL4'00'
ADDRESS  DC    XL16'FF'
         DC    XL4'00'            SCOPEID
ADDR     DC    XL16'00000000000000000000000000000001' Internet Address
PORTS    DC    H'11007'
*--------------------*
* WRITE MACRO PARMS   *
*--------------------*
NBYTE    DC    F'50'              SIZE OF BUFFER
BUF      DC    CL50' THIS IS FROM EZASO6AC!' BUFFER FOR WRITE
*------------------------*
* SHUTDOWN MACRO PARMS   *
*------------------------*
HOW      DC    F'2'               END COMMUNICATION TO- AND FROM-SOCKET
*--------------------*
* READ MACRO PARMS    *
*--------------------*
BUF2     DC    CL50'BUF2'         BUFFER FOR READ
*---------------*
*---------------*
MNTOP    DC    CL8'NTOP   '
MPTON    DC    CL8'PTON   '
MFADDRI  DC    CL8'FADDRI '
MGADDRI  DC    CL8'GADDRI '
MGNAMEI  DC    CL8'GNAMEI '
MINITAPI DC    CL8'INITAPI'
MSOCKET  DC    CL8'SOCKET'
MCONNECT DC    CL8'CONNECT'
MGETPEER DC    CL8'GETPEERN'
MREAD    DC    CL8'READ'
MWRITE   DC    CL8'WRITE'
MSHUTDOW DC    CL8'SHUTDOWN'
MTERMAPI DC    CL8'TERMAPI'
MSGSTART DC    CL8' STARTED'
MSGEND   DC    CL8' ENDED  '
MSGSUCC  DC    CL10' SUCCESS  '     Command results...
MSGFAIL  DC    CL10' FAIL:-( '                    ...
MSGRETC  DC    CL10' RETCODE= '                    ...
MSGERRN  DC    CL10' ERRNO=   '                    ...
MSGBUFF  DC    CL10' BUFFER:  '                    ...
BLANK35  DC    CL35' '
*-------------------------------------------------------------------------*
* MESSAGE AREA *
*--------------*
MSG      DC    0F'0'              MESSAGE AREA
         DC    AL2(MSGE-MSGNUM)   LENGTH OF MESSAGE
MSGNUM   DC    CL10'EZASO6AC:'    'EZASO6AC: '
MSGCMD   DC    CL8' '             COMMAND ISSUED
MSGRSLT1 DC    CL10' '            COMMAND RESULTS (SUCC, PASS, FAIL)
MSGRSLT2 DC    CL35' '            RETURNED VALUES
MSGE     EQU   *                  End of message
*-------------------------------------------------------------------------*
```

Figure 70. EZASO6AC sample client program for IPv6 (Part 9 of 10)

```
* MESSAGE RESULTS AREAS (fill in and move to MSGRSLT2) *
*-----------------------------------------------------*
*
MSGRTCD  DC    0CL35' '           GENERAL RETURNED VALUE
MSGRTCT  DC    CL9' RETCODE='     ' RETCODE= '
MSGRTHX  DC    CL1' '             'X' X FOR GETHOSTID
MSGRTCS  DC    CL1' '             '-' (NEGATIVE SIGN)
HEXRC    EQU   MSGRTCS            HEX RC WILL START AT SIGN LOCATION
MSGRTCV  DC    CL7' '             RETURNED VALUE (RETCODE)
MSGERRT  DC    CL10' ERRNO='      ' ERRNO=   '
MSGERRV  DC    CL7' '             RETURNED VALUE (ERRNO)
DWORK    DC    D'0'               WORK AREA
HEXTAB   EQU   *-240              TAB TO CONVERT TO PRINTABLE HEX
*                                 FIRST 240 BYTES NOT REFERENCED
         DC    CL16'0123456789ABCDEF'
PARMADDR DC    A(0)               PARM ADDRESS SAVE AREA
         EZBREHST DSECT=NO,LIST=YES,HOSTENT=NO,ADRINFO=YES
         LTORG
*--------------------------------------------------------------------*
* REG/SAVEAREA *
*--------------*
SOCSAVE  DC    9D'0'              SAVE AREA
*--------------------------------------------------------------------*
         CNOP  0,8
MYCB     EQU   *                  MY CONTROL BLOCK
REQAREA  EQU   *
ECB      DC    A(ECB)             SELF POINTER
         DC    CL100'WORK AREA'
MYTIE    EZASMI TYPE=TASK,STORAGE=CSECT     TIE
TYPE     DC    CL8'TYPE'
ERRNO    DC    F'0'
RETCODE  DC    F'0'
*
HOSTNAME DS    CL255                  HOST NAME FOR GETNAMEINFO
SERVNAME DS    CL32                   SERVICE NAME FOR GETNAMEINFO
         CNOP  0,4
HOSTNAMEL DC    AL4(L'HOSTNAME)        LENGTH OF HOST NAME
SERVNAMEL DC    AL4(L'SERVNAME)        LENGTH OF SERVICE NAME
NAMELEN  DC    AL4(L'NAME)            LENGTH OF NAME
FLAGS    DC    F'0'                   GETNAMEINFO FLAGS
*
MYNEXT   DC    A(MYCB)            NEXT IN CHAIN FOR MULTIPLES
         CNOP  0,8
MYLEN    EQU   *-MYCB
MYCB2    EQU   *
         ORG   *+MYLEN
         CNOP  0,8
         DC    CL8'&SYSDATE'
         DC    CL8'&SYSTIME'
         END
```

Figure 70. EZASO6AC sample client program for IPv6 (Part 10 of 10)

Chapter 13. CALL instruction application programming interface

This information describes the CALL instruction API for IPv4 or IPv6 socket applications. The following topics are included:

- "CALL instruction API environmental restrictions and programming requirements"
- "CALL instruction API output register information" on page 470
- "CALL instruction API compatibility considerations" on page 470
- "CALL instruction application programming interface (API)" on page 470
- "Understanding COBOL, Assembler, and PL/I call formats" on page 471
- "Converting parameter descriptions" on page 472
- "Diagnosing problems in applications using the CALL instruction API" on page 472
- "CALL instruction API error messages and return codes" on page 473
- "Code CALL instructions" on page 473
- "Using data translation programs for socket call interface" on page 614
- "Call interface sample programs" on page 633

CALL instruction API environmental restrictions and programming requirements

The following restrictions apply to both the Macro Socket API and the Callable Socket API:

Function	Restriction
SRB mode	These APIs can only be invoked in TCB mode (task mode).
Cross-memory mode	These APIs can only be invoked in a non-cross-memory environment (PASN=SASN=HASN).
Functional Recovery Routine (FRR)	Do not invoke these APIs with an FRR set. This causes system recovery routines to be bypassed and severely damage the system.
Locks	No locks should be held when issuing these calls.
INITAPI and TERMAPI socket commands	The INITAPI and TERMAPI socket commands must be issued under the same task.
Storage	Storage acquired for the purpose of containing data returned from a socket call must be obtained in the same key as the application program status word (PSW) at the time of the socket call.
Nested socket API calls	You cannot issue nested API calls within the same task. That is, if a request block (RB) issues a socket API call and is interrupted by an interrupt request block (IRB) in an STIMER exit, any additional socket API calls that the IRB attempts to issue are detected and flagged as errors.

© Copyright IBM Corp. 1989, 2010

Function	Restriction
Addressability mode (Amode) considerations	The EZASOKET API can be invoked while the caller is in either 31-bit or 24-bit Amode. However, if the application is running in 24-bit addressability mode at the time of the call, all addresses of parameters passed by the application must be addressable in 31-bit Amode. This implies that even if the addresses being passed reside in storage below the 16 MB line (and therefore addressable by 24-bit Amode programs) the high-order byte of these addresses needs to be 0.
Use of z/OS UNIX System Services	Address spaces using the EZASOKET API should not use any z/OS UNIX System Services socket API facilities such as z/OS UNIX Assembler Callable Services or Language Environment for z/OS C/C++. Doing so can yield unpredictable results.

CALL instruction API output register information

When control returns to the caller, the general purpose registers (GPRs) contain:

Register	Contents
0-1	Used as work registers by the system
2-13	Unchanged
14	Used as a work register by the system
15	Contains the entry point address EZASOKET

When control returns to the caller, the access registers (ARs) contain:

Register	Contents
0-1	Used as work registers by the system
2-14	Unchanged
15	Used as a work register by the system.

If a caller depends on register contents to remain the same before and after issuing a service, the caller must save the contents of a register before issuing the service and must restore them after the system returns control.

CALL instruction API compatibility considerations

Unless noted in *z/OS Communications Server: New Function Summary*, an application program compiled and link edited on a release of z/OS Communications Server IP can be used on higher level releases. That is, the API is upward compatible.

Application programs that are compiled and link edited on a release of z/OS Communications Server IP cannot be used on older releases. That is, the API is not downward compatible.

CALL instruction application programming interface (API)

This information describes the CALL instruction API for TCP/IP application programs written in the COBOL, PL/I, or System/370 Assembler language. The format and parameters are described for each socket call.

Notes:

1. Unless your program is running in a CICS environment, reentrant code and multithread applications are not supported by this interface.
2. For a PL/I program, include the following statement before your first call instruction.

   ```
   DCL EZASOKET ENTRY OPTIONS(ASM,INTER) EXT;
   ```

3. If you use the CALL instruction from code that will run as a part of a CICS transaction, see the *z/OS Communications Server: IP CICS Sockets Guide* for additional considerations.
4. The Sockets Extended module (EZASOKET) is located in the hlq.SEZATCP(EZASOKET) load module and should be resolved from there when it is processed by the binder. You can use the linkage editor MAP parameter to produce the module map report to verify where EZASOKET is resolved.

Understanding COBOL, Assembler, and PL/I call formats

This API is invoked by calling the EZASOKET program and performs the same functions as the C language calls. The parameters look different because of the differences in the programming languages.

COBOL language call format

The following is the 'EZASOKET' call format for COBOL language programs:

SOC-FUNCTION
A 16-byte character field, left-justified and padded on the right with blanks. Set to the name of the call. SOC-FUNCTION is case specific. It must be in uppercase.

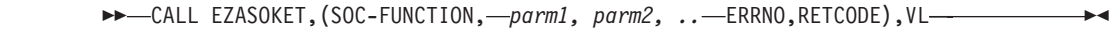
parm*n* A variable number of parameters depending on the type call.

ERRNO
If RETCODE is negative, there is an error number in ERRNO. This field is used in most, but not all, of the calls. It corresponds to the value returned by the tcperror() function in C.

RETCODE
A fullword binary variable containing a code returned by the EZASOKET call. This value corresponds to the normal return value of a C function.

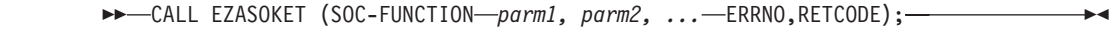
Assembler language call format

The following is the EZASOKET call format for assembler language programs.



PL/I language call format

The following is the EZASOKET call format for PL/I language programs:



SOC-FUNCTION
A 16-byte character field, left-justified and padded on the right with blanks. Set to the name of the call.

parm*n* A variable number of parameters depending on the type call.

ERRNO
If RETCODE is negative, there is an error number in ERRNO. This field is used in most, but not all, of the calls. It corresponds to the value returned by the tcperror() function in C.

RETCODE
A fullword binary variable containing a code returned by the EZASOKET call. This value corresponds to the normal return value of a C function.

Converting parameter descriptions

The parameter descriptions in this information are written using the VS COBOL II PIC language syntax and conventions, but you should use the syntax and conventions that are appropriate for the language you want to use.

Figure 71 shows examples of storage definition statements for COBOL, PL/I, and assembler language programs.

```
VS COBOL II PIC

  PIC S9(4) BINARY                  HALFWORD BINARY VALUE
  PIC S9(8) BINARY                  FULLWORD BINARY VALUE
  PIC   X(n)                        CHARACTER FIELD OF N BYTES

COBOL PIC

  PIC S9(4) COMP                    HALFWORD BINARY VALUE
  PIC S9(4) BINARY                  HALFWORD BINARY VALUE
  PIC S9(8) COMP                    FULLWORD BINARY VALUE
  PIC S9(8) BINARY                  FULLWORD BINARY VALUE
  PIC   X(n)                        CHARACTER FIELD OF N BYTES

PL/I DECLARE STATEMENT

  DCL   HALF       FIXED BIN(15),   HALFWORD BINARY VALUE
  DCL   FULL       FIXED BIN(31),   FULLWORD BINARY VALUE
  DCL   CHARACTER  CHAR(n)          CHARACTER FIELD OF n BYTES

ASSEMBLER DECLARATION

  DS    H                           HALFWORD BINARY VALUE
  DS    F                           FULLWORD BINARY VALUE
  DS    CLn                         CHARACTER FIELD OF n BYTES
```

Figure 71. Storage definition statement examples

Diagnosing problems in applications using the CALL instruction API

TCP/IP provides a trace facility that can be helpful in diagnosing problems in applications using the CALL instruction API. The trace is implemented using the TCP/IP Component Trace (CTRACE) SOCKAPI trace option. The SOCKAPI trace option allows all Call instruction socket API calls issued by an application to be traced in the TCP/IP CTRACE. The SOCKAPI trace records include information such as the type of socket call, input, and output parameters and return codes. This trace can be helpful in isolating failing socket API calls and in determining

the nature of the error or the history of socket API calls that may be the cause of an error. For more information about the SOCKAPI trace option, see *z/OS Communications Server: IP Diagnosis Guide*.

CALL instruction API error messages and return codes

For information about error messages, see *z/OS Communications Server: IP Messages Volume 1 (EZA)*.

For information about error codes that are returned by TCP/IP, see Appendix B, "Socket call error return codes," on page 885.

Code CALL instructions

This information contains the description, syntax, parameters , and other related information for each call instruction included in this API.

ACCEPT

A server issues the ACCEPT call to accept a connection request from a client. The call points to a socket that was previously created with a SOCKET call and marked by a LISTEN call.

The ACCEPT call is a blocking call. When issued, the ACCEPT call:

1. Accepts the first connection on a queue of pending connections.
2. Creates a new socket with the same properties as s, and returns its descriptor in RETCODE. The original sockets remain available to the calling program to accept more connection requests.
3. The address of the client is returned in NAME for use by subsequent server calls.

Notes:

1. The blocking or nonblocking mode of a socket affects the operation of certain commands. The default is blocking; nonblocking mode can be established by use of the FCNTL and IOCTL calls. When a socket is in blocking mode, an I/O call waits for the completion of certain events. For example, a READ call will block until the buffer contains input data. When an I/O call is issued:
   - If the socket is blocking, program processing is suspended until the event completes.
   - If the socket is nonblocking, program processing continues.
2. If the queue has no pending connection requests, ACCEPT blocks the socket unless the socket is in nonblocking mode. The socket can be set to nonblocking by calling FCNTL or IOCTL.
3. When multiple socket calls are issued, a SELECT call can be issued prior to the ACCEPT to ensure that a connection request is pending. Using this technique ensures that subsequent ACCEPT calls will not block.
4. TCP/IP does not provide a function for screening clients. As a result, it is up to the application program to control which connection requests it accepts, but it can close a connection immediately after discovering the identity of the client.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.

Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.

Figure 72 shows an example of ACCEPT call instructions.

```
WORKING-STORAGE SECTION.
    01  SOC-FUNCTION    PIC X(16)  VALUE IS 'ACCEPT'.
    01  S               PIC 9(4) BINARY.
* IPv4 socket address structure.
    01  NAME.
        03  FAMILY      PIC 9(4) BINARY.
        03  PORT        PIC 9(4) BINARY.
        03  IP-ADDRESS  PIC 9(8) BINARY.
        03  RESERVED    PIC X(8).
* IPv6 socket address structure.
    01  NAME.
        03  FAMILY      PIC 9(4) BINARY.
        03  PORT        PIC 9(4) BINARY.
        03  FLOWINFO    PIC 9(8) BINARY.
        03  IP-ADDRESS.
            10 FILLER   PIC 9(16) BINARY.
            10 FILLER   PIC 9(16) BINARY.
        03  SCOPE-ID    PIC X(8) BINARY.
    01  ERRNO           PIC 9(8) BINARY.
    01  RETCODE         PIC S9(8) BINARY.

PROCEDURE DIVISION.
     CALL 'EZASOKET' USING SOC-FUNCTION S NAME ERRNO RETCODE.
```

Figure 72. ACCEPT call instructions example

For equivalent PL/I and assembler language declarations, see "Converting parameter descriptions" on page 472.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing ACCEPT. Left-justify the field and pad it on the right with blanks.

S A halfword binary number specifying the descriptor of a socket that was previously created with a SOCKET call. In a concurrent server, this is the socket upon which the server listens.

Parameter values returned to the application

NAME
An IPv4 socket address structure that contains the client's socket address.

FAMILY
A halfword binary field specifying the IPv4 addressing family. The call returns the value decimal 2 for AF_INET.

PORT A halfword binary field that is set to the client's port number.

IP-ADDRESS
A fullword binary field that is set to the 32-bit IPv4 IP address, in network byte order, of the client's host machine.

RESERVED
Specifies 8 bytes of binary zeros. This field is required, but not used.

An IPv6 socket address structure that contains the client's socket address.

FAMILY
A halfword binary field specifying the IPv6 addressing family. For TCP/IP the value is decimal 19, indicating AF_INET6.

PORT A halfword binary field that is set to the client's port number.

FLOWINFO
A fullword binary field specifying the traffic class and flow label. This value of this field is undefined.

IP-ADDRESS
A 16-byte binary field that is set to the 128-bit IPv6 IP address, in network-byte-order, of the client's host machine.

SCOPE-ID
A fullword binary field which identifies a set of interfaces as appropriate for the scope of the address carried in the IPv6-ADDRESS field. For a link scope IPv6-ADDRESS, SCOPE-ID contains the link index for the IPv6-ADDRESS. For all other address scopes, SCOPE-ID is undefined.

ERRNO
A fullword binary field. If RETCODE is negative, the field contains an error number. See Appendix B, "Socket call error return codes," on page 885 for information about ERRNO return codes.

RETCODE
If the RETCODE value is positive, the RETCODE value is the new socket number.

If the RETCODE value is negative, check the ERRNO field for an error number.

Value	Description
> 0	Successful call.
–1	Check **ERRNO** for an error code.

BIND

In a typical server program, the BIND call follows a SOCKET call and completes the process of creating a new socket.

The BIND socket command can specify the port or let the system choose the port. A listener program should always bind to the same well-known port so that clients know the socket address to use when issuing a CONNECT, SENDTO, or SENDMSG request.

In addition to the port, the application also specifies an IP address on the BIND socket command. Most applications typically specify a value of 0 for the IP address, which allows these applications to accept new TCP connections or receive

UDP datagrams that arrive over any of the network interfaces of the local host. This enables client applications to contact the application using any of the IP addresses associated with the local host.

Alternatively, an application can indicate that it is only interested in receiving new TCP connections or UDP datagrams that are targeted towards a specific IP address associated with the local host. This can be accomplished by specifying the IP address in the appropriate field of the socket address structure passed on the NAME parameter.

Tip: Even if an application specifies the value 0 for the IP address on the BIND, the system administrator can override that value by specifying the BIND parameter on the PORT reservation statement in the TCP/IP profile. The effect of this override is similar to the effect of the application specifying an explicit IP address on the BIND macro. For more information, see *z/OS Communications Server: IP Configuration Reference*.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.

Figure 73 on page 477 shows an example of BIND call instructions.

```
WORKING-STORAGE SECTION.
    01  SOC-FUNCTION    PIC X(16)  VALUE IS 'BIND'.
    01  S               PIC 9(4) BINARY.

 * IPv4 socket address structure.
    01  NAME.
        03  FAMILY      PIC 9(4) BINARY.
        03  PORT        PIC 9(4) BINARY.
        03  IP-ADDRESS  PIC 9(8) BINARY.
        03  RESERVED    PIC X(8).

 * IPv6 socket address structure.
    01  NAME.
        03  FAMILY      PIC 9(4) BINARY.
        03  PORT        PIC 9(4) BINARY.
        03  FLOWINFO    PIC 9(8) BINARY.
        03  IP-ADDRESS.
            10 FILLER   PIC 9(16) BINARY.
            10 FILLER   PIC 9(16) BINARY.
        03  SCOPE-ID    PIC 9(8) BINARY.

    01  ERRNO           PIC 9(8) BINARY.
    01  RETCODE         PIC S9(8) BINARY.

PROCEDURE DIVISION.
     CALL 'EZASOKET' USING SOC-FUNCTION S NAME ERRNO RETCODE.
```

Figure 73. BIND call instruction example

For equivalent PL/I and assembler language declarations, see "Converting parameter descriptions" on page 472.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing BIND. The field is left-justified and padded to the right with blanks.

S A halfword binary number specifying the socket descriptor for the socket to be bound.

NAME

See Chapter 3, "Designing an iterative server program," on page 27 for more information.

Specifies the IPv4 socket address structure for the socket that is to be bound.

FAMILY
A halfword binary field specifying the IPv4 addressing family. The value is always set to decimal 2, indicating AF_INET.

PORT A halfword binary field that is set to the port number to which you want the socket to be bound.

Note: To determine the assigned port number, call the GETSOCKNAME command after calling the BIND command.

IP-ADDRESS
A fullword binary field that is set to the 32-bit IPv4 IP address (network byte order) of the socket to be bound.

RESERVED
Specifies an 8-byte character field that is required but not used.

Specifies the IPv6 socket address structure for the socket that is to be bound.

FAMILY
A halfword binary field specifying the IPv6 addressing family. For TCP/IP the value is decimal 19, indicating AF_INET6.

PORT A halfword binary field that is set to the port number to which you want the socket to be bound.

Note: To determine the assigned port number, call the GETSOCKNAME command after calling the BIND command.

FLOWINFO
A fullword binary field specifying the traffic class and flow label. This field must be set to 0.

IP-ADDRESS
A 16-byte binary field that is set to the 128-bit IPv6 IP address (network byte order) of the socket to be bound.

SCOPE-ID
A fullword binary field which identifies a set of interfaces as appropriate for the scope of the address carried in the IPv6-ADDRESS field. A value of 0 indicates the SCOPE-ID field does not identify the set of interfaces to be used, and may be specified for any address types and scopes. For a link scope IPv6-ADDRESS, SCOPE-ID may specify a link index which identifies a set of interfaces. For all other address scopes, SCOPE-ID must be set to 0.

Parameter values returned to the application

ERRNO
A fullword binary field. If RETCODE is negative, this field contains an error number. See Appendix B, "Socket call error return codes," on page 885 for information about ERRNO return codes.

RETCODE
A fullword binary field that returns one of the following values:

Value	Description
0	Successful call.
−1	Check **ERRNO** for an error code.

BIND2ADDRSEL

The BIND2ADDRSEL call binds a socket to the local IP address that would be selected by the stack to communicate with the input destination IP address.

Use the BIND2ADDRSEL call when the application must verify that the local IP address assigned by the stack meets its address selection criteria as specified by the IPV6_ADDR_PREFERENCES socket option before the stack sends any packets to the remote host. In a TCP or UDP application, the BIND2ADDRSEL call usually follows the SETSOCKOPT call with option IPV6_ADDR_PREFERENCES and precedes any communication with a remote host.

Result: The stack attempts to select a local IP address according to your application preferences. However, a successful BIND2ADDRSEL call does not guarantee that all of your source IP address selection preferences were met.

Guidelines:

- Use the SETSOCKOPT call to set the IPV6_ADDR_PREFERENCES option to indicate your selection preferences of source IP address before binding the socket and before allowing an implicit bind of the socket to occur.

  Result: If a socket has not been explicitly bound to a local IP address with a BIND or BIND2ADDRSEL call when a CONNECT, SENDTO, or SENDMSG call is issued, an implicit bind occurs. The stack chooses the local IP address used for outbound packets.

  Requirement: When your application is using stream sockets, and must prevent the stack from sending any packets whatsoever (such as SYN) to the remote host before it can verify that the local IP address meets the values specified for the IPV6_ADDR_PREFERENCES option, do not allow the CONNECT call to implicitly bind the socket to a local IP address. Instead, bind the socket with the BIND2ADDRSEL call and test the local IP address assigned with the INET6_IS_SRCADDR call. If the assigned local IP address is satisfactory, you can then use the CONNECT call to establish communication with the remote host.
- After you successfully issue the BIND2ADDRSEL call, use the GETSOCKNAME call to obtain the local IP address that is bound to the socket. When the local IP address is obtained, use the INET6_IS_SRCADDR call to verify that the local IP address meets your address selection criteria.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.

Figure 74 on page 480 shows an example of BIND2ADDRSEL call instructions.

```
WORKING-STORAGE SECTION.
         01  SOC-FUNCTION    PIC X(16)  VALUE IS 'BIND2ADDRSEL'.
         01  S               PIC 9(4) BINARY.
       * IPv6 socket address structure.
         01  NAME.
             03  FAMILY      PIC 9(4) BINARY.
             03  PORT        PIC 9(4) BINARY.
             03  FLOWINFO    PIC 9(8) BINARY.
             03  IP-ADDRESS.
                 10 FILLER   PIC 9(16) BINARY.
                 10 FILLER   PIC 9(16) BINARY.
             03  SCOPE-ID    PIC 9(8) BINARY.
         01  ERRNO           PIC 9(8) BINARY.
         01  RETCODE         PIC S9(8) BINARY.

      PROCEDURE DIVISION.
          CALL 'EZASOKET' USING SOC-FUNCTION S NAME ERRNO RETCODE.
```

Figure 74. BIND2ADDRSEL call instruction example

For equivalent PL/I and assembler language declarations, see "Converting parameter descriptions" on page 472.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing BIND2ADDRSEL. The field is left-justified and padded to the right with blanks.

S A halfword binary number specifying the socket descriptor for the socket that is to be bound.

Requirement: The socket must be an AF_INET6 socket. The type can be SOCK_STREAM or SOCK_DGRAM.

NAME
Specifies the IPv6 socket address structure of the remote host that the socket will communicate with. The IPv6 socket structure must specify the following fields:

FAMILY
A halfword binary field specifying the IPv6 addressing family. This field must be set to the decimal value 19, indicating AF_INET6.

PORT A halfword binary field. This field is ignored by BIND2ADDRSEL processing.

Tip: To determine the assigned port number, issue the GETSOCKNAME call after the BIND2ADDRSEL call completes.

FLOWINFO
A fullword binary field. This field is ignored by BIND2ADDRSEL processing.

IP-ADDRESS
A 16-byte binary field that is set to the 128-bit IPv6 IP address (network byte order) of the remote host that the socket will communicate with.

Rule: Specify an IPv4 address by using its IPv4-mapped IPv6 format.

SCOPE-ID
A fullword binary field that identifies a set of appropriate interfaces for the scope of the address that is specified in the

IPv6-ADDRESS field. The value 0 indicates that the SCOPE-ID field does not identify the set of interfaces to be used.

Requirement: The SCOPE-ID value must be nonzero if the address is a link-local address. For all other address scopes, SCOPE-ID must be set to 0.

Parameter values returned to the application

ERRNO

A fullword binary field. If RETCODE is negative, this field contains an error number. See Appendix B, "Socket call error return codes," on page 885 for information about ERRNO return codes.

RETCODE

A fullword binary field that returns one of the following values:

Value	Description
0	Successful call.
–1	Check **ERRNO** for an error code.

CLOSE

The CLOSE call performs the following functions:

- The CLOSE call shuts down a socket and frees all resources allocated to it. If the socket refers to an open TCP connection, the connection is closed.
- The CLOSE call is also issued by a concurrent server after it gives a socket to a child server program. After issuing the GIVESOCKET and receiving notification that the client child has successfully issued a TAKESOCKET, the concurrent server issues the close command to complete the passing of ownership. In high-performance, transaction-based systems the timeout associated with the CLOSE call can cause performance problems. In such systems you should consider the use of a SHUTDOWN call before you issue the CLOSE call. See "SHUTDOWN" on page 605 for more information.

Notes:

1. If a stream socket is closed while input or output data is queued, the TCP connection is reset and data transmission may be incomplete. The SETSOCKOPT call can be used to set a *linger* condition, in which TCP/IP will continue to attempt to complete data transmission for a specified period of time after the CLOSE call is issued. See SO-LINGER in the description of "SETSOCKOPT" on page 589.
2. A concurrent server differs from an iterative server. An iterative server provides services for one client at a time; a concurrent server receives connection requests from multiple clients and creates child servers that actually serve the clients. When a child server is created, the concurrent server obtains a new socket, passes the new socket to the child server, and then dissociates itself from the connection. The CICS Listener is an example of a concurrent server.
3. After an unsuccessful socket call, a close should be issued and a new socket should be opened. An attempt to use the same socket with another call results in a nonzero return code.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.

Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.

Figure 75 shows an example of CLOSE call instructions.

```
WORKING-STORAGE SECTION.
    01 SOC-FUNCTION PIC X(16) VALUE IS 'CLOSE'.
    01 S PIC 9(4) BINARY.
    01 ERRNO PIC 9(8) BINARY.
    01 RETCODE PIC S9(8) BINARY.

PROCEDURE DIVISION.
    CALL 'EZASOKET' USING SOC-FUNCTION S ERRNO RETCODE.
```

Figure 75. CLOSE call instruction example

For equivalent PL/I and assembler language declarations, see "Converting parameter descriptions" on page 472.

Parameter values set by the application

SOC-FUNCTION
A 16-byte field containing CLOSE. Left-justify the field and pad it on the right with blanks.

S A halfword binary field containing the descriptor of the socket to be closed.

Parameter values returned to the application

ERRNO
A fullword binary field. If RETCODE is negative, this field contains an error number. See Appendix B, "Socket call error return codes," on page 885 for information about ERRNO return codes.

RETCODE
A fullword binary field that returns one of the following:

Value	Description
0	Successful call.
–1	Check **ERRNO** for an error code.

CONNECT

The CONNECT call is issued by a client to establish a connection between a local socket and a remote socket.

Stream sockets

For stream sockets, the CONNECT call is issued by a client to establish connection with a server. The call performs two tasks:

- It completes the binding process for a stream socket if a BIND call has not been previously issued.
- It attempts to make a connection to a remote socket. This connection is necessary before data can be transferred.

UDP sockets

For UDP sockets, a CONNECT call need not precede an I/O call, but if issued, it allows you to send messages without specifying the destination.

The call sequence issued by the client and server for stream sockets is:

1. The *server* issues BIND and LISTEN to create a passive open socket.
2. The *client* issues CONNECT to request the connection.
3. The *server* accepts the connection on the passive open socket, creating a new connected socket.

The blocking mode of the CONNECT call conditions its operation.

- If the socket is in blocking mode, the CONNECT call blocks the calling program until the connection is established, or until an error is received.
- If the socket is in nonblocking mode, the return code indicates whether the connection request was successful.
  - A 0 RETCODE indicates that the connection was completed.
  - A nonzero RETCODE with an ERRNO of 36 (EINPROGRESS) indicates that the connection is not completed, but since the socket is nonblocking, the CONNECT call returns normally.

  The caller must test the completion of the connection setup by calling SELECT and testing for the ability to write to the socket.

The completion cannot be checked by issuing a second CONNECT. For more information, see "SELECT" on page 569.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.

Figure 76 on page 484 shows an example of CONNECT call instructions.

```
WORKING-STORAGE SECTION.
    01  SOC-FUNCTION    PIC X(16)  VALUE IS 'CONNECT'.
    01  S               PIC 9(4) BINARY.

* IPv4 socket address structure.
    01  NAME.
        03  FAMILY      PIC 9(4) BINARY.
        03  PORT        PIC 9(4) BINARY.
        03  IP-ADDRESS  PIC 9(8) BINARY.
        03  RESERVED    PIC X(8).

* IPv6 socket address structure.
    01  NAME.
        03  FAMILY      PIC 9(4) BINARY.
        03  PORT        PIC 9(4) BINARY.
        03  IP-ADDRESS  PIC 9(8) BINARY.
        03  FLOWINFO    PIC 9(8) BINARY.
        03  IP-ADDRESS.
            10 FILLER   PIC 9(16) BINARY.
            10 FILLER   PIC 9(16) BINARY.
        03  SCOPE-ID    PIC 9(8) BINARY.
    01  ERRNO           PIC 9(8) BINARY.
    01  RETCODE         PIC S9(8) BINARY.


PROCEDURE DIVISION.

 CALL 'EZASOKET' USING SOC-FUNCTION S NAME ERRNO RETCODE.
```

Figure 76. CONNECT call instruction example

For equivalent PL/I and assembler language declarations, see "Converting parameter descriptions" on page 472.

Parameter values set by the application

SOC-FUNCTION
A 16-byte field containing CONNECT. Left-justify the field and pad it on the right with blanks.

S A halfword binary number specifying the socket descriptor of the socket that is to be used to establish a connection.

NAME

An IPv4 socket address structure that contains the IPv4 socket address of the target to which the local, client socket is to be connected.

FAMILY
A halfword binary field specifying the IPv4 addressing family. The value must be decimal 2 for AF_INET.

PORT A halfword binary field that is set to the server's port number in network byte order. For example, if the port number is 5000 in decimal, it is stored as X'1388' in hex.

IP-ADDRESS
A fullword binary field that is set to the 32-bit IPv4 IP address of the server's host machine in network byte order. For example, if the IP address is 129.4.5.12 in dotted decimal notation, it would be represented as X'8104050C' in hex.

RESERVED
Specifies an 8-byte reserved field. This field is required, but is not used.

An IPv6 socket address structure that contains the IPv6 socket address of the target to which the local, client socket is to be connected.

FAMILY
A halfword binary field specifying the IPv6 addressing family. For TCP/IP the value is decimal 19 for AF_INET6.

PORT A halfword binary field that is set to the server's port number in network byte order. For example, if the port number is 5000 in decimal, it is stored as X'1388' in hex.

FLOWINFO
A fullword binary field specifying the traffic class and flow label. This field must be set to 0.

IP-ADDRESS
A 16-byte binary field that is set to the 128-bit IPv6 IP address of the server's host machine in network byte order. For example, if the IPv6 IP address is 12ab:0:0:cd30:123:4567:89ab:cedf in colon hex notation, it is set to X'12AB00000000CD300123456789ABCDEF'.

SCOPE-ID
A fullword binary field which identifies a set of interfaces as appropriate for the scope of the address carried in the IPv6-ADDRESS field. A value of 0 indicates the SCOPE-ID field does not identify the set of interfaces to be used, and may be specified for any address types and scopes. For a link scope IPv6-ADDRESS, SCOPE-ID may specify a link index which identifies a set of interfaces. For all other address scopes, SCOPE-ID must be set to 0.

Parameter values returned to the application

ERRNO
A fullword binary field. If RETCODE is negative, this field contains an error number. See Appendix B, "Socket call error return codes," on page 885 for information about ERRNO return codes.

RETCODE
A fullword binary field that returns one of the following:

Value	Description
0	Successful call.
–1	Check **ERRNO** for an error code.

FCNTL

The blocking mode of a socket can either be queried or set to nonblocking using the FNDELAY flag described in the FCNTL call. You can query or set the FNDELAY flag even though it is not defined in your program.

See "IOCTL" on page 540 for another way to control a socket's blocking mode.

Values for commands that are supported by the z/OS UNIX Systems Services fcntl callable service will also be accepted. See *z/OS UNIX System Services Assembler Callable Services Reference* for more information.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.

Figure 77 shows an example of FCNTL call instructions.

```
WORKING-STORAGE SECTION
    01  SOC-FUNCTION    PIC X(16)  VALUE IS 'FCNTL'.
    01  S               PIC 9(4) BINARY.
    01  COMMAND         PIC 9(8) BINARY.
    01  REQARG          PIC 9(8) BINARY.
    01  ERRNO           PIC 9(8) BINARY.
    01  RETCODE         PIC S9(8) BINARY.


PROCEDURE DIVISION
CALL 'EZASOKET' USING SOC-FUNCTION S COMMAND REQARG
                ERRNO RETCODE.
```

Figure 77. FCNTL call instruction example

For equivalent PL/I and assembler language declarations, see "Converting parameter descriptions" on page 472.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing FCNTL. The field is left-justified and padded on the right with blanks.

S A halfword binary number specifying the socket descriptor for the socket that you want to unblock or query.

COMMAND
A fullword binary number with the following values:

Value	Description
3	Query the blocking mode of the socket.
4	Set the mode to blocking or nonblocking for the socket.

REQARG
A fullword binary field containing a mask that TCP/IP uses to set the FNDELAY flag.

- If COMMAND is set to 3 ('query') the REQARG field should be set to 0.
- If COMMAND is set to 4 ('set')

– Set REQARG to 4 to turn the FNDELAY flag on. This places the socket in nonblocking mode.
– Set REQARG to 0 to turn the FNDELAY flag off. This places the socket in blocking mode.

Parameter values returned to the application

ERRNO

A fullword binary field. If RETCODE is negative, the field contains an error number. See Appendix B, “Socket call error return codes,” on page 885 for information about ERRNO return codes.

RETCODE

A fullword binary field that returns one of the following.

- If COMMAND was set to 3 (query), a bit string is returned.
  – If RETCODE contains X'00000004', the socket is nonblocking. (The FNDELAY flag is on.)
  – If RETCODE contains X'00000000', the socket is blocking. (The FNDELAY flag is off.)
- If COMMAND was set to 4 (set), a successful call is indicated by 0 in this field. In both cases, a RETCODE of −1 indicates an error (check the ERRNO field for the error number).

FREEADDRINFO

The FREEADDRINFO call frees all the address information structures returned by GETADDRINFO in the RES parameter.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See “Addressability mode (Amode) considerations” under “CALL instruction API environmental restrictions and programming requirements” on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.

Figure 78 on page 488 shows an example of FREEADDRINFO call instructions.

```
WORKING-STORAGE SECTION.
    01  SOC-FUNCTION    PIC X(16)  VALUE IS 'FREEADDRINFO'.
    01  ADDRINFO        PIC 9(8) BINARY.
    01  ERRNO           PIC 9(8) BINARY.
    01  RETCODE         PIC S9(8) BINARY.


PROCEDURE DIVISION.
CALL 'EZASOKET' USING SOC-FUNCTION ADDRINFO
                ERRNO RETCODE.
```

Figure 78. FREEADDRINFO call instruction example

Parameter values set by the application

Keyword **Description**

SOC-FUNCTION
A 16-byte character field containing FREEADDRINFO. The field is left-justified and padded on the right with blanks.

ADDRINFO Input parameter. The address of a set of address information structures returned by the GETADDRINFO RES argument.

Parameter values returned to the application

Keyword **Description**

ERRNO Output parameter. A fullword binary field. If **RETCODE** is negative, **ERRNO** contains a valid error number. Otherwise, ignore the **ERRNO** field.

See Appendix B, "Socket call error return codes," on page 885 for information about **ERRNO** return codes.

RETCODE Output parameter. A fullword binary field that returns one of the following:

Value	Description
0	Successful call.
–1	Check **ERRNO** for an error code.

GETADDRINFO

The GETADDRINFO call translates either the name of a service location (for example, a host name), a service name, or both, and returns a set of socket addresses and associated information to be used in creating a socket with which to address the specified service or sending a datagram to the specified service.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.

ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.

Figure 79 on page 490 shows an example of GETADDRINFO call instructions.

```
WORKING-STORAGE SECTION.
    01  SOC-FUNCTION    PIC X(16)  VALUE IS 'GETADDRINFO'.
    01  NODE            PIC X(255).
    01  NODELEN         PIC 9(8) BINARY.
    01  SERVICE         PIC X(32).
    01  SERVLEN         PIC 9(8) BINARY.
    01  AI-PASSIVE      PIC 9(8) BINARY VALUE 1.
    01  AI-CANONNAMEOK  PIC 9(8) BINARY VALUE 2.
    01  AI-NUMERICHOST  PIC 9(8) BINARY VALUE 4.
    01  AI-NUMERICSERV  PIC 9(8) BINARY VALUE 8.
    01  AI-V4MAPPED     PIC 9(8) BINARY VALUE 16.
    01  AI-ALL          PIC 9(8) BINARY VALUE 32.
    01  AI-ADDRCONFIG   PIC 9(8) BINARY VALUE 64.
    01 AI-EXTFLAGS     PIC 9(8) BINARY VALUE 128.
    01  HINTS           USAGE IS POINTER.
    01  RES             USAGE IS POINTER.
    01  CANNLEN         PIC 9(8) BINARY.
    01  ERRNO           PIC 9(8) BINARY.
    01  RETCODE         PIC S9(8) BINARY.


LINKAGE SECTION.
    01  HINTS-ADDRINFO.
        03  FLAGS           PIC 9(8) BINARY.
        03  AF              PIC 9(8) BINARY.
        03  SOCTYPE         PIC 9(8) BINARY.
        03  PROTO           PIC 9(8) BINARY.
        03  FILLER          PIC 9(8) BINARY.
        03  FILLER          PIC X(4).
        03  FILLER          PIC X(4).
        03  FILLER          PIC 9(8) BINARY.
        03  FILLER          PIC X(4).
        03  FILLER          PIC 9(8) BINARY.
        03  FILLER          PIC X(4).
        03  FILLER          PIC 9(8) BINARY.
        03  EFLAGS          PIC 9(8) BINARY.
    01  RES-ADDRINFO.
        03  FLAGS           PIC 9(8) BINARY.
        03  AF              PIC 9(8) BINARY.
        03  SOCTYPE         PIC 9(8) BINARY.
        03  PROTO           PIC 9(8) BINARY.
        03  NAMELEN         PIC 9(8) BINARY.
        03  FILLER          PIC X(4).
        03  FILLER          PIC X(4).
        03  CANONNAME       USAGE IS POINTER.
        03  FILLER          PIC X(4).
        03  NAME            USAGE IS POINTER.
        03  FILLER          PIC X(4).
        03  NEXT            USAGE IS POINTER.
        03  FILLER          PIC 9(8) BINARY.

PROCEDURE DIVISION.
       MOVE 'www.hostname.com' TO NODE.
       MOVE 16 TO HOSTLEN.
       MOVE 'TELNET' TO SERVICE.
       MOVE 6 TO SERVLEN.
       SET HINTS TO ADDRESS OF HINTS-ADDRINFO.
       CALL 'EZASOKET' USING SOC-FUNCTION NODE NODELEN SERVICE SERVLEN HINTS
             RES CANNLEN ERRNO RETCODE.
```

Figure 79. GETADDRINFO call instruction example

Parameter values set by the application

Keyword **Description**

SOC-FUNCTION
A 16-byte character field containing GETADDRINFO. The field is left-justified and padded on the right with blanks.

NODE An input parameter. Storage up to 255 bytes long that contains the host name being queried. If the AI-NUMERICHOST flag is specified in the storage pointed to by the HINTS field, then NODE should contain the queried host's IP address in presentation form. This is an optional field but if specified you must also code NODELEN. The NODE name being queried will consist of up to NODELEN or up to the first binary 0.

You can append scope information to the host name, using the format *node%scope information*. The combined information must be 255 bytes or less. For more information, see *z/OS Communications Server: IPv6 Network and Application Design Guide*.

NODELEN An input parameter. A fullword binary field set to the length of the host name specified in the NODE field and should not include extraneous blanks. This is an optional field but if specified you must also code NODE.

SERVICE An input parameter. Storage up to 32 bytes long that contains the service name being queried. If the AI-NUMERICSERV flag is specified in the storage pointed to by the HINTS field, then SERVICE should contain the queried port number in presentation form. This is an optional field but if specified you must also code SERVLEN. The SERVICE name being queried will consist of up to SERVLEN or up to the first binary 0.

SERVLEN An input parameter. A fullword binary field set to the length of the service name specified in the SERVICE field and should not include extraneous blanks. This is an optional field but if specified you must also code SERVICE.

HINTS An input parameter. If the HINTS argument is specified, it contains the address of an addrinfo structure containing input values that may direct the operation by providing options and limiting the returned information to a specific socket type, address family, or protocol. If the HINTS argument is not specified, then the information returned will be as if it referred to a structure containing the value 0 for the FLAGS, SOCTYPE and PROTO fields, and AF_UNSPEC for the AF field. Include the EZBREHST resolver macro so that your assembler program will contain the assembler mappings for the ADDR_INFO structure. The EZBREHST assembler macro is stored in the SYS1.MACLIB library. The macro defines the resolver hostent (host entry), address information (addrinfo) mappings, and services return codes. Copy definitions from the EZACOBOL sample module to your COBOL program for mapping the ADDRINFO structure. The EZACOBOL sample module is stored in the *hlq*.SEZAINST library. Copy definitions from the CBLOCK sample module to your PL/I program for mapping the ADDRINFO structure. The CBLOCK sample module is stored in *hlq*.SEZAINST library.

This is an optional field.

The address information structure has the following fields:

Field Description

FLAGS

A fullword binary field. Must have the value of 0 or the bitwise OR of one or more of the following values:

AI-PASSIVE (X'00000001') or the decimal value 1.

- Specifies how to fill in the NAME pointed to by the returned RES.
- If this flag is specified, then the returned address information will be suitable for use in binding a socket for accepting incoming connections for the specified service (for example, the BIND call). In this case, if the **NODE** argument is not specified, then the IP address portion of the socket address structure pointed to by the returned **RES** will be set to INADDR_ANY for an IPv4 address or to the IPv6 unspecified address (in6addr_any) for an IPv6 address.
- If this flag is not set, the returned address information will be suitable for the CONNECT call (for a connection-mode protocol) or for a CONNECT, SENDTO, or SENDMSG call (for a connectionless protocol). In this case, if the **NODE** argument is not specified, then the IP address portion of the socket address structure pointed to by the returned **RES** will be set to the default loopback address for an IPv4 address (127.0.0.0) or the default loopback address for an IPv6 address (::1).
- This flag is ignored if the **NODE** argument is specified.

AI-CANONNAMEOK (X'00000002') or the decimal value 2.

- If this flag is specified and the **NODE** argument is specified, then the GETADDRINFO call attempts to determine the canonical name corresponding to the **NODE** argument.

AI-NUMERICHOST (X'00000004') or the decimal value 4.

- If this flag is specified then the **NODE** argument must be a numeric host address in presentation form. Otherwise, an error of host not found [EAI_NONAME] is returned.

AI-NUMERICSERV (X'00000008') or the decimal value 8.

- If this flag is specified, the **SERVICE** argument must be a numeric port in presentation form. Otherwise, an error [EAI_NONAME] is returned.

AI-V4MAPPED (X'00000010') or the decimal value 16.

- If this flag is specified along with the AF field with the value of AF_INET6 or a value of AF_UNSPEC when IPv6 is supported, the caller will accept IPv4-mapped IPv6 addresses. When the AI-ALL flag is not also specified, if no IPv6 addresses are found, a query is made for IPv4

addresses. If IPv4 addresses are found, they are returned as IPv4-mapped IPv6 addresses.

- If the AF field does not have the value of AF_INET6 or the AF field contains AF_UNSPEC but IPv6 is not supported on the system, this flag is ignored.

AI-ALL (X'00000020') or the decimal value 32.

- When the AF field has a value of AF_INET6 and AI-ALL is set, the AI-V4MAPPED flag must also be set to indicate that the caller will accept all addresses (IPv6 and IPv4-mapped IPv6 addresses). When the AF field has a value of AF_UNSPEC when the system supports IPv6 and AI-ALL is set, the caller accepts IPv6 addreses and either IPv4 address (if AI-V4MAPPED is not set), or IPv4-mapped IPv6 addresses (if AI-V4MAPPED is set). A query is first made for IPv6 addresses and if successful, the IPv6 addresses are returned. Another query is then made for IPv4 addresses, and any IPv4 addresses found are returned as either IPv4-mapped IPv6 addresses (if AI-V4MAPPED is also specified), or as IPv4 addresses (if AI-V4MAPPED is not specified).
- If the AF field does not have the value of AF_INET6 or does not have the value of AF_UNSPEC when the system supports IPv6, this flag is ignored.

AI-ADDRCONFIG (X'00000040') or the decimal value 64.
If this flag is specified, then a query on the name in NODE will occur if the Resolver determines whether either of the following is true:

- If the system is IPv6 enabled and has at least one IPv6 interface, then the Resolver will make a query for IPv6 (AAAA or A6 DNS) records.
- If the system is IPv4 enabled and has at least one IPv4 interface, then the Resolver will make a query for IPv4 (A DNS) records.

The loopback address is not considered in this case as a valid interface.

AI-EXTFLAGS (X'00000080') or the decimal value 128.
Specifies this flag to request the extended form of the getaddrinfo function. The extended form allows additional hints to be passed to the resolver for determining the order of destination addresses that are returned. If this flag is specified, the EFLAGS field is required.

Tip: To perform the binary OR'ing of the flags above in a COBOL program, simply add the necessary COBOL statements as in the example below. Note that the value of the FLAGS field after the COBOL ADD is a decimal 80 or a

X'00000050', which is the sum of OR'ing AI_V4MAPPED and AI_ADDRCONFIG or X'00000010' and X'00000040':

```
01 AI-V4MAPPED   PIC 9(8) BINARY VALUE 16.
01 AI-ADDRCONFIG PIC 9(8) BINARY VALUE 64.

ADD AI-V4MAPPED TO FLAGS.
ADD AI-ADDRCONFG TO FLAGS.
```

AF A fullword binary field. Used to limit the returned information to a specific address family. The value of AF_UNSPEC means that the caller will accept any protocol family. The value of a decimal 0 indicates AF_UNSPEC. The value of a decimal 2 indicates AF_INET, and the value of a decimal 19 indicates AF_INET6.

SOCTYPE

A fullword binary field. Used to limit the returned information to a specific socket type. A value of 0 means that the caller will accept any socket type. If a specific socket type is not given (for example, a value of 0) then information on all supported socket types will be returned.

The following are the acceptable socket types:

Type name	Decimal value	Description
SOCK_STREAM	1	for stream socket
SOCK_DGRAM	2	for datagram socket
SOCK_RAW	3	for raw-protocol interface

Anything else will fail with return code EAI_SOCTYPE. Note that although SOCK_RAW will be accepted, it will only be valid when SERVICE is numeric (for example, SERVICE=23). A lookup for a SERVICE name will never occur in the appropriate services file (for example, *hlq*.ETC.SERVICES) using any protocol value other than SOCK_STREAM or SOCK_DGRAM.

If PROTO is not 0 and SOCTYPE is 0, then the only acceptable input values for PROTO are IPPROTO_TCP and IPPROTO_UDP. Otherwise, the GETADDRINFO call will be failed with return code of EAI_BADFLAGS.

If SOCTYPE and PROTO are both specified as 0, then GETADDRINFO will proceed as follows:

- If SERVICE is null, or if SERVICE is numeric, then any returned addrinfos will default to a specification of SOCTYPE as SOCK_STREAM.
- If SERVICE is specified as a service name (for example, SERVICE=FTP), the GETADDRINFO call will search the appropriate services file (for example, *hlq*.ETC.SERVICES) twice. The first search will use SOCK_STREAM as the protocol, and the second search will use SOCK_DGRAM as the protocol. No default socket type provision exists in this case.

If both SOCTYPE and PROTO are specified as nonzero, then they should be compatible, regardless of the value specified by SERVICE. In this context, *compatible* means one of the following:

- SOCTYPE=SOCK_STREAM and PROTO=IPPROTO_TCP
- SOCTYPE=SOCK_DGRAM and PROTO=IPPROTO_UDP
- SOCTYPE is specified as SOCK_RAW, in which case PROTO can be anything

PROTO

A fullword binary field. Used to limit the returned information to a specific protocol. A value of 0 means that the caller will accept any protocol.

The following are the acceptable protocols:

Protocol name	Decimal value	Description
IPPROTO_TCP	6	TCP
IPPROTO_UDP	17	user datagram

If SOCTYPE is 0 and PROTO is nonzero, the only acceptable input values for PROTO are IPPROTO_TCP and IPPROTO_UDP. Otherwise, the GETADDRINFO call will be failed with return code of EAI_BADFLAGS.

If PROTO and SOCTYPE are both specified as 0, then GETADDRINFO will proceed as follows:

- If SERVICE is null, or if SERVICE is numeric, then any returned addrinfos will default to a specification of SOCTYPE as SOCK_STREAM.
- If SERVICE is specified as a service name (for example, SERVICE=FTP), the GETADDRINFO will search the appropriate services file (for example, *hlq*.ETC.SERVICE) twice. The first search will use SOCK_STREAM as the protocol, and the second search will use SOCK_DGRAM as the protocol. No default socket type provision exists in this case.

If both PROTO and SOCTYPE are specified as nonzero, they should be compatible, regardless of the value specified by SERVICE. In this context, *compatible* means one of the following:

- SOCTYPE=SOCK_STREAM and PROTO=IPPROTO_TCP
- SOCTYPE=SOCK_DGRAM and PROTO=IPPROTO_UDP
- SOCTYPE=SOCK_RAW, in which case PROTO can be anything

If the lookup for the value specified in SERVICE fails [for example, the service name does not appear in an appropriate service file (such as, *hlq*.ETC.SERVICES) using the input protocol], then the GETADDRINFO call will be failed with return code of EAI_SERVICE.

NAMELEN A fullword binary field followed by 8 padding bytes. On input, this field must be 0.

CANONNAME

A fullword binary field followed by 4 padding bytes. On input, this field must be 0.

NAME A fullword binary field followed by 4 padding bytes. On input, this field must be 0.

NEXT A fullword binary field. On input, this field must be 0.

EFLAGS A fullword binary field that specifies the source IPv6 address selection preferences. This field is required if the value AI_EXTFLAGS is specified in the FLAGS field.

This field must contain the value 0 or the bitwise OR of one or more of the following values:

IPV6_PREFER_SRC_HOME (X'00000001') or the decimal value 1
Indicates that home source IPv6 addresses are preferred over care-of source IPv6 addresses.

IPV6_PREFER_SRC_COA (X'00000002') or the decimal value 2
Indicates that care-of source IPv6 addresses are preferred over home source IPv6 addresses.

IPV6_PREFER_SRC_TMP (X'00000004') or the decimal value 4
Indicates that temporary source IPv6 addresses are preferred over public source IPv6 addresses.

IPV6_PREFER_SRC_PUBLIC (X'00000008') or the decimal value 8
Indicates that public source IPv6 addresses are preferred over temporary source IPv6 addresses.

IPV6_PREFER_SRC_CGA (X'00000010') or the decimal value 16
Indicates that cryptographically generated source IPv6 addresses are preferred over non-cryptographically generated source IPv6 addresses.

IPV6_PREFER_SRC_NONCGA (X'00000020') or the decimal value 32
Indicates that non-cryptographically generated source IPv6 addresses are preferred over crytographically generated source IPv6 addresses.

Guidelines:

- If contradictory EFLAGS (for example, IPV6_PREFER_SRC_TMP and IPV6_PREFER_SRC_PUBLIC) or invalid EFLAGS (for example, X'00000040' or the decimal value 64) are specified, then the GETADDRINFO call fails with RETCODE -1 and ERRNO EAI_BADEXTFLAGS (decimal value 11).
- The COBOL constants for EFLAGS use hyphens instead of underscores.

RES

Initially a fullword binary field. On a successful return, this field contains a pointer to a chain of one or more address information structures. The structures are allocated in the key of the calling application. The structures that are returned on a GETADDRINFO call are serially reusable storage for the z/OS UNIX process. They can be used or referenced between process threads, but should not be used or referenced between processes. When you finish using the structures, explicitly release their storage by specifying the returned pointer on a FREEADDRINFO call. Include the

EZBREHST resolver macro so that your assembler program contains the assembler mappings for the ADDR_INFO structure. The EZBREHST assembler macro is stored in the SYS1.MACLIB library. Copy definitions from the EZACOBOL sample module to your COBOL program for mapping the ADDRINFO structure. The EZACOBOL sample module is stored in the *hlq*.SEZAINST library. Copy definitions from the CBLOCK sample module to your PL/I program for mapping the ADDRINFO structure. The CBLOCK sample module is stored in the *hlq*.SEZAINST library.

The address information structure contains the following fields:

Field Description

FLAGS
A fullword binary field that is not used as output.

AF A fullword binary field. The value returned in this field may be used as the AF argument on the SOCKET call to create a socket suitable for use with the returned address NAME.

SOCTYPE
A fullword binary field. The value returned in this field may be used as the SOCTYPE argument on the SOCKET call to create a socket suitable for use with the returned address NAME.

PROTO
A fullword binary field. The value returned in this field may be used as the PROTO argument on the SOCKET call to create a socket suitable for use with the returned address ADDR.

NAMELEN
A fullword binary field followed by 8 padding bytes. The length of the NAME socket address structure.

CANONNAME
A fullword binary field followed by 4 padding bytes. The canonical name for the value specified by NODE. If the NODE argument is specified, and if the AI-CANONNAMEOK flag was specified by the HINTS argument, then the CANONNAME field in the first returned address information structure will contain the address of storage containing the canonical name corresponding to the input NODE argument. If the canonical name is not available, then the CANONNAME field will refer to the NODE argument or a string with the same contents. The CANNLEN field contains the length of the returned canonical name.

NAME
A fullword binary field followed by 4 padding bytes. The address of the returned socket address structure. The value returned in this field can be used as the arguments for the CONNECT, BIND, or BIND2ADDRSEL call with such a socket, according to the AI-PASSIVE flag.

NEXT A fullword binary field. Contains the address of the next address information structure on the list, or 0's if it is the last structure on the list.

EFLAGS
A fullword binary field that is not used as output.

CANNLEN Initially an input parameter. A fullword binary field used to contain the length of the canonical name returned by the RES CANONNAME field. This is an optional field.

ERRNO Output parameter. A fullword binary field. If RETCODE is negative, ERRNO contains a valid error number. Otherwise, ignore the ERRNO field.

See Appendix B, "Socket call error return codes," on page 885 for information about ERRNO return codes.

RETCODE Output parameter. A fullword binary field that returns one of the following:

Value	Description
0	Successful call.
–1	Check ERRNO for an error code.

The ADDRINFO structure uses indirect addressing to return a variable number of NAMES. If you are coding in PL/I or assembler language, this structure can be processed in a relatively straight-forward manner. If you are coding in COBOL, this structure may be difficult to interpret. You can use the subroutine EZACIC09 to simplify interpretation of the information returned by the GETADDRINFO calls.

GETCLIENTID

GETCLIENTID call returns the identifier by which the calling application is known to the TCP/IP address space in the calling program. The CLIENT parameter is used in the GIVESOCKET and TAKESOCKET calls. See "GIVESOCKET" on page 533 for a discussion of the use of GIVESOCKET and TAKESOCKET calls.

Do not be confused by the terminology; when GETCLIENTID is called by a server, the identifier of the *caller* (not necessarily the *client*) is returned.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.

Figure 80 shows an example of GETCLIENTID call instructions.

```
WORKING-STORAGE SECTION.
    01  SOC-FUNCTION    PIC X(16)  VALUE IS 'GETCLIENTID'.
    01  CLIENT.
        03  DOMAIN      PIC 9(8) BINARY.
        03  NAME        PIC X(8).
        03  TASK        PIC X(8).
        03  RESERVED    PIC X(20).
    01  ERRNO           PIC 9(8) BINARY.
    01  RETCODE         PIC S9(8) BINARY.

PROCEDURE DIVISION.
     CALL 'EZASOKET' USING SOC-FUNCTION CLIENT ERRNO RETCODE.
```

Figure 80. GETCLIENTID call instruction example

For equivalent PL/I and assembler language declarations, see "Converting parameter descriptions" on page 472.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing GETCLIENTID. The field is left-justified and padded to the right with blanks.

Parameter values returned to the application

CLIENT
A client-ID structure that describes the application that issued the call.

DOMAIN
This is a fullword binary number specifying the domain of the client. On input this is an optional parameter for AF_INET, and required parameter for AF_INET6 to specify the domain of the client. For TCP/IP the value is a decimal 2, indicating AF_INET, or a decimal 19, indicating AF_INET6. On output, this is the returned domain of the client.

NAME
An 8-byte character field set to the caller's address space name.

TASK An 8-byte field set to the task identifier of the caller.

RESERVED
Specifies 20-byte character reserved field. This field is required, but not used.

ERRNO
A fullword binary field. If RETCODE is negative, the field contains an error number. See Appendix B, "Socket call error return codes," on page 885 for information about ERRNO return codes.

RETCODE
A fullword binary field that returns one of the following:

Value	Description
0	Successful call.
–1	Check **ERRNO** for an error code.

GETHOSTBYADDR

The GETHOSTBYADDR call returns the domain name and alias name of a host whose IPv4 IP address is specified in the call. A given TCP/IP host can have

multiple alias names and multiple host IPv4 IP addresses. The address resolution attempted depends on how the resolver is configured and if any local host tables exist. See *z/OS Communications Server: IP Configuration Guide* for information about configuring the resolver and how local host tables can be used.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state. The PSW key must match the key in which the MVS application task was attached
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.

Figure 81 shows an example of GETHOSTBYADDR call instructions.

```
WORKING-STORAGE SECTION.
    01  SOC-FUNCTION    PIC X(16)  VALUE IS 'GETHOSTBYADDR'.
    01  HOSTADDR        PIC 9(8) BINARY.
    01  HOSTENT         PIC 9(8) BINARY.
    01  RETCODE         PIC S9(8) BINARY.

PROCEDURE DIVISION.
     CALL 'EZASOKET' USING SOC-FUNCTION HOSTADDR HOSTENT RETCODE.
```

Figure 81. GETHOSTBYADDR call instruction example

For equivalent PL/I and assembler language declarations, see "Converting parameter descriptions" on page 472.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing GETHOSTBYADDR. The field is left-justified and padded on the right with blanks.

HOSTADDR
A fullword binary field set to the IP address (specified in network byte order) of the host whose name is being sought. See Appendix B, "Socket call error return codes," on page 885 for information about ERRNO return codes.

Parameter values returned to the application

HOSTENT
A fullword containing the address of the HOSTENT structure.

RETCODE
A fullword binary field that returns one of the following:

Value	Description
0	Successful call.
–1	Check **ERRNO** for an error code.

GETHOSTBYADDR returns the HOSTENT structure shown in Figure 82.

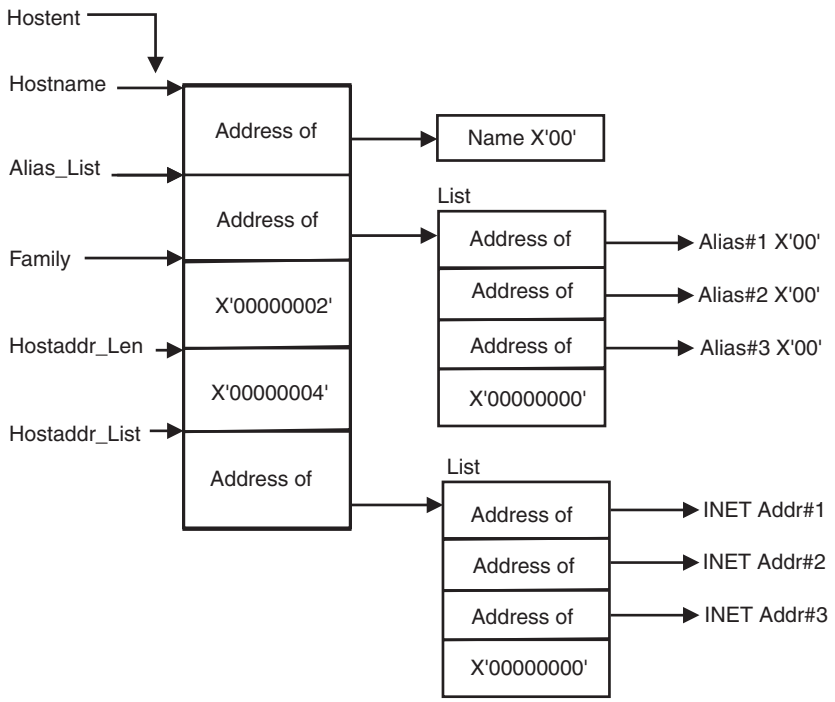


Figure 82. HOSTENT structure that is returned by the GETHOSTBYADDR call

GETHOSTBYADDR returns the HOSTENT structure shown in figure Figure 82. The HOSTENT structure is a tasks's serially reusable storage area. It should not be used or referenced between MVS tasks. The storage is freed when the task terminates. The assembler mapping of the structure is defined in macro EZBREHST, which is installed in the data set specified on your SMP/E DDDEF for MACLIB. The EZBREHST assembler macro is stored in the SYS1.MACLIB library. The macro defines the resolver hostent (host entry), address information (addrinfo) mappings, and services return codes. This structure contains:

- The address of the host name that is returned by the call. The name length is variable and is ended by X'00'.
- The address of a list of addresses that point to the alias names returned by the call. This list is ended by the pointer X'00000000'. Each alias name is a variable length field ended by X'00'.
- The value returned in the FAMILY field is always 2 for AF_INET.
- The length of the host IP address returned in the HOSTADDR_LEN field is always 4 for AF_INET.
- The address of a list of addresses that point to the host IP addresses returned by the call. The list is ended by the pointer X'00000000'. If the call cannot be resolved, the HOSTENT structure contains the ERRNO 10214.

The HOSTENT structure uses indirect addressing to return a variable number of alias names and IP addresses. If you are coding in PL/I or assembler language, this structure can be processed in a relatively straight-forward manner. If you are coding in COBOL, this structure may be difficult to interpret. You can use the subroutine EZACIC08 to simplify interpretation of the information returned by the GETHOSTBYADDR and GETHOSTBYNAME calls. For more information about EZACIC08, see "EZACIC08" on page 621.

GETHOSTBYNAME

The GETHOSTBYNAME call returns the alias name and the IPv4 IP address of a host whose domain name is specified in the call. A given TCP/IP host can have multiple alias names and multiple host IPv4 IP addresses.

The name resolution attempted depends on how the resolver is configured and if any local host tables exist. See *z/OS Communications Server: IP Configuration Guide* for information about configuring the resolver and how local host tables can be used.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state. The PSW key must match the key in which the MVS application task was attached.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.

Figure 83 shows an example of GETHOSTBYNAME call instructions.

```
WORKING-STORAGE SECTION.
    01  SOC-FUNCTION    PIC X(16)  VALUE IS 'GETHOSTBYNAME'.
    01  NAMELEN         PIC 9(8)  BINARY.
    01  NAME            PIC X(255).
    01  HOSTENT         PIC 9(8)  BINARY.
    01  RETCODE         PIC S9(8) BINARY.

PROCEDURE DIVISION.
     CALL 'EZASOKET' USING SOC-FUNCTION NAMELEN NAME
                     HOSTENT RETCODE.
```

Figure 83. GETHOSTBYNAME call instruction example

For equivalent PL/I and assembler language declarations, see "Converting parameter descriptions" on page 472.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing GETHOSTBYNAME. The field is left-justified and padded on the right with blanks.

NAMELEN
A value set to the length of the host name. The maximum length is 255.

NAME
A character string, up to 255 characters, set to a host name. Any trailing blanks will be removed from the specified name prior to trying to resolve it to an IP address. This call returns the address of the HOSTENT structure for this name.

Parameter values returned to the application

HOSTENT
A fullword binary field that contains the address of the HOSTENT structure.

RETCODE
A fullword binary field that returns one of the following:

Value	Description
0	Successful call.
–1	An error occurred.

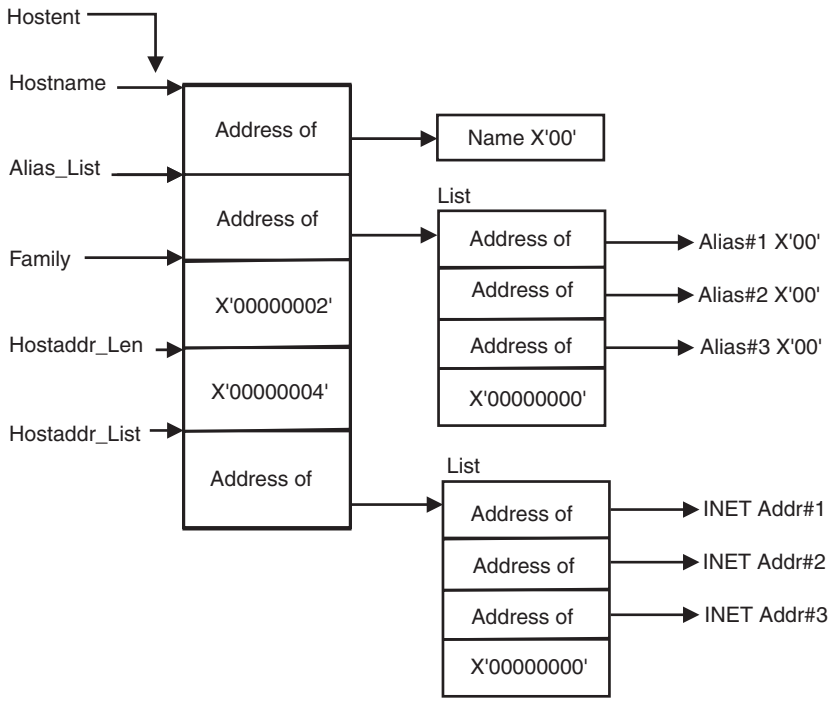


Figure 84. HOSTENT structure returned by the GETHOSTYBYNAME call

GETHOSTBYNAME returns the HOSTENT structure shown in Figure 84. The HOSTENT structure is a tasks's serially reusable storage area. It should not be used or referenced between MVS tasks. The storage is freed when the task terminates. The assembler mapping of the structure is defined in macro

EZBREHST, which is installed in the data set specified on your SMP/E DDDEF for MACLIB. The EZBREHST assembler macro is stored in the SYS1.MACLIB library. The macro defines the resolver hostent (host entry), address information (addrinfo) mappings, and services return codes. This structure contains:

- The address of the host name that is returned by the call. The name length is variable and is ended by X'00'.
- The address of a list of addresses that point to the alias names returned by the call. This list is ended by the pointer X'00000000'. Each alias name is a variable length field ended by X'00'.
- The value returned in the FAMILY field is always 2 for AF_INET.
- The length of the host IP address returned in the HOSTADDR_LEN field is always 4 for AF_INET.
- The address of a list of addresses that point to the host IP addresses returned by the call. The list is ended by the pointer X'00000000'. If the call cannot be resolved, the HOSTENT structure contains the ERRNO 10214.

The HOSTENT structure uses indirect addressing to return a variable number of alias names and IP addresses. If you are coding in PL/I or assembler language, this structure can be processed in a relatively straight-forward manner. If you are coding in COBOL, this structure may be difficult to interpret. You can use the subroutine EZACIC08 to simplify interpretation of the information returned by the GETHOSTBYADDR and GETHOSTBYNAME calls. For more information about EZACIC08, see "EZACIC08" on page 621.

GETHOSTID

The GETHOSTID call returns the 32-bit IP address for the current host.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.

Figure 85 on page 505 shows an example of GETHOSTID call instructions.

```
WORKING-STORAGE SECTION.
    01  SOC-FUNCTION    PIC X(16)  VALUE IS 'GETHOSTID'.
    01  RETCODE         PIC S9(8) BINARY.

PROCEDURE DIVISION.
     CALL 'EZASOKET' USING SOC-FUNCTION RETCODE.
```

Figure 85. GETHOSTID call instruction example

For equivalent PL/I and assembler language declarations, see "Converting parameter descriptions" on page 472.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing GETHOSTID. The field is left-justified and padded on the right with blanks.

RETCODE
Returns a fullword binary field containing the 32-bit IP address of the host. There is no ERRNO parameter for this call.

GETHOSTNAME

The GETHOSTNAME call returns the domain name of the local host.

Note: The host name returned is the host name the TCPIP stack learned at startup from the TCPIP.DATA file that was found.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.

Figure 86 on page 506 shows an example of GETHOSTNAME call instructions.

```
WORKING-STORAGE SECTION.
    01  SOC-FUNCTION    PIC X(16)  VALUE IS 'GETHOSTNAME'.
    01  NAMELEN         PIC 9(8) BINARY.
    01  NAME            PIC X(24).
    01  ERRNO           PIC 9(8) BINARY.
    01  RETCODE         PIC S9(8) BINARY.

PROCEDURE DIVISION.
     CALL 'EZASOKET' USING SOC-FUNCTION NAMELEN NAME
                     ERRNO RETCODE.
```

Figure 86. GETHOSTNAME call instruction example

For equivalent PL/I and assembler language declarations, see "Converting parameter descriptions" on page 472.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing GETHOSTNAME. The field is left-justified and padded on the right with blanks.

NAMELEN
A fullword binary field set to the length of the NAME field. The minimum length of the NAME field is 1 character. The maximum length of the NAME field is 255 characters.

Parameter values returned to the application

NAME
Indicates the receiving field for the host name. If the host name is shorter than the NAMELEN value, the NAME field is filled with binary zeros after the host name. If the host name is longer than the NAMELEN value, the name is truncated.

ERRNO
A fullword binary field. If RETCODE is negative, the field contains an error number. See Appendix B, "Socket call error return codes," on page 885 for information about ERRNO return codes.

RETCODE
A fullword binary field that returns one of the following:

Value	Description
0	Successful call.
–1	Check **ERRNO** for an error code.

GETIBMOPT

The GETIBMOPT call returns the number of TCP/IP images installed on a given MVS system and their status, versions, and names. With this information, the caller can dynamically choose the TCP/IP image with which to connect by using the INITAPI call. The GETIBMOPT call is optional. If you do not use the GETIBMOPT call, follow the standard method to determine the connecting TCP/IP image:

- Connect to the TCP/IP specified by TCPIPJOBNAME in the active TCPIP.DATA file.
- Locate TCPIP.DATA using the search order described in the *z/OS Communications Server: IP Configuration Reference*.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.

Figure 87 shows an example of GETIBMOPT call instructions.

```
 WORKING-STORAGE SECTION.
     01  SOC-FUNCTION    PIC X(16)  VALUE IS 'GETIBMOPT'.
     01  COMMAND         PIC 9(8)   BINARY VALUE IS 1.
     01  BUF.
         03  NUM-IMAGES  PIC 9(8) COMP.
         03  TCP-IMAGE   OCCURS 8 TIMES.
             05  TCP-IMAGE-STATUS  PIC 9(4) BINARY.
             05  TCP-IMAGE-VERSION PIC 9(4) BINARY.
             05  TCP-IMAGE-NAME    PIC X(8)
     01  ERRNO           PIC 9(8)   BINARY.
     01  RETCODE         PIC S9(8)  BINARY.

PROCEDURE DIVISION.

    CALL 'EZASOKET' USING SOC-FUNCTION COMMAND BUF ERRNO RETCODE.
```

Figure 87. GETIBMOPT call instruction example

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing GETIBMOPT. The field is left-justified and padded on the right with blanks.

COMMAND A value or the address of a fullword binary number specifying the command to be processed. The only valid value is 1.

Parameter values returned to the application

BUF A 100-byte buffer into which each active TCP/IP image status, version, and name are placed.

On successful return, these buffer entries contain the status, names, and versions of up to eight active TCP/IP images. The following layout shows the BUF field upon completion of the call.

The NUM_IMAGES field indicates how many entries of TCP_IMAGE are included in the total BUF field. If the NUM_IMAGES returned is 0, there are no TCP/IP images present.

The status field can have a combination of the following information:

Status field	Meaning
X'8xxx'	Active
X'4xxx'	Terminating
X'2xxx'	Down
X'1xxx'	Stopped or stopping

Note: In the above status fields, *xxx* is reserved for IBM use and can contain any value.

When the status field is returned with a combination of Down and Stopped, TCP/IP abended. Stopped, when returned alone, indicates that TCP/IP was stopped.

The version field is:

Version	Field
TCP/IP z/OS Communications Server V1R4	X'0614'
TCP/IP z/OS Communications Server V1R5	X'0615'
TCP/IP z/OS Communications Server V1R6	X'0616'
TCP/IP z/OS Communications Server V1R7	X'0617'
TCP/IP z/OS Communications Server V1R8	X'0618'
TCP/IP z/OS Communications Server V1R9	X'0619'
TCP/IP z/OS Communications Server V1R10	X'061A'
TCP/IP z/OS Communications Server V1R11	X'061B'

The name field is the PROC name, left-justified, and padded with blanks.

NUM_IMAGES (4 bytes)		
Status (2 bytes)	Version (2 bytes)	Name (8 bytes)
Status (2 bytes)	**Version (2 bytes)**	**Name (8 bytes)**
Status (2 bytes)	**Version (2 bytes)**	**Name (8 bytes)**
Status (2 bytes)	**Version (2 bytes)**	**Name (8 bytes)**
Status (2 bytes)	**Version (2 bytes)**	**Name (8 bytes)**
Status (2 bytes)	**Version (2 bytes)**	**Name (8 bytes)**
Status (2 bytes)	**Version (2 bytes)**	**Name (8 bytes)**
Status (2 bytes)	**Version (2 bytes)**	**Name (8 bytes)**

Figure 88. Example of name field

ERRNO
A fullword binary field. If RETCODE is negative, this contains an error number. See Appendix B, "Socket call error return codes," on page 885 for information about ERRNO return codes.

RETCODE
A fullword binary field with the following values:

Value	Description
–1	Call returned error. See ERRNO field.
0	Successful call.

GETNAMEINFO

The GETNAMEINFO call returns the node name and service location of a socket address that is specified in the call. On successful completion, GETNAMEINFO returns the node and service named, if requested, in the buffers provided.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.

Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.

```
WORKING-STORAGE SECTION.
    01  SOC-FUNCTION      PIC X(16)  VALUE IS 'GETNAMEINFO'.
    01  NAMELEN           PIC 9(8) BINARY.
    01  HOST              PIC X(255).
    01  HOSTLEN           PIC 9(8) BINARY.
    01  SERVICE           PIC X(32).
    01  SERVLEN           PIC 9(8) BINARY.
    01  FLAGS             PIC 9(8) BINARY VALUE 0.
    01  NI-NOFQDN         PIC 9(8) BINARY VALUE 1.
    01  NI-NUMERICHOST    PIC 9(8) BINARY VALUE 2.
    01  NI-NAMEREQD       PIC 9(8) BINARY VALUE 4.
    01  NI-NUMERICSERVER  PIC 9(8) BINARY VALUE 8.
    01  NI-DGRAM          PIC 9(8) BINARY VALUE 16.
    01  NI-NUMERICSCOPE   PIC 9(8) BINARY VALUE 32.



* IPv4 socket structure.
    01  NAME.
        03  FAMILY      PIC 9(4) BINARY.
        03  PORT        PIC 9(4) BINARY.
        03  IP-ADDRESS  PIC 9(8) BINARY.
        03  RESERVED    PIC X(8).

* IPv6 socket structure.
    01  NAME.
        03  FAMILY      PIC 9(4) BINARY.
        03  PORT        PIC 9(4) BINARY.
        03  FLOWINFO    PIC 9(8) BINARY.
        03  IP-ADDRESS.
            10 FILLER   PIC 9(16) BINARY.
            10 FILLER   PIC 9(16) BINARY.
        03  SCOPE-ID    PIC 9(8) BINARY.

    01  ERRNO           PIC 9(8) BINARY.
    01  RETCODE         PIC S9(8) BINARY.

PROCEDURE DIVISION.

     MOVE 28 TO NAMELEN.
     MOVE 255 TO HOSTLEN.
     MOVE 32 TO SERVLEN.
     MOVE NI-NAMEREQD TO FLAGS.
     CALL 'EZASOKET' USING SOC-FUNCTION NAME NAMELEN HOST
           HOSTLEN SERVICE SERVLEN FLAGS ERRNO RETCODE.
```

Figure 89. GETNAMEINFO call instruction example

Parameter values set by the application

Keyword **Description**

SOC-FUNCTION

A 16-byte character field containing GETNAMEINFO. The field is left-justified and padded on the right with blanks.

NAME

An input parameter. A socket address structure to be translated which has the following fields:

The IPv4 socket address structure must specify the following fields:

Field Description

FAMILY
A halfword binary number specifying the IPv4 addressing family. For TCP/IP the value is a decimal 2, indicating **AF_INET**.

PORT A halfword binary number specifying the port number.

IP-ADDRESS
A fullword binary number specifying the 32-bit IPv4 IP address.

RESERVED
An 8-byte reserved field. This field is required, but is not used.

The IPv6 socket address structure specifies the following fields:

Field Description

FAMILY
A halfword binary field specifying the IPv6 addressing family. For TCP/IP the value is a decimal 19, indicating AF_INET6.

PORT A halfword binary number specifying the port number.

FLOWINFO
A fullword binary field specifying the traffic class and flow label. This value of this field is undefined.

IP-ADDRESS
A 16-byte binary field specifying the 128-bit IPv6 IP address, in network byte order.

SCOPE-ID
A fullword binary field that identifies a set of interfaces as appropriate for the scope of the address carried in the IPv6-ADDRESS field. For a link-local scope IPv6-ADDRESS, SCOPE-ID contains the interface index for the IPv6-ADDRESS. For all other address scopes, SCOPE-ID is undefined and is ignored by the resolver.

NAMELEN An input parameter. A fullword binary field. The length of the socket address structure pointed to by the NAME argument.

HOST On input, storage capable of holding the returned resolved host name, which may be up to 255 bytes long, for the input socket address. If inadequate storage is specified to contain the resolved host name, then the resolver will return the host name up to the storage specified and truncation may occur. If the host's name cannot be located, the numeric form of the host's address is returned instead of its name. However, if the NI_NAMEREQD option is specified and no host name is located then an error is returned. This is an optional field, but if you specify it, you also must code HOSTLEN. One or both of the following groups of parameters are required:

- The HOST and HOSTLEN parameters
- The SERVICE and SERVLEN parameters

Otherwise, an error occurs.

If the IPv6-ADDRESS value is a link-local address, and the SCOPE-ID interface index is nonzero, scope information is appended to the resolved host name using the format *host%scope information*. The scope information can be either the numeric form of the SCOPE-ID interface index or the interface name associated with the SCOPE-ID interface index. Use the NI_NUMERICSCOPE option to select which form should be returned. The combined host name and scope information will still be at most 255 bytes long. For more information about scope information and GETNAMEINFO processing, see *z/OS Communications Server: IPv6 Network and Application Design Guide*.

HOSTLEN An output parameter. A fullword binary field that contains the length of the host storage used to contain the returned resolved host name. The HOSTLEN value must be equal to or greater than the length of the longest host name, or host name and scope information combination, to be returned. The GETNAMEINFO call returns the host name, or host name and scope information combination, up to the length specified by the HOSTLEN value. On output, the HOSTLEN value contains the length of the returned resolved host name or host name and scope information combination. If HOSTLEN is 0 on input, then the resolved host name is not returned. This is an optional field but if specified you must also code the HOST value. One or both of the following groups of parameters are required:

- The HOST and HOSTLEN parameters
- The SERVICE and SERVLEN parameters

Otherwise, an error occurs.

SERVICE On input, storage capable of holding the returned resolved service name, which may be up to 32 bytes long, for the input socket address. If inadequate storage is specified to contain the resolved service name, then the resolver will return the service name up to the storage specified and truncation may occur. If the service name cannot be located, or if NI_NUMERICSERV was specified in the FLAGS operand, then the numeric form of the service address is returned instead of its name. This is an optional field, but if you specify it, you also must code the SERVLEN value. One or both of the following groups of parameters are required:

- The HOST and HOSTLEN parameters
- The SERVICE and SERVLEN parameters

Otherwise, an error occurs.

SERVLEN An output parameter. A fullword binary field. The length of the SERVICE storage used to contain the returned resolved service name. SERVLEN must be equal to or greater than the length of the longest service name to be returned. GETNAMEINFO will return the service name up to the length specified by SERVLEN. On output, SERVLEN will contain the length of the returned resolved service name. If SERVLEN is 0 on input, then the service name information will not be returned. This is an optional field, but if you specify it, you also must code the SERVICE value. One or both of the following groups of parameters are required:

- The HOST and HOSTLEN parameters

- The SERVICE and SERVLEN parameters

Otherwise, an error occurs.

FLAGS An input parameter. A fullword binary field. This is an optional field. The FLAGS field must contain either a binary value or decimal value, depending on the programming language used:

Flag name	Binary value	Decimal value	Description
'NI_NOFQDN'	X'00000001'	1	Return the NAME portion of the fully qualified domain name.
'NI_NUMERICHOST'	X'00000002'	2	Only return the numeric form of host's address.
'NI_NAMEREQD'	X'00000004'	4	Return an error if the host's name cannot be located.
'NI_NUMERICSERV'	X'00000008'	8	Only return the numeric form of the service address.
'NI_DGRAM'	X'00000010'	16	Indicates that the service is a datagram service. The default behavior is to assume that the service is a stream service.
'NI_NUMERICSCOPE'	X'00000020'	32	Only return the numeric form of the scope information, when applicable

ERRNO Output parameter. A fullword binary field. If RETCODE is negative, ERRNO contains a valid error number. Otherwise, ignore the ERRNO field.

See Appendix B, "Socket call error return codes," on page 885 for information about ERRNO return codes.

RETCODE Output parameter. A fullword binary field that returns one of the following:

Value	Description
0	Successful call.
–1	Check **ERRNO** for an error code.

GETPEERNAME

The GETPEERNAME call returns the name of the remote socket to which the local socket is connected.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.

Control parameters:	All parameters must be addressable by the caller and in the primary address space.

Figure 90 shows an example of GETPEERNAME call instructions.

```
WORKING-STORAGE SECTION.
    01  SOC-FUNCTION    PIC X(16)  VALUE IS 'GETPEERNAME'.
    01  S               PIC 9(4) BINARY.

* IPv4 socket structure.
    01  NAME.
        03  FAMILY      PIC 9(4) BINARY.
        03  PORT        PIC 9(4) BINARY.
        03  IP-ADDRESS  PIC 9(8) BINARY.
        03  RESERVED    PIC X(8).

* IPv6 socket structure.
    01  NAME.
        03  FAMILY      PIC 9(4) BINARY.
        03  PORT        PIC 9(4) BINARY.
        03  FLOWINFO    PIC 9(8) BINARY.
        03  IP-ADDRESS.
            10 FILLER   PIC 9(16) BINARY.
            10 FILLER   PIC 9(16) BINARY.
        03  SCOPE-ID    PIC 9(8) BINARY.

    01  ERRNO           PIC 9(8) BINARY.
    01  RETCODE         PIC S9(8) BINARY.

PROCEDURE DIVISION.
     CALL 'EZASOKET' USING SOC-FUNCTION S NAME ERRNO RETCODE.
```

Figure 90. GETPEERNAME call instruction example

For equivalent PL/I and assembler language declarations, see "Converting parameter descriptions" on page 472.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing GETPEERNAME. The field is left-justified and padded on the right with blanks.

S A halfword binary number set to the socket descriptor of the local socket connected to the remote peer whose address is required.

Parameter Values Returned to the Application

NAME
An IPv4 socket address structure to contain the peer name. The structure that is returned is the socket address structure for the remote socket connected to the local socket specified in field **S**.

FAMILY
A halfword binary field containing the connection peer's IPv4 addressing family. The call always returns the value decimal 2, indicating AF_INET.

PORT A halfword binary field set to the connection peer's port number.

IP-ADDRESS
A fullword binary field set to the 32-bit IPv4 IP address of the connection peer's host machine.

RESERVED
Specifies an 8-byte reserved field. This field is required, but not used.

An IPv6 socket address structure to contain the peer name. The structure that is returned is the socket address structure for the remote socket that is connected to the local socket specified in field S.

FAMILY
A halfword binary field containing the connection peer's IPv6 addressing family. The call always returns the value decimal 19, indicating AF_INET6.

PORT A halfword binary field set to the connection peer's port number.

FLOWINFO
A fullword binary field specifying the traffic class and flow label. This value of this field is undefined.

IP-ADDRESS
A 16-byte binary field set to the 128-bit IPv6 IP address of the connection peer's host machine.

SCOPE-ID
A fullword binary field which identifies a set of interfaces as appropriate for the scope of the address carried in the IPv6-ADDRESS field. For a link scope IPv6-ADDRESS, SCOPE-ID contains the link index for the IPv6-ADDRESS. For all other address scopes, SCOPE-ID is undefined.

ERRNO
A fullword binary field. If RETCODE is negative, the field contains an error number. See Appendix B, "Socket call error return codes," on page 885 for information about ERRNO return codes.

RETCODE
A fullword binary field that returns one of the following:

Value	Description
0	Successful call.
–1	Check **ERRNO** for an error code.

GETSOCKNAME

The GETSOCKNAME call returns the address currently bound to a specified socket. If the socket is not currently bound to an address, the call returns with the FAMILY field set, and the rest of the structure set to 0.

Since a stream socket is not assigned a name until after a successful call to either BIND, CONNECT, or ACCEPT, the GETSOCKNAME call can be used after an implicit bind to discover which port was assigned to the socket.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.

Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.

Figure 91 shows an example of GETSOCKNAME call instructions.

```
WORKING-STORAGE SECTION.
    01  SOC-FUNCTION    PIC X(16)  VALUE IS 'GETSOCKNAME'.
    01  S               PIC 9(4) BINARY.

* IPv4 socket address structure.
    01  NAME.
        03  FAMILY      PIC 9(4) BINARY.
        03  PORT        PIC 9(4) BINARY.
        03  IP-ADDRESS  PIC 9(8) BINARY.
        03  RESERVED    PIC X(8).

* IPv6 socket address structure.
    01  NAME.
        03  FAMILY      PIC 9(4) BINARY.
        03  PORT        PIC 9(4) BINARY.
        03  FLOWINFO    PIC 9(8) BINARY.
        03  IP-ADDRESS.
            10 FILLER   PIC 9(16) BINARY.
            10 FILLER   PIC 9(16) BINARY.
        03  SCOPE-ID    PIC 9(8) BINARY.
    01  ERRNO           PIC 9(8) BINARY.
    01  RETCODE         PIC S9(8) BINARY.

PROCEDURE DIVISION.
     CALL 'EZASOKET' USING SOC-FUNCTION S NAME ERRNO RETCODE.
```

Figure 91. GETSOCKNAME call instruction example

For equivalent PL/I and assembler language declarations, see "Converting parameter descriptions" on page 472.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing GETSOCKNAME. The field is left-justified and padded on the right with blanks.

S A halfword binary number set to the descriptor of a local socket whose address is required.

Parameter values returned to the application

NAME
Specifies the IPv4 socket address structure returned by the call.

FAMILY
A halfword binary field containing the IPv4 addressing family. The call always returns the value decimal 2, indicating AF_INET.

PORT A halfword binary field set to the port number bound to this socket. If the socket is not bound, 0 is returned.

IP-ADDRESS
A fullword binary field set to the 32-bit IP address of the local host machine.

RESERVED
Specifies 8 bytes of binary zeros. This field is required but not used.

NAME
Specifies the IPv6 socket address structure returned by the call.

FAMILY
A halfword binary field containing the IPv6 addressing family. The call always returns the value decimal 19, indicating AF_INET6.

PORT A halfword binary field set to the port number bound to this socket. If the socket is not bound, 0 is returned.

FLOWINFO
A fullword binary field specifying the traffic class and flow label. This value of this field is undefined.

IP-ADDRESS
A 16 byte binary field set to the 128-bit IPv6 IP address in network byte order, of the local host machine.

SCOPE-ID
A fullword binary field which identifies a set of interfaces as appropriate for the scope of the address carried in the IPv6-ADDRESS field. For a link scope IPv6-ADDRESS, SCOPE-ID contains the link index for the IPv6-ADDRESS. For all other address scopes, SCOPE-ID is undefined.

ERRNO
A fullword binary field. If RETCODE is negative, the field contains an error number. See Appendix B, "Socket call error return codes," on page 885 for information about ERRNO return codes.

RETCODE
A fullword binary field that returns one of the following:

Value	Description
0	Successful call.
–1	Check **ERRNO** for an error code.

GETSOCKOPT

The GETSOCKOPT call queries the options that are set by the SETSOCKOPT call.

Several options are associated with each socket. These options are described below. You must specify the option to be queried when you issue the GETSOCKOPT call.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.

Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.

Figure 92 shows an example of GETSOCKOPT call instructions.

```
WORKING-STORAGE SECTION.
    01  SOC-FUNCTION    PIC X(16)  VALUE IS 'GETSOCKOPT'.
    01  S               PIC 9(4) BINARY.
    01  OPTNAME         PIC 9(8) BINARY.

    01  OPTVAL          PIC 9(8) BINARY.
    If OPNAME = SO-LINGER then
    01  OPTVAL          PIC X(16).

    01  OPTLEN          PIC 9(8) BINARY.
    01  ERRNO           PIC 9(8) BINARY.
    01  RETCODE         PIC S9(8) BINARY.

PROCEDURE DIVISION.
     CALL 'EZASOKET' USING SOC-FUNCTION S OPTNAME
                     OPTVAL OPTLEN ERRNO RETCODE.
```

Figure 92. GETSOCKOPT call instruction example

For equivalent PL/I and assembler language declarations, see "Converting parameter descriptions" on page 472.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing GETSOCKOPT. The field is left-justified and padded on the right with blanks.

S A halfword binary number specifying the socket descriptor for the socket requiring options.

OPTNAME
Set **OPTNAME** to the required option before you issue GETSOCKOPT. See the following table for a list of the options and their unique requirements.

See Appendix D, "GETSOCKOPT/SETSOCKOPT command values," on page 917 for the numeric values of **OPTNAME**.

Note: COBOL programs cannot contain field names with the underbar character. Fields representing the option name should contain dashes instead.

OPTLEN
Input parameter. A fullword binary field containing the length of the data returned in **OPTVAL**. See the following table for determining on what to base the value of **OPTLEN**.

Parameter values returned to the application

OPTVAL

For the GETSOCKOPT API, **OPTVAL** will be an output parameter. See the following table for a list of the options and their unique requirements.

ERRNO

A fullword binary field. If RETCODE is negative, the field contains an error number. See Appendix B, "Socket call error return codes," on page 885 for information about ERRNO return codes.

RETCODE

A fullword binary field that returns one of the following:

Value	Description
0	Successful call.
–1	Check ERRNO for an error code.

Table 18. OPTNAME options for GETSOCKOPT and SETSOCKOPT

OPTNAME options (input)	SETSOCKOPT, OPTVAL (input)	GETSOCKOPT, OPTVAL (output)
IP_ADD_MEMBERSHIP Use this option to enable an application to join a multicast group on a specific interface. An interface has to be specified with this option. Only applications that want to receive multicast datagrams need to join multicast groups. This is an IPv4-only socket option.	Contains the IP_MREQ structure as defined in SYS1.MACLIB(BPXYSOCK). The IP_MREQ structure contains a 4-byte IPv4 multicast address followed by a 4-byte IPv4 interface address. See SEZAINST(CBLOCK) for the PL/I example of IP_MREQ. See SEZAINST(EZACOBOL) for the COBOL example of IP-MREQ.	N/A
IP_ADD_SOURCE_MEMBERSHIP Use this option to enable an application to join a source multicast group on a specific interface and a specific source address. You must specify an interface and a source address with this option. Applications that want to receive multicast datagrams need to join source multicast groups. This is an IPv4-only socket option.	Contains the IP_MREQ_SOURCE structure as defined in SYS1.MACLIB(BPXYSOCK). The IP_MREQ_SOURCE structure contains a 4-byte IPv4 multicast address followed by a 4-byte IPv4 source address and a 4-byte IPv4 interface address. See SEZAINST(CBLOCK) for the PL/I example of IP_MREQ_SOURCE. See SEZAINST(EZACOBOL) for the COBOL example of IP-MREQ-SOURCE.	N/A

Table 18. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

OPTNAME options (input)	SETSOCKOPT, OPTVAL (input)	GETSOCKOPT, OPTVAL (output)
IP_BLOCK_SOURCE Use this option to enable an application to block multicast packets that have a source address that matches the given IPv4 source address. You must specify an interface and a source address with this option. The specified multicast group must have been joined previously. This is an IPv4-only socket option.	Contains the IP_MREQ_SOURCE structure as defined in SYS1.MACLIB(BPXYSOCK). The IP_MREQ_SOURCE structure contains a 4-byte IPv4 multicast address followed by a 4-byte IPv4 source address and a 4-byte IPv4 interface address. See SEZAINST(CBLOCK) for the PL/I example of IP_MREQ_SOURCE. See SEZAINST(EZACOBOL) for the COBOL example of IP-MREQ-SOURCE.	N/A
IP_DROP_MEMBERSHIP Use this option to enable an application to exit a multicast group or to exit all sources for a multicast group. This is an IPv4-only socket option.	Contains the IP_MREQ structure as defined in SYS1.MACLIB(BPXYSOCK). The IP_MREQ structure contains a 4-byte IPv4 multicast address followed by a 4-byte IPv4 interface address. See SEZAINST(CBLOCK) for the PL/I example of IP_MREQ. See SEZAINST(EZACOBOL) for the COBOL example of IP-MREQ.	N/A
IP_DROP_SOURCE_MEMBERSHIP Use this option to enable an application to exit a source multicast group. This is an IPv4-only socket option.	Contains the IP_MREQ_SOURCE structure as defined in SYS1.MACLIB(BPXYSOCK). The IP_MREQ_SOURCE structure contains a 4-byte IPv4 multicast address followed by a 4-byte IPv4 source address and a 4-byte IPv4 interface address. See SEZAINST(CBLOCK) for the PL/I example of IP_MREQ_SOURCE. See SEZAINST(EZACOBOL) for the COBOL example of IP-MREQ-SOURCE.	N/A
IP_MULTICAST_IF Use this option to set or obtain the IPv4 interface address used for sending outbound multicast datagrams from the socket application. This is an IPv4-only socket option. **Note:** Multicast datagrams can be transmitted only on one interface at a time.	A 4-byte binary field containing an IPv4 interface address.	A 4-byte binary field containing an IPv4 interface address.

Table 18. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

OPTNAME options (input)	SETSOCKOPT, OPTVAL (input)	GETSOCKOPT, OPTVAL (output)
IP_MULTICAST_LOOP Use this option to control or determine whether a copy of multicast datagrams are looped back for multicast datagrams sent to a group to which the sending host itself belongs. The default is to loop the datagrams back. This is an IPv4-only socket option.	A 1-byte binary field. To enable, set to 1. To disable, set to 0.	A 1-byte binary field. If enabled, will contain a 1. If disabled, will contain a 0.
IP_MULTICAST_TTL Use this option to set or obtain the IP time-to-live of outgoing multicast datagrams. The default value is '01'x meaning that multicast is available only to the local subnet. This is an IPv4-only socket option.	A 1-byte binary field containing the value of '00'x to 'FF'x.	A 1-byte binary field containing the value of '00'x to 'FF'x.
IP_UNBLOCK_SOURCE Use this option to enable an application to unblock a previously blocked source for a given IPv4 multicast group. You must specify an interface and a source address with this option. This is an IPv4-only socket option.	Contains the IP_MREQ_SOURCE structure as defined in SYS1.MACLIB(BPXYSOCK). The IP_MREQ_SOURCE structure contains a 4-byte IPv4 multicast address followed by a 4-byte IPv4 source address and a 4-byte IPv4 interface address. See SEZAINST(CBLOCK) for the PL/I example of IP_MREQ_SOURCE. See SEZAINST(EZACOBOL) for the COBOL example of IP-MREQ-SOURCE.	

Table 18. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

OPTNAME options (input)	SETSOCKOPT, OPTVAL (input)	GETSOCKOPT, OPTVAL (output)
IPV6_ADDR_PREFERENCES Use this option to query or set IPv6 address preferences of a socket. The default source address selection algorithm considers these preferences when it selects an IP address that is appropriate to communicate with a given destination address. This is an AF_INET6-only socket option. **Result:** These flags are only preferences. The stack could assign a source IP address that does not conform to the IPV6_ADDR_PREFERENCES flags that you specify. **Guideline:** Use the INET6_IS_SRCADDR function to test whether the source IP address matches one or more IPV6_ADDR_PREFERENCES flags.	Contains the 4-byte flags field IPV6_ADDR_PREFERENCES_ FLAGS that is defined in SYS1.MACLIB(BPXYSOCK) with the following flags: **IPV6_PREFER_SRC_HOME (X'00000001')** Prefer home address **IPV6_PREFER_SRC_COA (X'00000002')** Prefer care-of address **IPV6_PREFER_SRC_TMP (X'00000004')** Prefer temporary address **IPV6_PREFER_SRC_PUBLIC (X'00000008')** Prefer public address **IPV6_PREFER_SRC_CGA (X'00000010')** Prefer cryptographically generated address **IPV6_PREFER_SRC_NONCGA (X'00000020')** Prefer non-cryptographically generated address Some of these flags are contradictory. Combining contradictory flags, such as IPV6_PREFER_SRC_CGA and IPV6_PREFER_SRC_NONCGA, results in error code EINVAL. See IPV6_ADDR_PREFERENCES and Mapping of GAI_HINTS/GAI_ADDRINFO EFLAGS in SEZAINST(CBLOCK) for the PL/I example of the OPTNAME and flag definitions. See IPV6_ADDR_PREFERENCES and AI_EFLAGS mappings in SEZAINST(EZACOBOL) for the COBOL example of the OPTNAME and flag definitions.	Contains the 4-byte flags field IPV6_ADDR_PREFERENCES_ FLAGS that is defined in SYS1.MACLIB(BPXYSOCK) with the following flags: **IPV6_PREFER_SRC_HOME (X'00000001')** Prefer home address **IPV6_PREFER_SRC_COA (X'00000002')** Prefer care-of address **IPV6_PREFER_SRC_TMP (X'00000004')** Prefer temporary address **IPV6_PREFER_SRC_PUBLIC (X'00000008')** Prefer public address **IPV6_PREFER_SRC_CGA (X'00000010')** Prefer cryptographically generated address **IPV6_PREFER_SRC_ NONCGA (X'00000020')** Prefer non-cryptographically generated address See IPV6_ADDR_ PREFERENCES and Mapping of GAI_HINTS/GAI_ADDRINFO EFLAGS in SEZAINST(CBLOCK) for the PL/I example of the OPTNAME and flag definitions. See IPV6_ADDR_PREFERENCES and AI_EFLAGS mappings in SEZAINST(EZACOBOL) for the COBOL example of the OPTNAME and flag definitions.

Table 18. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

OPTNAME options (input)	SETSOCKOPT, OPTVAL (input)	GETSOCKOPT, OPTVAL (output)
IPV6_JOIN_GROUP Use this option to control the reception of multicast packets and specify that the socket join a multicast group. This is an IPv6-only socket option.	Contains the IPV6_MREQ structure as defined in SYS1.MACLIB(BPXYSOCK). The IPV6_MREQ structure contains a 16-byte IPv6 multicast address followed by a 4-byte IPv6 interface index number. If the interface index number is 0, then the stack chooses the local interface. See the SEZAINST(CBLOCK) for the PL/I example of IPV6_MREQ. See SEZAINST(EZACOBOL) for the COBOL example of IPV6-MREQ.	N/A
IPV6_LEAVE_GROUP Use this option to control the reception of multicast packets and specify that the socket leave a multicast group. This is an IPv6-only socket option.	Contains the IPV6_MREQ structure as defined in SYS1.MACLIB(BPXYSOCK). The IPV6_MREQ structure contains a 16-byte IPv6 multicast address followed by a 4-byte IPv6 interface index number. If the interface index number is 0, then the stack chooses the local interface. See the SEZAINST(CBLOCK) for the PL/I example of IPV6_MREQ. See SEZAINST(EZACOBOL) for the COBOL example of IPV6-MREQ.	N/A
IPV6_MULTICAST_HOPS Use to set or obtain the hop limit used for outgoing multicast packets. This is an IPv6-only socket option.	Contains a 4-byte binary value specifying the multicast hops. If not specified, then the default is 1 hop. -1 indicates use stack default. 0 – 255 is the valid hop limit range. **Note:** An application must be APF authorized to enable it to set the hop limit value above the system defined hop limit value. CICS applications cannot execute as APF authorized.	Contains a 4-byte binary value in the range 0 – 255 indicating the number of multicast hops.

Table 18. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

OPTNAME options (input)	SETSOCKOPT, OPTVAL (input)	GETSOCKOPT, OPTVAL (output)
IPV6_MULTICAST_IF Use this option to set or obtain the index of the IPv6 interface used for sending outbound multicast datagrams from the socket application. This is an IPv6-only socket option.	Contains a 4-byte binary field containing an IPv6 interface index number.	Contains a 4-byte binary field containing an IPv6 interface index number.
IPV6_MULTICAST_LOOP Use this option to control or determine whether a multicast datagram is looped back on the outgoing interface by the IP layer for local delivery when datagrams are sent to a group to which the sending host itself belongs. The default is to loop multicast datagrams back. This is an IPv6-only socket option.	A 4-byte binary field. To enable, set to 1. To disable, set to 0.	A 4-byte binary field. If enabled, contains a 1. If disabled, contains a 0.
IPV6_UNICAST_HOPS Use this option to set or obtain the hop limit used for outgoing unicast IPv6 packets. This is an IPv6-only socket option.	Contains a 4-byte binary value specifying the unicast hops. If not specified, then the default is 1 hop. -1 indicates use stack default. 0 – 255 is the valid hop limit range. **Note:** APF authorized applications are permitted to set a hop limit that exceeds the system configured default. CICS applications cannot execute as APF authorized.	Contains a 4-byte binary value in the range 0 – 255 indicating the number of unicast hops.
IPV6_V6ONLY Use this option to set or determine whether the socket is restricted to send and receive only IPv6 packets. The default is to not restrict the sending and receiving of only IPv6 packets. This is an IPv6-only socket option.	A 4-byte binary field. To enable, set to 1. To disable, set to 0.	A 4-byte binary field. If enabled, contains a 1. If disabled, contains a 0.

Table 18. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

OPTNAME options (input)	SETSOCKOPT, OPTVAL (input)	GETSOCKOPT, OPTVAL (output)
MCAST_BLOCK_SOURCE Use this option to enable an application to block multicast packets that have a source address that matches the given source address. You must specify an interface index and a source address with this option. The specified multicast group must have been joined previously.	Contains the GROUP_SOURCE_REQ structure as defined in SYS1.MACLIB(BPXYSOCK). The GROUP_SOURCE_REQ structure contains a 4-byte interface index number followed by a socket address structure of the multicast address and a socket address structure of the source address. See SEZAINST(CBLOCK) for the PL/I example of GROUP_SOURCE_REQ. See SEZAINST(EZACOBOL) for the COBOL example of GROUP-SOURCE-REQ.	N/A
MCAST_JOIN_GROUP Use this option to enable an application to join a multicast group on a specific interface. You must specify an interface index. Applications that want to receive multicast datagrams must join multicast groups.	Contains the GROUP_REQ structure as defined in SYS1.MACLIB(BPXYSOCK). The GROUP_REQ structure contains a 4-byte interface index number followed by a socket address structure of the multicast address. See SEZAINST(CBLOCK) for the PL/I example of GROUP_REQ. See SEZAINST(EZACOBOL) for the COBOL example of GROUP-REQ.	N/A
MCAST_JOIN_SOURCE_GROUP Use this option to enable an application to join a source multicast group on a specific interface and a source address. You must specify an interface index and the source address. Applications that want to receive multicast datagrams only from specific source addresses need to join source multicast groups.	Contains the GROUP_SOURCE_REQ structure as defined in SYS1.MACLIB(BPXYSOCK). The GROUP_SOURCE_REQ structure contains a 4-byte interface index number followed by a socket address structure of the multicast address and a socket address structure of the source address. See SEZAINST(CBLOCK) for the PL/I example of GROUP_SOURCE_REQ. See SEZAINST(EZACOBOL) for the COBOL example of GROUP-SOURCE-REQ.	N/A

Table 18. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

OPTNAME options (input)	SETSOCKOPT, OPTVAL (input)	GETSOCKOPT, OPTVAL (output)
MCAST_LEAVE_GROUP Use this option to enable an application to exit a multicast group or exit all sources for a given multicast groups.	Contains the GROUP_REQ structure as defined in SYS1.MACLIB(BPXYSOCK). The GROUP_REQ structure contains a 4-byte interface index number followed by a socket address structure of the multicast address. See SEZAINST(CBLOCK) for the PL/I example of GROUP_REQ. See SEZAINST(EZACOBOL) for the COBOL example of GROUP-REQ.	N/A
MCAST_LEAVE_SOURCE_GROUP Use this option to enable an application to exit a source multicast group.	Contains the GROUP_SOURCE_REQ structure as defined in SYS1.MACLIB(BPXYSOCK). The GROUP_SOURCE_REQ structure contains a 4-byte interface index number followed by a socket address structure of the multicast address and a socket address structure of the source address. See SEZAINST(CBLOCK) for the PL/I example of GROUP_SOURCE_REQ. See SEZAINST(EZACOBOL) for the COBOL example of GROUP-SOURCE-REQ.	N/A
MCAST_UNBLOCK_SOURCE Use this option to enable an application to unblock a previously blocked source for a given multicast group. You must specify an interface index and a source address with this option.	Contains the GROUP_SOURCE_REQ structure as defined in SYS1.MACLIB(BPXYSOCK). The GROUP_SOURCE_REQ structure contains a 4-byte interface index number followed by a socket address structure of the multicast address and a socket address structure of the source address. See SEZAINST(CBLOCK) for the PL/I example of GROUP_SOURCE_REQ. See SEZAINST(EZACOBOL) for the COBOL example of GROUP-SOURCE-REQ.	N/A

Table 18. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

OPTNAME options (input)	SETSOCKOPT, OPTVAL (input)	GETSOCKOPT, OPTVAL (output)
SO_ASCII Use this option to set or determine the translation to ASCII data option. When SO_ASCII is set, data is translated to ASCII. When SO_ASCII is not set, data is not translated to or from ASCII. **Note:** This is a REXX-only socket option.	To enable, set to ON. To disable, set to OFF. **Note:** The *optvalue* is returned and is optionally followed by the name of the translation table that is used if translation is applied to the data.	If enabled, contains ON. If disabled, contains OFF. **Note:** The *optvalue* is returned and is optionally followed by the name of the translation table that is used if translation is applied to the data.
SO_BROADCAST Use this option to set or determine whether a program can send broadcast messages over the socket to destinations that can receive datagram messages. The default is disabled. **Note:** This option has no meaning for stream sockets.	A 4-byte binary field. To enable, set to 1 or a positive value. To disable, set to 0.	A 4-byte field. If enabled, contains a 1. If disabled, contains a 0.
SO_DEBUG Use SO_DEBUG to set or determine the status of the debug option. The default is *disabled*. The debug option controls the recording of debug information. **Notes:** 1. This is a REXX-only socket option. 2. This option has meaning only for stream sockets.	To enable, set to ON. To disable, set to OFF.	If enabled, contains ON. If disabled, contains OFF.
SO_EBCDIC Use this option to set or determine the translation to EBCDIC data option. When SO_EBCDIC is set, data is translated to EBCDIC. When SO_EBCDIC is not set, data is not translated to or from EBCDIC. This option is ignored by EBCDIC hosts. **Note:** This is a REXX-only socket option.	To enable, set to ON. To disable, set to OFF. **Note:** The *optvalue* is returned and is optionally followed by the name of the translation table that is used if translation is applied to the data.	If enabled, contains ON. If disabled, contains OFF. **Note:** The *optvalue* is returned and is optionally followed by the name of the translation table that is used if translation is applied to the data.
SO_ERROR Use this option to request pending errors on the socket or to check for asynchronous errors on connected datagram sockets or for other errors that are not explicitly returned by one of the socket calls. The error status is clear afterwards.	N/A	A 4-byte binary field containing the most recent ERRNO for the socket.

Table 18. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

OPTNAME options (input)	SETSOCKOPT, OPTVAL (input)	GETSOCKOPT, OPTVAL (output)
SO_KEEPALIVE Use this option to set or determine whether the keep alive mechanism periodically sends a packet on an otherwise idle connection for a stream socket. The default is disabled. When activated, the keep alive mechanism periodically sends a packet on an otherwise idle connection. If the remote TCP does not respond to the packet or to retransmissions of the packet, the connection is terminated with the error ETIMEDOUT.	A 4-byte binary field. To enable, set to 1 or a positive value. To disable, set to 0.	A 4-byte binary field. If enabled, contains a 1. If disabled, contains a 0.

SO_LINGER
 	
Use this option to control or determine how TCP/IP processes data that has not been transmitted when a CLOSE is issued for the socket. The default is disabled.
 	
Notes:
1. This option has meaning only for stream sockets.
2. If you set a zero linger time, the connection cannot close in an orderly manner, but stops, resulting in a RESET segment being sent to the connection partner. Also, if the aborting socket is in nonblocking mode, the close call is treated as though no linger option had been set.
 	
When SO_LINGER is set and CLOSE is called, the calling program is blocked until the data is successfully transmitted or the connection has timed out.
 	
When SO_LINGER is not set, the CLOSE returns without blocking the caller, and TCP/IP continues to attempt to send data for a specified time. This usually allows sufficient time to complete the data transfer.
 	
Use of the SO_LINGER option does not guarantee successful completion because TCP/IP only waits the amount of time specified in OPTVAL for SO_LINGER.
	Contains an 8-byte field containing two 4-byte binary fields.
	
	Assembler coding:
	`ONOFF  DS F`
	`LINGER  DS F`
	
	COBOL coding:
	`ONOFF  PIC 9(8) BINARY.`
	`LINGER PIC 9(8) BINARY.`
	
	Set ONOFF to a nonzero value to enable and set to 0 to disable this option. Set LINGER to the number of seconds that TCP/IP lingers after the CLOSE is issued.
		Contains an 8-byte field containing two 4-byte binary fields.
		
		Assembler coding:
		`ONOFF  DS F`
		`LINGER  DS F`
		
		COBOL coding:
		`ONOFF  PIC 9(8) BINARY.`
		`LINGER PIC 9(8) BINARY.`
		
		A nonzero value returned in ONOFF indicates enabled, a 0 indicates disabled. LINGER indicates the number of seconds that TCP/IP will try to send data after the CLOSE is issued.

Table 18. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

OPTNAME options (input)	SETSOCKOPT, OPTVAL (input)	GETSOCKOPT, OPTVAL (output)
SO_OOBINLINE Use this option to control or determine whether out-of-band data is received. **Note:** This option has meaning only for stream sockets. When this option is set, out-of-band data is placed in the normal data input queue as it is received and is available to a RECV or a RECVFROM even if the OOB flag is not set in the RECV or the RECVFROM. When this option is disabled, out-of-band data is placed in the priority data input queue as it is received and is available to a RECV or a RECVFROM only when the OOB flag is set in the RECV or the RECVFROM.	A 4-byte binary field. To enable, set to 1 or a positive value. To disable, set to 0.	A 4-byte binary field. If enabled, contains a 1. If disabled, contains a 0.
SO_RCVBUF Use this option to control or determine the size of the data portion of the TCP/IP receive buffer. The size of the data portion of the receive buffer is protocol-specific, based on the following values prior to any SETSOCKOPT call: • TCPRCVBufrsize keyword on the TCPCONFIG statement in the PROFILE.TCPIP data set for a TCP Socket • UDPRCVBufrsize keyword on the UDPCONFIG statement in the PROFILE.TCPIP data set for a UDP Socket • The default of 65 535 for a raw socket	A 4-byte binary field. To enable, set to a positive value specifying the size of the data portion of the TCP/IP receive buffer. To disable, set to a 0.	A 4-byte binary field. If enabled, contains a positive value indicating the size of the data portion of the TCP/IP receive buffer. If disabled, contains a 0.

Table 18. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

OPTNAME options (input)	SETSOCKOPT, OPTVAL (input)	GETSOCKOPT, OPTVAL (output)
SO_RCVTIMEO Use this option to control or determine the maximum length of time that a receive-type function can wait before it completes. If a receive-type function has blocked for the maximum length of time that was specified without receiving data, control is returned with an errno set to EWOULDBLOCK. The default value for this option is 0, which indicates that a receive-type function does not time out. When the MSG_WAITALL flag (stream sockets only) is specified, the timeout takes precedence. The receive-type function can return the partial count. See the explanation of that operation's MSG_WAITALL flag parameter. The following receive-type functions are supported: • READ • READV • RECV • RECVFROM • RECVMSG	This option requires a TIMEVAL structure, which is defined in SYS1.MACLIB(BPXYRLIM) macro. The TIMEVAL structure contains the number of seconds and microseconds specified as fullword binary numbers. The seconds can be a value in the range 0 - 2 678 400 (equal to 31 days), and the microseconds can be a value in the range 0 - 1 000 000 (equal to 1 second). Although TIMEVAL value can be specified using microsecond granularity, the internal TCP/IP timers that are used to implement this function have a granularity of approximately 100 milliseconds.	This option stores a TIMEVAL structure that is defined in the SYS1.MACLIB(BPXYRLIM) macro. The TIMEVAL structure contains the number of seconds and microseconds, which are specified as fullword binary numbers. The number of seconds value that is returned is in the range 0 - 2 678 400 (equal to 31 days). The number of microseconds value that is returned is in the range 0 - 1 000 000.

Table 18. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

OPTNAME options (input)	SETSOCKOPT, OPTVAL (input)	GETSOCKOPT, OPTVAL (output)
SO_REUSEADDR Use this option to control or determine whether local addresses are reused. The default is disabled. This alters the normal algorithm used with BIND. The normal BIND algorithm allows each Internet address and port combination to be bound only once. If the address and port have been already bound, then a subsequent BIND will fail and result error will be EADDRINUSE. When this option is enabled, the following situations are supported: • A server can BIND the same port multiple times as long as every invocation uses a different local IP address and the wildcard address INADDR_ANY is used only one time per port. • A server with active client connections can be restarted and can bind to its port without having to close all of the client connections. • For datagram sockets, multicasting is supported so multiple bind() calls can be made to the same class D address and port number. • If you require multiple servers to BIND to the same port and listen on INADDR_ANY, see the SHAREPORT option on the PORT statement in TCPIP.PROFILE.	A 4-byte binary field. To enable, set to 1 or a positive value. To disable, set to 0.	A 4-byte binary field. If enabled, contains a 1. If disabled, contains a 0.
SO_SNDBUF Use this option to control or determine the size of the data portion of the TCP/IP send buffer. The size is of the TCP/IP send buffer is protocol specific and is based on the following: • The TCPSENDBufrsize keyword on the TCPCONFIG statement in the PROFILE.TCPIP data set for a TCP socket • The UDPSENDBufrsize keyword on the UDPCONFIG statement in the PROFILE.TCPIP data set for a UDP socket • The default of 65 535 for a raw socket	A 4-byte binary field. To enable, set to a positive value specifying the size of the data portion of the TCP/IP send buffer. To disable, set to a 0.	A 4-byte binary field. If enabled, contains a positive value indicating the size of the data portion of the TCP/IP send buffer. If disabled, contains a 0.

Table 18. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

OPTNAME options (input)	SETSOCKOPT, OPTVAL (input)	GETSOCKOPT, OPTVAL (output)
SO_SNDTIMEO Use this option to control or determine the maximum length of time that a send-type function can remain blocked before it completes. If a send-type function has blocked for this length of time, it returns with a partial count or, if no data is sent, with an errno set to EWOULDBLOCK. The default value for this is 0, which indicates that a send-type function does not time out. For a SETSOCKOPT, the following send-type functions are supported: • SEND • SENDMSG • SENDTO • WRITE • WRITEV	This option requires a TIMEVAL structure, which is defined in the SYS1.MACLIB(BPXYRLIM) macro. The TIMEVAL structure contains the number of seconds and microseconds specified as fullword binary numbers. The seconds value is in the range 0 - 2 678 400 (equal to 31 days), and the microseconds value is in the range 0 - 1 000 000 (equal to 1 second). Although the TIMEVAL value can be specified using microsecond granularity, the internal TCP/IP timers that are used to implement this function have a granularity of approximately 100 milliseconds.	This option stores a TIMEVAL structure that is defined in SYS1.MACLIB(BPXYRLIM). The TIMEVAL structure contains the number of seconds and microseconds, which are specified as fullword binary numbers. The number of seconds value that is returned is in the range 0 - 2 678 400 (equal to 31 days). The microseconds value that is returned is in the range 0 - 1 000 000.
SO_TYPE Use this option to return the socket type.	N/A	A 4-byte binary field indicating the socket type: X'1' indicates SOCK_STREAM. X'2' indicates SOCK_DGRAM. X'3' indicates SOCK_RAW.
TCP_KEEPALIVE Use this option to set or determine whether a socket-specific timeout value (in seconds) is to be used in place of a configuration-specific value whenever keep alive timing is active for that socket. When activated, the socket-specified timer value remains in effect until respecified by SETSOCKOPT or until the socket is closed. See the *z/OS Communications Server: IP Programmer's Guide and Reference* for more information about the socket option parameters.	A 4-byte binary field. To enable, set to a value in the range of 1 – 2 147 460. To disable, set to a value of 0.	A 4-byte binary field. If enabled, contains the specific timer value (in seconds) that is in effect for the given socket. If disabled, contains a 0 indicating keep alive timing is not active.

Table 18. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

OPTNAME options (input)	SETSOCKOPT, OPTVAL (input)	GETSOCKOPT, OPTVAL (output)

TCP_NODELAY
 	
Use this option to set or determine whether data sent over the socket is subject to the Nagle algorithm (RFC 896).
 	
Under most circumstances, TCP sends data when it is presented. When this option is enabled, TCP will wait to send small amounts of data until the acknowledgment for the previous data sent is received. When this option is disabled, TCP will send small amounts of data even before the acknowledgment for the previous data sent is received.
Note: Use the following to set **TCP_NODELAY OPTNAME** value for COBOL programs:
`01 TCP-NODELAY-VAL PIC 9(10) COMP VALUE 2147483649.`
`01 TCP-NODELAY-REDEF REDEFINES TCP-NODELAY-VAL.`
`05 FILLER PIC 9(6) BINARY.`
`05 TCP-NODELAY PIC 9(8) BINARY.`
	A 4-byte binary field.
	
	To enable, set to a 0.
	
	To disable, set to a 1 or nonzero.
		A 4-byte binary field.
		
		If enabled, contains a 0.
		
		If disabled, contains a 1.

GIVESOCKET

The GIVESOCKET call is used to pass a socket from one process to another.

UNIX-based platforms use a command called FORK to create a new child process that has the same descriptors as the parent process. You can use this new child process in the same way that you used the parent process.

TCP/IP normally uses GETCLIENTID, GIVESOCKET, and TAKESOCKET calls in the following sequence:

1. A process issues a GETCLIENTID call to get the job name of its region and its MVS subtask identifier. This information is used in a GIVESOCKET call.
2. The process issues a GIVESOCKET call to prepare a socket for use by a child process.
3. The child process issues a TAKESOCKET call to get the socket. The socket now belongs to the child process, and can be used by TCP/IP to communicate with another process.

   Note: The TAKESOCKET call returns a new socket descriptor in RETCODE. The child process must use this new socket descriptor for all calls that use this socket. The socket descriptor that was passed to the TAKESOCKET call must not be used.
4. After issuing the GIVESOCKET command, the parent process issues a SELECT command that waits for the child to get the socket.
5. When the child gets the socket, the parent receives an exception condition that releases the SELECT command.
6. The parent process closes the socket.

The original socket descriptor can now be reused by the parent.

Sockets that have been given, but not taken for a period of four days, will be closed and will no longer be available for taking. If a select for the socket is outstanding, it will be posted.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.

Figure 93 shows an example of GIVESOCKET call instructions.

```
WORKING-STORAGE SECTION.
    01  SOC-FUNCTION    PIC X(16)  VALUE IS 'GIVESOCKET'.
    01  S               PIC 9(4) BINARY.
    01  CLIENT.
        03  DOMAIN      PIC 9(8) BINARY.
        03  NAME        PIC X(8).
        03  TASK        PIC X(8).
        03  RESERVED    PIC X(20).
    01  ERRNO           PIC 9(8) BINARY.
    01  RETCODE         PIC S9(8) BINARY.

PROCEDURE DIVISION.
     CALL 'EZASOKET' USING SOC-FUNCTION S CLIENT ERRNO RETCODE.
```

Figure 93. GIVESOCKET call instruction example

For equivalent PL/I and assembler language declarations, see "Converting parameter descriptions" on page 472.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing GIVESOCKET. The field is left-justified and padded on the right with blanks.

S A halfword binary number set to the socket descriptor of the socket to be given.

CLIENT
A structure containing the identifier of the application to which the socket should be given.

DOMAIN
A fullword binary number that must be set to decimal 2, indicating AF_INET, or decimal 19 indicating AF_INET6.

Note: A socket given by GIVESOCKET can only be taken by a TAKESOCKET with the same DOMAIN (AF_INET or AF_INET6).

NAME
Specifies an eight-character field, left-justified, padded to the right with blanks, that can be set to the name of the MVS address space that will contain the application that is going to take the socket.

- If the socket-taking application is in the *same* address space as the socket-giving application (as in CICS), NAME can be specified. The socket-giving application can determine its own address space name by issuing the GETCLIENTID call.
- If the socket-taking application is in a *different* MVS address space, this field should be set to blanks. When this is done, any MVS address space that requests the socket can have it.

TASK Specifies an 8-byte field that can be set to blanks, or to the identifier of the socket-taking MVS subtask. If this field is set to blanks, any subtask in the address space specified in the NAME field can take the socket.

- As used by IMS and CICS, the field should be set to blanks.
- If TASK identifier is non-blank, the socket-receiving task should already be in execution when the GIVESOCKET is issued.

RESERVED
A 20-byte reserved field. This field is required, but not used.

Parameter values returned to the application

ERRNO
A fullword binary field. If RETCODE is negative, the field contains an error number. See Appendix B, "Socket call error return codes," on page 885 for information about ERRNO return codes.

RETCODE
A fullword binary field that returns one of the following:

Value	Description
0	Successful call.
–1	Check **ERRNO** for an error code.

INET6_IS_SRCADDR

The INET6_IS_SRCADDR call verifies whether the input IP address matches an IP address in the node that conforms to all IPV6_ADDR_PREFERENCES flags specified in the call. You can use this call with IPv6 addresses or with IPv4-mapped IPv6 addresses.

You can use this call to test local IP addresses to verify whether these addresses have the characteristics that are required by your application.

See RFC 5014 *IPv6 Socket API for Source Address Selection* for more information about the INET6_IS_SRCADDR call. See Appendix F, "Related protocol specifications," on page 927 for information about accessing RFCs.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.

Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.

Figure 94 shows an example of INET6_IS_SRCADDR call instructions.

```
WORKING-STORAGE SECTION.
         01  SOC-FUNCTION    PIC X(16)  VALUE IS 'INET6_IS_SRCADDR'.
         * IPv6 socket address structure.
         01  NAME.
             03  FAMILY      PIC 9(4) BINARY.
             03  PORT        PIC 9(4) BINARY.
             03  FLOWINFO    PIC 9(8) BINARY.
             03  IP-ADDRESS.
                 10 FILLER   PIC 9(16) BINARY.
                 10 FILLER   PIC 9(16) BINARY.
             03  SCOPE-ID    PIC 9(8) BINARY.
         01  FLAGS           PIC 9(8) BINARY
             88 IPV6-PREFER-SRC-HOME         PIC 9(8) BINARY VALUE 1.
             88 IPV6-PREFER-SRC-COA          PIC 9(8) BINARY VALUE 2.
             88 IPV6-PREFER-SRC-TMP          PIC 9(8) BINARY VALUE 4.
             88 IPV6-PREFER-SRC-PUBLIC       PIC 9(8) BINARY VALUE 8.
             88 IPV6-PREFER-SRC-CGA          PIC 9(8) BINARY VALUE 16.
             88 IPV6-PREFER-SRC-NONCGA       PIC 9(8) BINARY VALUE 32.
         01  ERRNO           PIC 9(8) BINARY.
         01  RETCODE         PIC S9(8) BINARY.

       PROCEDURE DIVISION.
            CALL 'EZASOKET' USING SOC-FUNCTION NAME FLAGS ERRNO RETCODE.
```

Figure 94. INET6_IS_SRCADDR call instruction example

For equivalent PL/I and assembler language declarations, see "Converting parameter descriptions" on page 472.

Parameter values set by the application

SOC-FUNCTION

A 16-byte character field containing INET6_IS_SRCADDR.

NAME

Specifies the AF_INET6 socket address structure for the address that is to be tested.

Requirement: You must specify an AF_INET6 address. You can specify an IPv6 address, or an IPv4-mapped IPv6 address.

The IPv6 socket address structure specifies the following fields:

FAMILY
A halfword binary field that specifies the IPv6 addressing family. For TCP/IP the value is the decimal value 19, indicating AF_INET6.

PORT A halfword binary field. This field is ignored by INET6_IS_SRCADDR processing.

FLOWINFO
A fullword binary field that specifies the traffic class and flow label. This field is ignored by INET6_IS_SRCADDR processing.

IP-ADDRESS
A 16-byte binary field that is set to the 128-bit IPv6 IP address (network byte order) of the IP address to be tested.

Rule: Specify an IPv4 address by using its IPv4-mapped IPv6 address format.

SCOPE-ID
A fullword binary field that identifies a set of appropriate interfaces for the scope of the address that is specified in the IP-ADDRESS field. The value 0 indicates that the SCOPE-ID field does not identify the set of interfaces to be used.

Requirements:

- If the IP address is a link-local address, this field must be set to a nonzero value.
- If the IP address is not a link-local address, this field must be set to 0.

FLAGS
A fullword binary field that contains one or more valid IPV6_ADDR_PREFERENCES flags.

Flag name	Binary value	Decimal value	Description
IPV6_PREFER_SRC_HOME	X'00000001'	1	Test whether the input IP address is a home address.[1]
IPV6_PREFER_SRC_COA	X'00000002'	2	Test whether the input IP address is a care-of address.[2]
IPV6_PREFER_SRC_TMP	X'00000004'	4	Test whether the input IP address is a temporary address.
IPV6_PREFER_SRC_PUBLIC	X'00000008'	8	Test whether the input IP address is a public address.
IPV6_PREFER_SRC_CGA	X'00000010'	16	Test whether the input IP address is cryptographically generated.[2]
IPV6_PREFER_SRC_NONCGA	X'00000020'	32	Test whether the input IP address is not cryptographically generated.[1]

Notes:

1. Any valid IP address that is known to the stack satisfies this flag.
2. z/OS Communications Server does not support this type of address. The call always returns FALSE if this flag is specified with a valid IP address that is known to the stack.

Tips:

- The SEZAINST(EZACOBOL) and SEZAINST(CBLOCK) samples contain mappings for these flags. For assembler programs, the flags are defined in the system maclib member BPXYSOCK.
- Some of these flags are contradictory, for example:
  - The flag IPV6_PREFER_SRC_HOME contradicts the flag IPV6_PREFER_SRC_COA.
  - The flag IPV6_PREFER_SRC_CGA contradicts the flag IPV6_PREFER_SRC_NONCGA.
  - The flag IPV6_PREFER_SRC_TMP contradicts the flags IPV6_PREFER_SRC_PUBLIC.

  Result: If you specify contradictory flags in the call, the result is FALSE.

Parameter values returned to the application

ERRNO

A fullword binary field. If the RETCODE value is negative, the field contains an error number. See Appendix B, "Socket call error return codes," on page 885 for information about ERRNO return codes.

RETCODE

A fullword binary field that returns one of the following values:

Value	Description
0	FALSE The call was successful and the result is FALSE. The input AF_INET6 address corresponds to an IP address on the node, but does not conform to one or more IPV6_ADDR_PREFERENCES flags that are specified in the call.
1	TRUE The call was successful and the result is TRUE. The input AF_INET6 address corresponds to an IP address on the node and conforms to all IPV6_ADDR_PREFERENCES flags that are specified in the call.
–1	Check **ERRNO** for an error code.

INITAPI

The INITAPI call connects an application to the TCP/IP interface. Almost all sockets programs that are written in COBOL, PL/I, or assembler language must issue the INITAPI socket command before they issue other socket commands.

The exceptions to this rule are the following calls, which, when issued first, will generate a default INITAPI call.

- GETCLIENTID
- GETHOSTID
- GETHOSTNAME
- GETIBMOPT
- SELECT
- SELECTEX
- SOCKET
- TAKESOCKET

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.

Figure 95 shows an example of INITAPI call instructions.

```
WORKING-STORAGE SECTION.
    01  SOC-FUNCTION    PIC X(16)  VALUE IS 'INITAPI'.
    01  MAXSOC          PIC 9(4) BINARY.
    01  IDENT.
        02  TCPNAME     PIC X(8).
        02  ADSNAME     PIC X(8).
    01  SUBTASK         PIC X(8).
    01  MAXSNO          PIC 9(8) BINARY.
    01  ERRNO           PIC 9(8) BINARY.
    01  RETCODE         PIC S9(8) BINARY.

PROCEDURE DIVISION.
     CALL 'EZASOKET' USING SOC-FUNCTION MAXSOC IDENT SUBTASK
     MAXSNO ERRNO RETCODE.
```

Figure 95. INITAPI call instruction example

For equivalent PL/I and assembler language declarations, see "Converting parameter descriptions" on page 472.

Parameter values set by the application

SOC-FUNCTION

A 16-byte character field containing INITAPI. The field is left-justified and padded on the right with blanks.

MAXSOC

A halfword binary field set to the maximum number of sockets this application will ever have open at one time. The maximum number is 65 535 and the minimum number is 50. This value is used to determine the amount of memory that is allocated for socket control blocks and buffers. If less than 50 are requested, MAXSOC defaults to 50.

IDENT

A structure containing the identities of the TCP/IP address space and the calling program's address space. Specify IDENT on the INITAPI call from an address space.

TCPNAME

An 8-byte character field that should be set to the MVS job name of the TCP/IP address space with which you are connecting.

ADSNAME
An 8-byte character field set to the identity of the calling program's address space. For explicit-mode IMS server programs, use the TIMSrvAddrSpc field passed in the TIM. If ADSNAME is not specified, the system derives a value from the MVS control block structure.

SUBTASK
Indicates an 8-byte field that contains a unique subtask identifier, which is used to distinguish between multiple subtasks within a single address space. Use your own job name as part of your subtask name. This ensures that, if you issue more than one INITAPI command from the same address space, each SUBTASK parameter is unique.

Restriction: EZASOKET calls outside of the CICS environment are not reentrant. If EZASOKET is to be used by a multithread or multitask application, a separate copy needs to be loaded for each thread or task. See *z/OS Communications Server: IP CICS Sockets Guide* for information about use in the CICS environment.

Parameter values returned to the application

MAXSNO
A fullword binary field that contains the highest socket number assigned to this application. The lowest socket number is 0. If you have 50 sockets, they are numbered from 0 to 49. If MAXSNO is not specified, the value for MAXSNO is 49.

ERRNO
A fullword binary field. If RETCODE is negative, the field contains an error number. See Appendix B, "Socket call error return codes," on page 885 for information about ERRNO return codes.

RETCODE
A fullword binary field that returns one of the following:

Value	Description
0	Successful call.
–1	Check **ERRNO** for an error code.

IOCTL

The IOCTL call is used to control certain operating characteristics for a socket.

Before you issue an IOCTL socket command, you must load a value that represents the characteristic that you want to control into the COMMAND field.

The variable length parameters REQARG and RETARG are arguments that are passed to and returned from IOCTL. The length of REQARG and RETARG is determined by the value that you specify in COMMAND. See Table 19 on page 549 for information about REQARG and RETARG.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.

Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.

Figure 96 shows an example of IOCTL call instructions.

```
       WORKING-STORAGE SECTION.
       01  SOC-FUNCTION           PIC X(16) VALUE 'IOCTL'.
       01  S                      PIC 9(4)  BINARY.
       01  COMMAND                PIC 9(8)  BINARY.

       01  IFREQ.
         03 NAME                    PIC X(16).
         03 FAMILY                  PIC 9(4)  BINARY.
         03 PORT                    PIC 9(4)  BINARY.
         03 ADDRESS                 PIC 9(8)  BINARY.
         03 RESERVED                PIC X(8).

       01  IFREQOUT.
         03 NAME                    PIC X(16).
         03 FAMILY                  PIC 9(4)  BINARY.
         03 PORT                    PIC 9(4)  BINARY.
         03 ADDRESS                 PIC 9(8)  BINARY.
         03 RESERVED                PIC X(8).

       01  GRP-IOCTL-TABLE.
        02 IOCTL-ENTRY OCCURS 100 TIMES.
         03 NAME                    PIC X(16).
         03 FAMILY                  PIC 9(4)  BINARY.
         03 PORT                    PIC 9(4)  BINARY.
         03 ADDRESS                 PIC 9(8)  BINARY.
         03 NULLS                   PIC X(8).

       01  IOCTL-REQARG           USAGE IS POINTER.
       01  IOCTL-RETARG           USAGE IS POINTER.
       01  ERRNO                  PIC 9(8) BINARY.
       01  RETCODE                PIC 9(8) BINARY.


    PROCEDURE DIVISION.
         CALL 'EZASOKET' USING SOC-FUNCTION S COMMAND REQARG
               RETARG ERRNO RETCODE.
```

Figure 96. IOCTL call instruction example

For equivalent PL/I and assembler language declarations, see "Converting parameter descriptions" on page 472.

Parameter values set by the application

SOC-FUNCTION

A 16-byte character field containing IOCTL. The field is left-justified and padded to the right with blanks.

S A halfword binary number set to the descriptor of the socket to be controlled.

COMMAND
To control an operating characteristic, set this field to one of the following symbolic names. A value in a bit mask is associated with each symbolic name. By specifying one of these names, you are turning on a bit in a mask which communicates the requested operating characteristic to TCP/IP.

FIONBIO
Sets or clears blocking status.

FIONREAD
Returns the number of immediately readable bytes for the socket.

SIOCATMARK
Determines whether the current location in the data input is pointing to out-of-band data.

SIOCGHOMEIF6
Requests all IPv6 home interfaces.

- When the SIOCGHOMEIF6 IOCTL is issued, the REGARQ must contain a Network Configuration Header. The NETCONFHDR is defined in the SYS1.MACLIB(BPXYIOC6) for assembler language. The following fields are input fields and must be filled out:

  NchEyeCatcher
  Contains eye catcher '6NCH'

  NchIoctl
  Contains the command code

  NchBufferLength
  Buffer length large enough to contain all the IPv6 interface records. Each interface record is length of HOME-IF-ADDRESS. If buffer is not large enough, then errno will be set to ERANGE and the NchNumEntryRet will be set to number of interfaces. Based on NchNumEntryRet and size of HOME-IF-ADDRESS, calculate the necessary storage to contain the entire list.

  NchBufferPtr
  This is a pointer to an array of HOME-IF structures returned on a successful call. The size will depend on the number of qualifying interfaces returned.

  NchNumEntryRet
  If return code is 0 this will be set to number of HOME-IF-ADDRESS returned. If errno is ERANGE, then will be set to number of qualifying interfaces. No interfaces are returned. Recalculate The NchBufferLength based on this value times the size of HOME-IF-ADDRESS.

  REQARG and RETARG
  Point to the arguments that are passed between the calling program and IOCTL. The length of the argument is determined by the COMMAND request. REQARG is an input parameter and is used to pass arguments to

IOCTL. RETARG is an output parameter and is used for arguments returned by IOCTL. For the lengths and meanings of REQARG and RETARG for each COMMAND type, see Table 19 on page 549.

```
Working-Storage Section.
       01  SIOCGHOMEIF6-VAL       pic s9(10) binary value 3222599176.
       01  SIOCGHOMEIF6-REDEF REDEFINES SIOCGHOMEIF6-VAL.
           05 FILLER              PIC 9(6) COMP.
           05 SIOCGHOMEIF6        PIC 9(8) COMP.
       01  IOCTL-RETARG           USAGE IS POINTER.
       01  NET-CONF-HDR.
           05 NCH-EYE-CATCHER     PIC X(4) VALUE '6NCH'.
           05 NCH-IOCTL           PIC 9(8) BINARY.
           05 NCH-BUFFER-LENTH    PIC 9(8) BINARY.
           05 NCH-BUFFER-PTR      USAGE IS POINTER.
           05 NCH-NUM-ENTRY-RET   PIC 9(8) BINARY.
      01  HOME-IF.
           03 HOME-IF-ADDRESS.
              05 FILLER           PIC 9(16) BINARY.

Linkage Section.

       01 L1.
          03 NetConfHdr.
             05 NchEyeCatcher     pic x(4).
             05 NchIoctl          pic 9(8) binary.
             05 NchBufferLength   pic 9(8) binary.
             05 NchBufferPtr      usage is pointer.
             05 NchNumEntryRet    pic 9(8) binary.
      * Allocate storage based on your need.
          03 Allocated-Storage    pic x(nn).

       Procedure Division using L1.
           move '6NCH' to NchEyeCatcher.
           set NchBufferPtr to address of Allocated-Storage.
      * Set NchBufferLength to the length of your allocated storage.
           move nn to NchBufferLength.
           move SIOCGHOMEIF6 to NchIoctl.
           Call 'EZASOKET' using soket-ioctl socket-descriptor
                                 SIOCGHOMEIF6
                                 NETCONFHDR NETCONFHDR
                                 errno retcode.
```

Figure 97. COBOL language example for SIOCGHOMEIF6

SIOCGIFADDR
Requests the IPv4 network interface address for a given interface name. For assembler, see the IOCN_IFNAME field in the SYS1.MACLIB(BPXYIOCC) API. For COBOL, see the IFR-NAME field in the SEZAINST(EZACOBOL) API. For PL/I, see the IFR_NAME field in the SEZAINST(CBLOCK) API.

SIOCGIFBRDADDR
Requests the IPv4 network interface broadcast address for a given interface name. For assembler, see the IOCN_IFNAME field in the SYS1.MACLIB(BPXYIOCC) API. For COBOL, see the IFR-NAME field in the SEZAINST(EZACOBOL) API. For PL/I, see the IFR_NAME field in the SEZAINST(CBLOCK) API.

SIOCGIFCONF
Requests the IPv4 network interface configuration. The configuration is a variable number of 32-byte structures. For assembler, see the IOCN_IFREQ field in the

SYS1.MACLIB(BPXYIOCC) API for the structure format. For COBOL, see the IFREQ field in the SEZAINST(EZACOBOL) API for the structure format. For PL/I, see the IFREQ field in the SEZAINST(CBLOCK) API for the structure format.

- When IOCTL is issued, REQARG must contain the length of the array to be returned. To determine the length of REQARG, multiply the structure length (array element) by the number of interfaces requested. The maximum number of array elements that TCP/IP can return is 100.
- When IOCTL is issued, RETARG must be set to the beginning of the storage area that you have defined in your program for the array to be returned.

SIOCGIFDSTADDR
Requests the network interface destination address for a given interface name. For assembler, see the IOCN_IFNAME field in the SYS1.MACLIB(BPXYIOCC) API. For COBOL, see the IFR-NAME field in the SEZAINST(EZACOBOL) API. For PL/I, see the IFR_NAME field in the SEZAINST(CBLOCK) API.

SIOCGIFMTU
Requests the IPv4 network interface MTU (maximum transmission unit) for a given interface name. For assembler, see the IOCN_IFNAME field in the SYS1.MACLIB(BPXYIOCC) API. For COBOL, see the IFR-NAME field in the SEZAINST(EZACOBOL) API. For PL/I, see the IFR_NAME field in the SEZAINST(CBLOCK) API.

SIOCGIFNAMEINDEX
Requests all interface names and interface indexes including local loopback but excluding VIPAs. Information is returned for both IPv4 and IPv6 interfaces whether they are active or inactive. For IPv6 interfaces, information is only returned for an interface if it has at least one available IP address.

The configuration consists of IF_NAMEINDEX structure, which is defined in SYS1.MACLIB(BPX1IOCC) for the assembler language.

- When the SIOCGIFNAMEINDEX IOCTL is issued, the first word in REQARG must contain the length (in bytes) to contain an IF-NAME-INDEX structure to return the interfaces. The formula to compute this length is as follows:
  1. Determine the number of interfaces expected to be returned upon successful completion of this command.
  2. Multiply the number of interfaces by the array element (size of IF-NIINDEX, IF-NINAME, and IF-NIEXT) to get the size of the array element.
  3. Add the size of the IF-NITOTALIF and IF-NIENTRIES to the size of the array to get the total number of bytes needed to accommodate the name and index information returned.
- When IOCTL is issued, RETARG must be set to the address of the beginning of the area in your program's storage that is reserved for the IF-NAMEINDEX structure that is to be returned by IOCTL.
- The command 'SIOCGIFNAMEINDEX' returns a variable number of all the qualifying network interfaces.

```
WORKING-STORAGE SECTION.
      01 SIOCGIFNAMEINDEX-VAL pic 9(10) binary value 1073804803.
      01 SIOCGIFNAMEINDEX-REDEF REDEFINES SIOCGIFNAMEINDEX-VAL.
         05 FILLER            PIC 9(6) COMP.
         05 SIOCGIFNAMEINDEX  PIC 9(8) COMP.
      01 reqarg               pic 9(8) binary.
      01 reqarg-header-only   pic 9(8) binary.
      01 IF-NIHEADER.
         05 IF-NITOTALIF      PIC 9(8) BINARY.
         05 IF-NIENTRIES      PIC 9(8) BINARY.
         01 IF-NAME-INDEX-ENTRY.
            05 IF-NIINDEX     PIC 9(8) BINARY.
            05 IF-NINAME      PIC X(16).
            05 IF-NINAMETERM  PIC X(1).
            05 IF-NIRESV1     PIC X(3).
         01 OUTPUT-STORAGE    PIC X(500).
      Procedure Division.
          move 8 to reqarg-header-only.
          Call 'EZASOKET' using soket-ioctl socket-descriptor
                               SIOCGIFNAMEINDEX
                               REQARG-HEADER-ONLY IF-NIHEADER
                               errno retcode.
          move 500 to reqarg.
          Call 'EZASOKET' using soket-ioctl socket-descriptor
                               SIOCGIFNAMEINDEX
                               REQARG OUTPUT-STORAGE
                               errno retcode.
```

Figure 98. COBOL language example for SIOCGIFNAMEINDEX

SIOCGIPMSFILTER

Requests a list of the IPv4 source addresses that comprise the source filter, with the current mode on a given interface and a multicast group for a socket. The source filter can include or exclude the set of source address, depending on the filter mode (MCAST_INCLUDE or MCAST_EXCLUDE). When the SIOCGIPMSFILTER IOCTL is issued, the REQARG parameter must contain a IP_MSFILTER structure, which is defined in SYS1.MACLIB(BPXYIOCC) for assembler language, in SEZAINST(CBLOCK) for PL/I, and in SEZAINST(EZACOBOL) for COBOL. The IP_MSFILTER must include an interface address (input), a multicast address (input), filter mode (output), the number of source addresses in the following array (input and output), and an array of source addresses (output). On input, the number of source addresses is the number of source addresses that will fit in the input array. On output, the number of source addresses contains the total number of source filters in the output array. If the application does not know the size of the source list prior to processing, it can make a reasonable guess (for example, 0), and if when the call completes the number of source addresses is a greater value, the IOCTL can be repeated with a buffer that is large enough. That is, on output, the number of source addresses is always updated to be the total number of sources in the filter, but the array holds as many source addresses as will fit, up to the minimum of the array size passed in as the input number.

Calculate the size of IF_MSFILTER value as follows:

1. Determine the number of expected source addresses.

2. Multiply the number of source addresses by the array element (size of the IMSF_SrcEntry value) to determine the size of all array elements.
3. Add the size of all array elements to the size of the IMSF_Header value to determine the total number of bytes needed to accommodate the source addresses information that is returned.

SIOCGMSFILTER

Requests a list of the IPv4 or IPv6 source addresses that comprise the source filter, with the current mode on a given interface index and a multicast group for a socket. The source filter can include or exclude the set of source address, depending on the filter mode (MCAST_INCLUDE or MCAST_EXCLUDE). When the SIOCGMSFILTER IOCTL is issued, the REQARG parameter must contain a GROUP_FILTER structure, which is defined in SYS1.MACLIB(BPXYIOCC) for assembler , in SEZAINST(CBLOCK) for PL/I, and in SEZAINST(EZACOBOL) for COBOL. The GROUP_FILTER option must include an interface index (input), a socket address structure of the multicast address (input), filter mode (output), the number of source addresses in the following array (output), and an array of the socket address structure of source addresses (input and output). On input, the number of source addresses is the number of source addresses that will fit in the input array. On output, the number of source addresses contains the total number of source filters in the output array. If the application does not know the size of the source list prior to processing, it can make a reasonable guess (for example, 0), and if when the call completes the number of source addresses is a greater value, the IOCTL can be repeated with a buffer that is large enough. That is, on output, the number of source addresses is always updated to be the total number of sources in the filter, but the array holds as many source addresses as will fit, up to the minimum of the array size passed in as the input number.

Calculate the size of the GROUP_FILTER value as follows:

1. Determine the number of source addresses expected.
2. Multiply the number of source addresses by the array element (size of the GF_SrcEntry value) to determine the size of all array elements.
3. Add the size of all array elements to the size of the GF_Header value to determine the total number of bytes needed to accommodate the source addresses information returned.

SIOCGPARTNERINFO

Provides an interface for an application to retrieve security information about its partner. When you issue the SIOCGPARTNERINFO IOCTL, the REQARG parameter must contain a PartnerInfo structure. The PartnerInfo structure is defined in members within SEZANMAC; EZBPINF1 defines the PL/I layout, EZBPINFA defines the assembler layout, and EZBPINFB defines the COBOL layout. For more information about using the SIOCGPARTNERINFO IOCTL, see *z/OS Communications Server: IP Programmer's Guide and Reference*.

SIOCSAPPLDATA

The SIOCSAPPLDATA IOCTL enables an application to set 40

bytes of user-specified application data against a socket endpoint. You can also use this application data to identify socket endpoints in interfaces such as Netstat, SMF, or network management applications. When the SIOCSAPPLDATA IOCTL is issued, the REQARG parameter must contain a SetApplData structure as defined by the EZBYAPPL macro. See the CBLOCK and the EZACOBOL samples for the equivalent SetApplData and SetADcontainer structure definitions for PL/I and COBOL programming environments. See *z/OS Communications Server: IP Programmer's Guide and Reference* for more information about programming the SIOCSAPPLDATA IOCTL.

SetAD_buffer: The user-defined application data is 40 bytes of data that identifies the endpoint with the application. You can obtain this application data from the following sources:

- Netstat reports. The information is displayed in the ALL/-A report. If you use the APPLDATA modifier, then the information also is displayed on the ALLConn/-a and COnn/-c reports.
- The SMF 119 TCP connection termination record. See TCP connection termination record (subtype 2) in *z/OS Communications Server: IP Programmer's Guide and Reference* for more information.
- Network management interfaces. See Network management interfaces in *z/OS Communications Server: IP Programmer's Guide and Reference* for more information.

Consider the following guidelines:

- The application must document the content, format and meaning of the ApplData strings that it associates with the sockets that it owns.
- The application should uniquely identify itself with printable EBCDIC characters at the beginning of the string. Strings beginning with 3-character IBM product identifiers, such as TCP/IP's EZA or EZB, are reserved for IBM use. IBM product identifiers begin with a letter in the range A-I.
- Use printable EBCDIC characters for the entire string to enable searching with Netstat filters.

Tip: Separate application data elements with a blank for easier reading.

SIOCSIPMSFILTER

Sets a list of the IPv4 source addresses that comprise the source filter, with the current mode on a given interface and a multicast group for a socket. The source filter can include or exclude the set of source address, depending on the filter mode (MCAST_INCLUDE or MCAST_EXCLUDE). When the SIOCSIPMSFILTER IOCTL is issued, the REQARG parameter must contain a IP_MSFILTER structure, which is defined in SYS1.MACLIB(BPXYIOCC) for assembler, in SEZAINST(CBLOCK) for PL/I and in SEZAINST(EZACOBOL) for COBOL. The IP_MSFILTER option must include an interface address, a multicast address, filter mode, the number of source addresses in the following array, and an array of source addresses.

Calculate the size of the IF_MSFILTER value as follows:

1. Determine the number of expected source addresses.

2. Multiply the number of source addresses by the array element (size of the IMSF_SrcEntry value) to determine the size of all array elements.
3. Add the size of all array elements to the size of the IMSF_Header value to determine the total number of bytes needed to accommodate the source addresses information that is returned.

SIOCSMSFILTER

Sets a list of the IPv4 or IPv6 source addresses that comprise the source filter, along with the current mode on a given interface index and a multicast group for a socket. The source filter can include or exclude the set of source address, depending on the filter mode (INCLUDE or EXCLUDE). When the SIOCSMSFILTER IOCTL is issued, the REQARG parameter must contain a GROUP_FILTER structure which is defined in SYS1.MACLIB(BPXYIOCC) for assembler, in SEZAINST(CBLOCK) for PL/I, and in SEZAINST(EZACOBOL) for COBOL. The GROUP_FILTER option must include an interface index, a socket address structure of the multicast address, filter mode, the number of source addresses in the following array, and an array of the socket address structure of source addresses.

Calculate the size of GROUP_FILTER as follows:

1. Determine the number of source addresses expected.
2. Multiply the number of source addresses by the array element (size of the GF_SrcEntry value) to get the size of all array elements.
3. Add the size of all array elements to the size of the GF_Header value to get the total number of bytes needed to accommodate the source addresses information returned.

SIOCSPARTNERINFO

The SIOCSPARTNERINFO IOCTL sets an indicator to retrieve the partner security credentials during connection setup and saves the information, enabling an application to issue a SIOCGPARTNERINFO IOCTL without suspending the application, or at least minimizing the time it takes to retrieve the information. The SIOCSPARTNERINFO IOCTL must be issued prior to the SIOCGPARTNERINFO IOCTL. When you issue the SIOCSPARTNERINFO IOCTL, the REQARG parameter must contain a constant value, PI_REQTYPE_SET_PARTNERDATA. This constant is defined in members within SEZANMAC; EZBPINF1 defines the PL/I layout, EZBPINFA defines the assembler layout, and EZBPINFB defines the COBOL layout. For more information about using the SIOCSPARTNERINFO IOCTL, see *z/OS Communications Server: IP Programmer's Guide and Reference*.

SIOCTTLSCTL

Controls Application Transparent Transport Layer Security (AT-TLS) for the connection. REQARG and RETARG must contain a TTLS_IOCTL structure. If a partner certificate is requested, the TTLS_IOCTL must include a pointer to additional buffer space and the length of that buffer. Information is returned in the TTLS_IOCTL structure. If a partner certificate is requested and one is available, it is returned in the additional buffer space. The TTLS_IOCTL structure is defined in members within SEZANMAC.

EZBZTLS1 defines the PL/I layout, EZBZTLSP defines the assembler layout, and EZBZTLSB defines the COBOL layout. For more usage details, see the Application Transparent TLS (AT-TLS) information in *z/OS Communications Server: IP Programmer's Guide and Reference*.

Restriction: Use of this ioctl for functions other than query requires that the AT-TLS policy mapped to the connection be defined with the ApplicationControlled parameter set to On.

REQARG and RETARG

Points to arguments that are passed between the calling program and IOCTL. The length of the argument is determined by the COMMAND request. REQARG is an input parameter or an output parameter and is used to pass and receive arguments to and from IOCTL. RETARG is an output parameter and receives arguments from IOCTL. The REQARG and RETARG parameters are described in Table 19.

Table 19. IOCTL call arguments

COMMAND/CODE	SIZE	REQARG	SIZE	RETARG
FIONBIO X'8004A77E'	4	Set socket mode to: X'00'=blocking, X'01'=nonblocking.	0	Not used.
FIONREAD X'4004A77F'	0	Not used.	4	Number of characters available for read.
SIOCATMARK X'4004A707'	0	Not used.	4	X'00'= not at OOB data X'01'= at OOB data.
SIOCGHOMEIF6 X'C014F608'	20	NetConfHdr		See Figure 97 on page 543 NetConfHdr.
SIOCGIFADDR X'C020A70D'	32	First 16 bytes - interface name. Last 16 bytes - not used.	32	Network interface address. For assembler, see the IOCN_SADDRIF field in the SYS1.MACLIB(BPXYIOCC) API. For COBOL, see the IFR-ADDR field in the SEZAINST(EZACOBOL) API. For PL/I, see the IFR_ADDR field in the SEZAINST(CBLOCK) API.
SIOCGIFBRDADDR X'C020A712'	32	First 16 bytes - interface name. Last 16 bytes - not used.	32	Network interface address. For assembler, see the IOCN_SADDRIFBROADCAST field in the SYS1.MACLIB(BPXYIOCC) API. For COBOL, see the IFR-BROADADDR field in the SEZAINST(EZACOBOL) API. For PL/I, see the IFR_BROADADDR field in the SEZAINST(CBLOCK) API.
SIOCGIFCONF X'C008A714'	8	Size of RETARG.	See note[1].	
SIOCGIFDSTADDR X'C020A70F'	32	First 16 bytes - interface name. Last 16 bytes - not used.	32	Destination interface address. For assembler, see the IOCN_SADDRIFDEST field in the SYS1.MACLIB(BPXYIOCC) API. For COBOL, see the IFR-DSTADDR field in the SEZAINST(EZACOBOL) API. For PL/I, see the IFR_DSTADDR field in the SEZAINST(CBLOCK) API.

Table 19. IOCTL call arguments (continued)

COMMAND/CODE	SIZE	REQARG	SIZE	RETARG
SIOCGIFMTU X'C020A726'	32	First 16 bytes - interface name. Last 16 bytes - not used.	32	IPv4 interface MTU (maximum transmission unit). For assembler, see the IOCN_MTUSIZE field in the SYS1.MACLIB(BPXYIOCC) API. For COBOL, see the IFR-MTU field in the SEZAINST(EZACOBOL) API. For PL/I, see the IFR_MTU field in the SEZAINST(CBLOCK) API.
SIOCGIFNAMEINDEX X'4000F603'	4	First 4 bytes size of return buffer.		See Figure 98 on page 545 IF-NAMEINDEX .
SIOCGIPMSFILTER X'C000A724'	–	See IP_MSFILTER structure in macro BPXYIOCC. See note 2.	0	Not used
SIOCGMSFILTER X'C000F610'	–	See GROUP_FILTER structure in macro BPXYIOCC. See note 3	0	Not used
SIOCGPARTNERINFO X'C000F612'	–	For the PartnerInfo structure layout, see SEZANMAC(EZBPINFA) for assembler, SEZANMAC(EZBPINF1) for PL/I, and SEZANMAC(EZBPINFB) for COBOL. See note 4.	0	Not used
SIOCSAPPLDATA X'8018D90C'	–	See SETAPPLDATA structure in macro EZBYAPPL	0	Not used
SIOCSIPMSFILTER X'8000A725'	–	See IP_MSFILTER structure in macro BPXYIOCC. See note 2.	0	Not used
SIOCSMSFILTER X'8000F611'	–	See GROUP_FILTER structure in macro BPXYIOCC. See note 3	0	Not used
SIOCSPARTNERINFO X'8004F613'	4	See PI_REQTYPE_SET_PARTNERDATA in SEZANMAC(EZBPINFA) for assembler, SEZANMAC(EZBPINF1) for PL/I, and SEZANMAC(EZBPINFB) for COBOL.	0	Not used
SIOCTTLSCTL X'C038D90B'	56	For IOCTL structure layout, see SEZANMAC(EZBZTLS1) for PL/I, SEZANMAC(EZBZTLSP) for assembler, and SEZANMAC(EZBZTLSB) for COBOL.	56	For IOCTL structure layout, see SEZANMAC(EZBZTLS1) for PL/I, SEZANMAC(EZBZTLSP) for assembler, and SEZANMAC(EZBZTLSB) for COBOL.

Notes:

1. When you call IOCTL with the SIOCGIFCONF command set, REQARG should contain the length in bytes of RETARG. Each interface is assigned a 32-byte array element and REQARG should be set to the number of interfaces times 32. TCP/IP Services can return up to 100 array elements.
2. The size of the IP_MSFILTER structure must be equal to or greater than the size of the IMSF_Header value.
3. The size of the GROUP_FILTER structure must be equal to or greater than the size of GF_Header value.
4. The size of the PartnerInfo structure must be equal to or greater than the PI_FIXED_SIZE value.

Parameter values returned to the application

RETARG

Returns an array whose size is based on the value in COMMAND. See Table 19 for information about REQARG and RETARG.

ERRNO

A fullword binary field. If RETCODE is negative, the field contains an error number. See Appendix B, “Socket call error return codes,” on page 885 for information about ERRNO return codes.

RETCODE

A fullword binary field that returns one of the following:

Value	Description
0	Successful call.
–1	Check **ERRNO** for an error code.

The COMMAND SIOGIFCONF returns a variable number of network interface configurations. Figure 99 contains an example of a COBOL II routine that can be used to work with such a structure.

Note: This call can only be programmed in languages that support address pointers. Figure 99 shows a COBOL II example for SIOCGIFCONF.

```
WORKING-STORAGE SECTION.
  77   REQARG        PIC 9(8) COMP.
  77   COUNT         PIC 9(8) COMP VALUE max number of interfaces.
LINKAGE SECTION.
  01   RETARG.
       05   IOCTL-TABLE OCCURS 1 TO max TIMES DEPENDING ON COUNT.
            10    NAME     PIC X(16).
            10    FAMILY   PIC 9(4) BINARY.
            10    PORT     PIC 9(4) BINARY.
            10    ADDR     PIC 9(8) BINARY.
            10    NULLS    PIC X(8).
PROCEDURE DIVISION.
  MULTIPLY COUNT BY 32 GIVING REQARQ.
  CALL 'EZASOKET' USING SOC-FUNCTION S COMMAND
      REQARG RETARG ERRNO RETCODE.
```

Figure 99. COBOL II example for SIOCGIFCONF

LISTEN

The LISTEN call:

- Completes the bind, if BIND has not already been called for the socket.
- Creates a connection-request queue of a specified length for incoming connection requests.

Note: The LISTEN call is not supported for datagram sockets or raw sockets.

The LISTEN call is typically used by a server to receive connection requests from clients. When a connection request is received, a new socket is created by a subsequent ACCEPT call, and the original socket continues to listen for additional connection requests. The LISTEN call converts an active socket to a passive socket and conditions it to accept connection requests from clients. Once a socket becomes passive it cannot initiate connection requests.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.

Figure 100 shows an example of LISTEN call instructions.

```
WORKING-STORAGE SECTION.
    01  SOC-FUNCTION    PIC X(16)  VALUE IS 'LISTEN'.
    01  S               PIC 9(4) BINARY.
    01  BACKLOG         PIC 9(8) BINARY.
    01  ERRNO           PIC 9(8) BINARY.
    01  RETCODE         PIC S9(8) BINARY.

PROCEDURE DIVISION.
    CALL 'EZASOKET' USING SOC-FUNCTION S BACKLOG ERRNO RETCODE.
```

Figure 100. LISTEN call instruction example

For equivalent PL/I and assembler language declarations, see "Converting parameter descriptions" on page 472.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing LISTEN. The field is left-justified and padded to the right with blanks.

S A halfword binary number set to the socket descriptor.

BACKLOG
A fullword binary number set to the number of communication requests to be queued.

Rule: The BACKLOG value specified on the LISTEN call is limited to the value configured by the SOMAXCONN statement in the stack's TCPIP PROFILE (default=10); no error is returned if a larger backlog is requested. SOMAXCONN might need to be updated if a larger backlog is desired. see *z/OS Communications Server: IP Configuration Reference* for details.

Parameter values returned to the application

ERRNO
A fullword binary field. If RETCODE is negative, the field contains an error number. See Appendix B, "Socket call error return codes," on page 885 for information about ERRNO return codes.

RETCODE
A fullword binary field that returns one of the following:

Value	Description
0	Successful call.
–1	Check **ERRNO** for an error code.

NTOP

The NTOP call converts an IP address from its numeric binary form into a standard text presentation form. On successful completion, NTOP returns the converted IP address in the buffer provided.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.

Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.

Figure 101 shows an example of NTOP call instructions.

```
WORKING-STORAGE SECTION.
    01  SOC-ACCEPT-FUNCTION      PIC X(16)  VALUE IS 'ACCEPT'.
    01  SOC-NTOP-FUNCTION        PIC X(16)  VALUE IS 'NTOP'.
    01  S                        PIC 9(4) BINARY.

* IPv4 socket structure.
    01  NAME.
        03  FAMILY      PIC 9(4) BINARY.
        03  PORT        PIC 9(4) BINARY.
        03  IP-ADDRESS  PIC 9(8) BINARY.
        03  RESERVED    PIC X(8).

* IPv6 socket structure.
    01  NAME.
        03  FAMILY      PIC 9(4) BINARY.
        03  PORT        PIC 9(4) BINARY.
        03  FLOWINFO    PIC 9(8) BINARY.
        03  IP-ADDRESS.
            10 FILLER   PIC 9(16) BINARY.
            10 FILLER   PIC 9(16) BINARY.
        03  SCOPE-ID    PIC 9(8) BINARY.
    01  NTOP-FAMILY     PIC 9(8) BINARY.
    01  ERRNO           PIC 9(8) BINARY.
    01  RETCODE         PIC S9(8) BINARY.

    01  PRESENTABLE-ADDRESS      PIC X(45).
    01  PRESENTABLE-ADDRESS-LEN  PIC 9(4) BINARY.

PROCEDURE DIVISION.

     CALL 'EZASOKET' USING SOC-ACCEPT-FUNCTION S NAME
          ERRNO RETCODE.
     CALL 'EZASOKET' USING SOC-NTOP-FUNCTION NTOP-FAMILY IP-ADDRESS
            PRESENTABLE-ADDRESS
          PRESENTABLE-ADDRESS-LEN ERRNO RETURN-CODE.
```

Figure 101. NTOP call instruction example

Parameter values set by the application

Keyword	Description
FAMILY	The addressing family for the IP address being converted. The value of decimal 2 must be specified for AF_INET and 19 for AF_INET6.
IP-ADDRESS	A field containing the numeric binary form of the IPv4 or IPv6 address being converted. For an IPv4 address this field must be a

fullword and for an IPv6 address this field must be 16 bytes. The address must be in network byte order.

Parameter values returned to the application

Keyword **Description**

PRESENTABLE-ADDRESS
A field used to receive the standard text presentation form of the IPv4 or IPv6 address being converted. For IPv4 the address will be in dotted-decimal format and for IPv6 the address will be in colon-hex format. The size of the IPv4 address will be a maximum of 15 bytes and the size of the converted IPv6 address will be a maximum of 45 bytes. Consult the value returned in PRESENTABLE-ADDRESS-LEN for the actual length of the value in PRESENTABLE-ADDRESS.

PRESENTABLE-ADDRESS-LEN
Initially, an input parameter. The address of a binary halfword field that is used to specify the length of DSTADDR field on input and upon a successful return will contain the length of converted IP address.

ERRNO Output parameter. A fullword binary field. If RETCODE is negative, ERRNO contains a valid error number. Otherwise, ignore the ERRNO field.

See Appendix B, "Socket call error return codes," on page 885 for information about ERRNO return codes.

RETCODE A fullword binary field that returns one of the following:

Value	Description
0	Successful call.
–1	Check ERRNO for an error code.

PTON

The PTON call converts an IP address in its standard text presentation form to its numeric binary form. On successful completion, PTON returns the converted IP address in the buffer provided.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.

Figure 102 shows an example of PTON call instructions.

```
WORKING-STORAGE SECTION.
    01  SOC-BIND-FUNCTION      PIC X(16)  VALUE IS 'BIND'.
    01  SOC-PTON-FUNCTION      PIC X(16)  VALUE IS 'PTON'.
    01  S                      PIC 9(4) BINARY.

* IPv4 socket structure.
    01  NAME.
        03  FAMILY      PIC 9(4) BINARY.
        03  PORT        PIC 9(4) BINARY.
        03  IP-ADDRESS  PIC 9(8) BINARY.
        03  RESERVED    PIC X(8).

* IPv6 socket structure.
    01  NAME.
        03  FAMILY      PIC 9(4) BINARY.
        03  PORT        PIC 9(4) BINARY.
        03  FLOWINFO    PIC 9(8) BINARY.
        03  IP-ADDRESS.
            10 FILLER   PIC 9(16) BINARY.
            10 FILLER   PIC 9(16) BINARY.
        03  SCOPE-ID    PIC 9(8) BINARY.

    01  AF-INET         PIC 9(8) BINARY VALUE 2.
    01  AF-INET6        PIC 9(8) BINARY VALUE 19.

* IPv4 address.
    01  PRESENTABLE-ADDRESS      PIC X(45).
    01  PRESENTABLE-ADDRESS-IPV4 REDEFINES PRESENTABLE-ADDRESS.
        05  PRESENTABLE-IPV4-ADDRESS PIC X(15) VALUE '192.26.5.19'.
        05  FILLER      PIC X(30).
    01  PRESENTABLE-ADDRESS-LEN  PIC 9(4) BINARY VALUE 11.

* IPv6 address.
    01  PRESENTABLE-ADDRESS      PIC X(45)
          VALUE '12f9:0:0:c30:123:457:9cb:1112'.
    01  PRESENTABLE-ADDRESS-LEN  PIC 9(4) BINARY VALUE 29.

* IPv4-mapped IPv6 address.
    01  PRESENTABLE-ADDRESS      PIC X(45)
          VALUE '12f9:0:0:c30:123:457:192.26.5.19'.
    01  PRESENTABLE-ADDRESS-LEN  PIC 9(4) BINARY VALUE 32.

    01  ERRNO           PIC 9(8) BINARY.
    01  RETCODE         PIC S9(8) BINARY.


PROCEDURE DIVISION.

* IPv4 address.
     CALL 'EZASOKET' USING SOC-PTON-FUNCTION AF-INET PRESENTABLE-ADDRESS
           PRESENTABLE-ADDRESS-LEN IP-ADDRESS ERRNO RETURN-CODE.
* IPv6 address.
     CALL 'EZASOKET' USING SOC-PTON-FUNCTION AF-INET6 PRESENTABLE-ADDRESS
           PRESENTABLE-ADDRESS-LEN IP-ADDRESS ERRNO RETURN-CODE.
     CALL 'EZASOKET' USING SOC-BIND-FUNCTION S NAME ERRNO RETURN-CODE.
```

Figure 102. PTON call instruction example

Parameter values set by the application

Keyword	Description
FAMILY	The addressing family for the IP address being converted. The value of decimal 2 must be specified for AF_INET and 19 for AF_INET6.

PRESENTABLE-ADDRESS
A field containing the standard text presentation form of the IPv4 or IPv6 address being converted. For IPv4 the address will be in dotted-decimal format and for IPv6 the address will be in colon-hex format.

PRESENTABLE-ADDRESS-LEN
Input parameter. The address of a binary halfword field that must contain the length of the IP address to be converted.

Parameter values returned to the application

Keyword	Description
IP-ADDRESS	A field containing the numeric binary form of the IPv4 or IPv6 address being converted. For an IPv4 address this field must be a fullword and for an IPv6 address this field must be 16 bytes. The address must be in network byte order.
ERRNO	Output parameter. A fullword binary field. If RETCODE is negative, ERRNO contains a valid error number. Otherwise, ignore the ERRNO field. See Appendix B, "Socket call error return codes," on page 885 for information about ERRNO return codes.
RETCODE	A fullword binary field that returns one of the following:

Value	Description
0	Successful call.
–1	Check ERRNO for an error code.

READ

The READ call reads the data on socket s. This is the conventional TCP/IP read data operation. If a datagram packet is too long to fit in the supplied buffer, datagram sockets discard extra bytes.

For stream sockets, data is processed as streams of information with no boundaries separating the data. For example, if programs A and B are connected with a stream socket and program A sends 1000 bytes, each call to this function can return any number of bytes, up to the entire 1000 bytes. The number of bytes returned will be contained in RETCODE. Therefore, programs using stream sockets should place this call in a loop that repeats until all data has been received.

Note: See "EZACIC05" on page 617 for a subroutine that will translate ASCII input data to EBCDIC.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.

ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.

Figure 103 shows an example of READ call instructions.

```
WORKING-STORAGE SECTION.
    01  SOC-FUNCTION    PIC X(16)  VALUE IS 'READ'.
    01  S               PIC 9(4) BINARY.
    01  NBYTE           PIC 9(8) BINARY.
    01  BUF             PIC X(length of buffer).
    01  ERRNO           PIC 9(8) BINARY.
    01  RETCODE         PIC S9(8) BINARY.

PROCEDURE DIVISION.
     CALL 'EZASOKET' USING SOC-FUNCTION S NBYTE BUF
                     ERRNO RETCODE.
```

Figure 103. READ call instruction example

For equivalent PL/I and assembler language declarations, see "Converting parameter descriptions" on page 472.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing READ. The field is left-justified and padded to the right with blanks.

S A halfword binary number set to the socket descriptor of the socket that is going to read the data.

NBYTE
A fullword binary number set to the size of BUF. READ does not return more than the number of bytes of data in NBYTE even if more data is available.

Parameter values returned to the application

BUF On input, a buffer to be filled by completion of the call. The length of BUF must be at least as long as the value of NBYTE.

ERRNO
A fullword binary field. If RETCODE is negative, the field contains an error number. See Appendix B, "Socket call error return codes," on page 885 for information about ERRNO return codes.

RETCODE
A fullword binary field that returns one of the following:

Value	Description
0	A 0 return code indicates that the connection is closed and no data is available.
>0	A positive value indicates the number of bytes copied into the buffer.
–1	Check **ERRNO** for an error code.

READV

The READV function reads data on a socket and stores it in a set of buffers. If a datagram packet is too long to fit in the supplied buffers, datagram sockets discard extra bytes.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.

Figure 104 shows an example of READV call instructions.

```
WORKING-STORAGE SECTION.
01  SOC-FUNCTION         PIC X(16) VALUE 'READV'.
01  S                      PIC 9(4)  BINARY.
01  IOVCNT                 PIC 9(8)  BINARY.

01  IOV.
    03 BUFFER-ENTRY OCCURS N TIMES.
      05 BUFFER-POINTER    USAGE IS POINTER.
      05 RESERVED          PIC X(4).
      05 BUFFER_LENGTH     PIC 9(8) BINARY.

01  ERRNO                  PIC 9(8) BINARY.
01  RETCODE                PIC 9(8) BINARY.


PROCEDURE DIVISION.
SET BUFFER-POINTER(1) TO ADDRESS OF BUFFER1.
SET BUFFER-LENGTH(1) TO LENGTH OF BUFFER1.
SET BUFFER-POINTER(2) TO ADDRESS OF BUFFER2.
SET BUFFER-LENGTH(2) TO LENGTH OF BUFFER2.
"   "                "  "         "
"   "                "  "         "
SET BUFFER-POINTER(n) TO ADDRESS OF BUFFERn.
SET BUFFER-LENGTH(n) TO LENGTH OF BUFFERn.
Call 'EZASOCKET' USING SOC-FUNCTION S IOV IOVCNT ERRNO RETCODE.
```

Figure 104. READV call instruction example

For equivalent PL/I and assembler language declarations, see "Converting parameter descriptions" on page 472.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing READV. The field is left-justified and padded to the right with blanks.

S A value or the address of a halfword binary number specifying the descriptor of the socket into which the data is to be read.

IOV An array of tripleword structures with the number of structures equal to the value in IOVCNT and the format of the structures as follows:

Fullword 1
Pointer to the address of a data buffer, which is filled in on completion of the call

Fullword 2
Reserved

Fullword 3
The length of the data buffer referenced in fullword one

IOVCNT
A fullword binary field specifying the number of data buffers provided for this call.

Parameter values returned to the application

ERRNO
A fullword binary field. If RETCODE is negative, this contains an error number. See Appendix B, "Socket call error return codes," on page 885 for information about ERRNO return codes.

RETCODE
A fullword binary field that returns one of the following:

Value	Description
0	A 0 return code indicates that the connection is closed and no data is available.
>0	A positive value indicates the number of bytes copied into the buffer.
–1	Check **ERRNO** for an error code.

RECV

The RECV call, like READ, receives data on a socket with descriptor S. RECV applies only to connected sockets. If a datagram packet is too long to fit in the supplied buffers, datagram sockets discard extra bytes.

For additional control of the incoming data, RECV can:
- Peek at the incoming message without having it removed from the buffer
- Read out-of-band data

For stream sockets, data is processed as streams of information with no boundaries separating the data. For example, if programs A and B are connected with a stream socket and program A sends 1000 bytes, each call to this function can return any number of bytes, up to the entire 1000 bytes. The number of bytes returned will be contained in RETCODE. Therefore, programs using stream sockets should place RECV in a loop that repeats until all data has been received.

If data is not available for the socket, and the socket is in blocking mode, RECV blocks the caller until data arrives. If data is not available and the socket is in nonblocking mode, RECV returns a –1 and sets ERRNO to 35 (EWOULDBLOCK). See "FCNTL" on page 485 or "IOCTL" on page 540 for a description of how to set nonblocking mode.

For raw sockets, RECV adds a 20-byte header.

Note: See "EZACIC05" on page 617 for a subroutine that will translate ASCII input data to EBCDIC.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.

Figure 105 shows an example of RECV call instructions.

```
WORKING-STORAGE SECTION.
    01  SOC-FUNCTION    PIC X(16)  VALUE IS 'RECV'.
    01  S               PIC 9(4) BINARY.
    01  FLAGS           PIC 9(8) BINARY.
        88  NO-FLAG                VALUE IS 0.
        88  OOB                    VALUE IS 1.
        88  PEEK                   VALUE IS 2.
    01  NBYTE           PIC 9(8) BINARY.
    01  BUF             PIC X(length of buffer).
    01  ERRNO           PIC 9(8) BINARY.
    01  RETCODE         PIC S9(8) BINARY.

PROCEDURE DIVISION.
     CALL 'EZASOKET' USING SOC-FUNCTION S FLAGS NBYTE BUF
                     ERRNO RETCODE.
```

Figure 105. RECV call instruction example

For equivalent PL/I and assembler language declarations, see "Converting parameter descriptions" on page 472.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing RECV. The field is left-justified and padded to the right with blanks.

S A halfword binary number set to the socket descriptor of the socket to receive the data.

FLAGS
A fullword binary field with values as follows:

Literal Value	Binary Value	Description
NO-FLAG	X'00000000'	Read data.
MSG-OOB	X'00000001'	Receive out-of-band data (stream sockets only). Even if the OOB flag is not set, out-of-band data can be read if the SO-OOBINLINE option is set for the socket.
MSG-PEEK	X'00000002'	Peek at the data, but do not destroy data. If the peek flag is set, the next receive operation reads the same data.
MSG-WAITALL	X'00000040'	Requests that the function block until the full amount of data that was requested can be returned (stream sockets only). The function might return a smaller amount of data if the connection is closed, if an error is pending, or if the SO_RCVTIMEO field is set and the timer has expired for the socket.

NBYTE
A value or the address of a fullword binary number set to the size of BUF. RECV does not receive more than the number of bytes of data in NBYTE even if more data is available.

Parameter values returned to the application

BUF The input buffer to receive the data.

ERRNO
A fullword binary field. If RETCODE is negative, the field contains an error number. See Appendix B, "Socket call error return codes," on page 885 for information about ERRNO return codes.

RETCODE
A fullword binary field that returns one of the following:

Value	Description
0	The socket is closed.
>0	A positive return code indicates the number of bytes copied into the buffer.
–1	Check **ERRNO** for an error code.

RECVFROM

The RECVFROM call receives data on a socket with descriptor S and stores it in a buffer. The RECVFROM call applies to both connected and unconnected sockets. The socket address is returned in the NAME structure. If a datagram packet is too long to fit in the supplied buffers, datagram sockets discard extra bytes.

For datagram protocols, RECVFROM returns the source address associated with each incoming datagram. For connection-oriented protocols like TCP, GETPEERNAME returns the address associated with the other end of the connection.

If NAME is nonzero, the call returns the address of the sender. The NBYTE parameter should be set to the size of the buffer.

On return, NBYTE contains the number of data bytes received.

For stream sockets, data is processed as streams of information with no boundaries separating the data. For example, if programs A and B are connected with a stream socket and program A sends 1000 bytes, each call to this function can return any number of bytes, up to the entire 1000 bytes. The number of bytes returned will be contained in RETCODE. Therefore, programs using stream sockets should place RECVFROM in a loop that repeats until all data has been received.

For raw sockets, RECVFROM adds a 20-byte header.

If data is not available for the socket, and the socket is in blocking mode, RECVFROM blocks the caller until data arrives. If data is not available and the socket is in nonblocking mode, RECVFROM returns a −1 and sets ERRNO to 35 (EWOULDBLOCK). See "FCNTL" on page 485 or "IOCTL" on page 540 for a description of how to set nonblocking mode.

Note: See "EZACIC05" on page 617 for a subroutine that will translate ASCII input data to EBCDIC.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.

Figure 106 on page 563 shows an example of RECVFROM call instructions.

```
WORKING-STORAGE SECTION.
    01  SOC-FUNCTION    PIC X(16)  VALUE IS 'RECVFROM'.
    01  S               PIC 9(4) BINARY.
    01  FLAGS           PIC 9(8) BINARY.
        88  NO-FLAG                VALUE IS 0.
        88  OOB                    VALUE IS 1.
        88  PEEK                   VALUE IS 2.
    01  NBYTE           PIC 9(8) BINARY.
    01  BUF             PIC X(length of buffer).

* IPv4 socket address structure.
    01  NAME.
        03  FAMILY      PIC 9(4) BINARY.
        03  PORT        PIC 9(4) BINARY.
        03  IP-ADDRESS  PIC 9(8) BINARY.
        03  RESERVED    PIC X(8).

* IPv6 socket address structure.
    01  NAME.
        03  FAMILY      PIC 9(4) BINARY.
        03  PORT        PIC 9(4) BINARY.
        03  FLOWINFO    PIC 9(8) BINARY.
        03  IP-ADDRESS.
            10 FILLER   PIC 9(16) BINARY.
            10 FILLER   PIC 9(16) BINARY.
        03  SCOPE-ID    PIC 9(8) BINARY.

    01  ERRNO           PIC 9(8) BINARY.
    01  RETCODE         PIC S9(8) BINARY.

PROCEDURE DIVISION.
     CALL 'EZASOKET' USING SOC-FUNCTION S FLAGS
                           NBYTE BUF NAME ERRNO RETCODE.
```

Figure 106. RECVFROM call instruction example

For equivalent PL/I and assembler language declarations, see "Converting parameter descriptions" on page 472.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing RECVFROM. The field is left-justified and padded to the right with blanks.

S A halfword binary number set to the socket descriptor of the socket to receive the data.

FLAGS
A fullword binary field containing flag values as follows:

Literal Value	Binary Value	Description
NO-FLAG	X'00000000'	Read data.
MSG-OOB	X'00000001'	Receive out-of-band data (stream sockets only). Even if the OOB flag is not set, out-of-band data can be read if the SO-OOBINLINE option is set for the socket.
MSG-PEEK	X'00000002'	Peek at the data, but do not destroy data. If the peek flag is set, the next receive operation reads the same data.
MSG-WAITALL	X'00000040'	Requests that the function block until the requested amount of data can be returned (stream sockets only). The function might return a smaller amount of data if the connection is closed, if an error is pending, or if the SO_RCVTIMEO field is set and the timer has expired for the socket.

NBYTE
A fullword binary number specifying the length of the input buffer.

Parameter values returned to the application

BUF Defines an input buffer to receive the input data.

NAME

An IPv4 socket address structure containing the address of the socket that sent the data. The structure is as follows:

FAMILY
A halfword binary number specifying the IPv4 addressing family. The value is always decimal 2, indicating AF_INET.

PORT A halfword binary number specifying the port number of the sending socket.

IP-ADDRESS
A fullword binary number specifying the 32-bit IPv4 IP address of the sending socket.

RESERVED
An 8-byte reserved field. This field is required, but is not used.

An IPv6 socket address structure containing the address of the socket that sent the data. The structure is as follows:

Field Description

FAMILY
A halfword binary number specifying the IPv6 addressing family. The value is decimal 19, indicating AF_INET6.

PORT A halfword binary number specifying the port number of the sending socket.

FLOWINFO
A fullword binary field specifying the traffic class and flow label. This value of this field is undefined.

IP-ADDRESS
A 16-byte binary field set to the 128-bit IPv6 IP address of the sending socket.

SCOPE-ID
A fullword binary field which identifies a set of interfaces as appropriate for the scope of the address carried in the IPv6-ADDRESS field. For a link scope IPv6-ADDRESS, SCOPE-ID contains the link index for the IPv6-ADDRESS. For all other address scopes, SCOPE-ID is undefined.

ERRNO
A fullword binary field. If RETCODE is negative, the field contains an error number. See Appendix B, "Socket call error return codes," on page 885 for information about ERRNO return codes.

RETCODE
A fullword binary field that returns one of the following:

Value	Description
0	The socket is closed.
>0	A positive return code indicates the number of bytes of data transferred by the read call.
–1	Check **ERRNO** for an error code.

RECVMSG

The RECVMSG call receives messages on a socket with descriptor S and stores them in an array of message headers. If a datagram packet is too long to fit in the supplied buffers, datagram sockets discard extra bytes.

For datagram protocols, RECVMSG returns the source address associated with each incoming datagram. For connection-oriented protocols like TCP, GETPEERNAME returns the address associated with the other end of the connection.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.

Figure 107 on page 566 shows an example of RECVMSG call instructions.

```
WORKING-STORAGE SECTION.
           01  SOC-FUNCTION    PIC X(16)  VALUE IS 'RECVMSG'.
           01  S               PIC 9(4)   BINARY.
           01  MSG-HDR.
               03  MSG-NAME        USAGE IS POINTER.
               03  MSG-NAME-LEN    PIC 9(8) COMP.
               03  IOV             USAGE IS POINTER.
               03  IOVCNT          USAGE IS POINTER.
               03  MSG-ACCRIGHTS   USAGE IS POINTER.
               03  MSG-ACCRIGHTS-LEN USAGE IS POINTER.

           01  FLAGS           PIC 9(8)   BINARY.
               88  NO-FLAG                  VALUE IS 0.
               88  OOB                      VALUE IS 1.
               88  PEEK                     VALUE IS 2.
           01  ERRNO           PIC 9(8)   BINARY.
           01  RETCODE         PIC S9(8)  BINARY.

      LINKAGE SECTION.
           01 L1.
              03 RECVMSG-IOVECTOR.
                 05 IOV1A               USAGE IS POINTER.
                 05 IOV1AL              PIC 9(8) COMP.
                 05 IOV1L               PIC 9(8) COMP.
                 05 IOV2A               USAGE IS POINTER.
                 05 IOV2AL              PIC 9(8) COMP.
                 05 IOV2L               PIC 9(8) COMP.
                 05 IOV3A               USAGE IS POINTER.
                 05 IOV3AL              PIC 9(8) COMP.
                 05 IOV3L               PIC 9(8) COMP.

           03 RECVMSG-BUFFER1     PIC X(16).
           03 RECVMSG-BUFFER2     PIC X(16).
           03 RECVMSG-BUFFER3     PIC X(16).
           03 RECVMSG-BUFNO       PIC 9(8) COMP.

    * IPv4 socket address structure.
       03  NAME.
           05  FAMILY      PIC 9(4) BINARY.
           05  PORT        PIC 9(4) BINARY.
           05  IP-ADDRESS  PIC 9(8) BINARY.
           05  RESERVED    PIC X(8).

   * IPv6 socket address structure.
       03  NAME.
           05  FAMILY      PIC 9(4) BINARY.
           05  PORT        PIC 9(4) BINARY.
           53  FLOWINFO    PIC 9(8) BINARY.
           05  IP-ADDRESS.
               10 FILLER   PIC 9(16) BINARY.
               10 FILLER   PIC 9(16) BINARY.
           05  SCOPE-ID    PIC 9(8) BINARY.
```

Figure 107. RECVMSG call instruction example (Part 1 of 2)

```
PROCEDURE DIVISION USING L1.

           SET MSG-NAME TO ADDRESS OF NAME.
           MOVE LENGTH OF NAME TO MSG-NAME-LEN.
           SET IOV TO ADDRESS OF RECVMSG-IOVECTOR.
           MOVE 3 TO RECVMSG-BUFNO.
           SET IOVCNT TO ADDRESS OF RECVMSG-BUFNO.
           SET IOV1A TO ADDRESS OF RECVMSG-BUFFER1.
           MOVE 0 TO IOV1AL.
           MOVE LENGTH OF RECVMSG-BUFFER1 TO IOV1L.
           SET IOV2A TO ADDRESS OF RECVMSG-BUFFER2.
           MOVE 0 TO IOV2AL.
           MOVE LENGTH OF RECVMSG-BUFFER2 TO IOV2L.
           SET IOV3A TO ADDRESS OF RECVMSG-BUFFER3.
           MOVE 0 TO IOV3AL.
           MOVE LENGTH OF RECVMSG-BUFFER3 TO IOV3L.
           SET MSG-ACCRIGHTS TO NULLS.
           SET MSG-ACCRIGHTS-LEN TO NULLS.
           MOVE 0 TO FLAGS.
           MOVE SPACES TO RECVMSG-BUFFER1.
           MOVE SPACES TO RECVMSG-BUFFER2.
           MOVE SPACES TO RECVMSG-BUFFER3.

      CALL 'EZASOKET' USING SOC-FUNCTION S MSG-HDR FLAGS ERRNO RETCODE.
```

Figure 107. RECVMSG call instruction example (Part 2 of 2)

For equivalent PL/I and assembler language declarations, see "Converting parameter descriptions" on page 472.

Parameter values set by the application

S A value or the address of a halfword binary number specifying the socket descriptor.

MSG On input, a pointer to a message header into which the message is received upon completion of the call.

Field Description

NAME
On input, a pointer to a buffer where the sender address is stored upon completion of the call. The storage being pointed to should be for an IPv4 socket address or an IPv6 socket address. The IPv4 socket address structure contains the following fields:

Field Description

FAMILY
Output parameter. A halfword binary number specifying the IPv4 addressing family. The value for IPv4 socket descriptor (S parameter) is decimal 2, indicating AF_INET.

PORT Output parameter. A halfword binary number specifying the port number of the sending socket.

IP-ADDRESS
Output parameter. A fullword binary number specifying the 32-bit IPv4 IP address of the sending socket.

RESERVED
Output parameter. An 8-byte reserved field. This field is required, but is not used.

The IPv6 socket address structure contains the following fields:

Field Description

FAMILY
Output parameter. A halfword binary number specifying the IPv6 addressing family. The value for IPv6 socket descriptor (S parameter) is decimal 19, indicating AF_INET6.

PORT Output parameter. A halfword binary number specifying the port number of the sending socket.

FLOWINFO
A fullword binary field specifying the traffic class and flow label. This value of this field is undefined.

IP–ADDRESS
Output parameter. A 16 byte binary field specifying the 128–bit IPv6 IP address, in network byte order, of the sending socket.

SCOPE-ID
A fullword binary field which identifies a set of interfaces as appropriate for the scope of the address carried in the IPv6-ADDRESS field. For a link scope IPv6-ADDRESS, SCOPE-ID contains the link index for the IPv6-ADDRESS. For all other address scopes, SCOPE-ID is undefined.

NAME-LEN
On input, a pointer to the size of the NAME.

IOV On input, a pointer to an array of tripleword structures with the number of structures equal to the value in IOVCNT and the format of the structures as follows:

Fullword 1
A pointer to the address of a data buffer. This data buffer must be in the home address space.

Fullword 2
Reserved. This storage will be cleared.

Fullword 3
A pointer to the length of the data buffer referenced in fullword 1.

In COBOL, the IOV structure must be defined separately in the Linkage section, as shown in the example.

IOVCNT
On input, a pointer to a fullword binary field specifying the number of data buffers provided for this call.

ACCRIGHTS
On input, a pointer to the access rights received. This field is ignored.

ACCRLEN
On input, a pointer to the length of the access rights received. This field is ignored.

FLAGS
A fullword binary field with values as follows:

Literal Value	Binary Value	Description
NO-FLAG	X'00000000'	Read data.
MSG-OOB	X'00000001'	Receive out-of-band data (stream sockets only). Even if the OOB flag is not set, out-of-band data can be read if the SO-OOBINLINE option is set for the socket.
MSG-PEEK	X'00000002'	Peek at the data, but do not destroy data. If the peek flag is set, the next receive operation reads the same data.
MSG-WAITALL	X'00000040'	Requests that the function block until the requested amount of data can be returned (stream sockets only). The function might return a smaller amount of data if the connection is closed, if an error is pending, or if the SO_RCVTIMEO field is set and the timer has expired for the socket.

Parameter values returned to the application

ERRNO

A fullword binary field. If RETCODE is negative, this contains an error number. See Appendix B, "Socket call error return codes," on page 885 for information about ERRNO return codes.

RETCODE

A fullword binary field with the following values:

Value	Description
<0	Call returned error. See ERRNO field.
0	Connection partner has closed connection.
>0	Number of bytes read.

SELECT

In a process where multiple I/O operations can occur it is necessary for the program to be able to wait on one or several of the operations to complete.For example, consider a program that issues a READ to multiple sockets whose blocking mode is set. Because the socket would block on a READ call, only one socket could be read at a time. Setting the sockets nonblocking would solve this problem, but would require polling each socket repeatedly until data became available. The SELECT call allows you to test several sockets and to execute a subsequent I/O call only when one of the tested sockets is ready, thereby ensuring that the I/O call will not block.

To use the SELECT call as a timer in your program, do one of the following:
- Set the read, write, and exception arrays to zeros.
- Specify MAXSOC <= 0.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.

Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.

Defining which sockets to test

The SELECT call monitors for read operations, write operations, and exception operations:

- When a socket is ready to read, one of the following has occurred:
  - A buffer for the specified sockets contains input data. If input data is available for a given socket, a read operation on that socket will not block.
  - A connection has been requested on that socket.
- When a socket is ready to write, TCP/IP can accommodate additional output data. If TCP/IP can accept additional output for a given socket, a write operation on that socket will not block.
- When an exception condition has occurred on a specified socket it is an indication that a TAKESOCKET has occurred for that socket.
- A timeout occurs on the SELECT call. The timeout period can be specified when the SELECT call is issued.

Each socket descriptor is represented by a bit in a bit string. The length of this bit-mask array is dependent on the value of the MAXSOC parameter and must be a multiple of 4 bytes.

See "Selecting requests in a concurrent server program" on page 45 for more information.

Note: To simplify string processing in COBOL, you can use the program EZACIC06 to convert each bit in the string to a character. For more information, see "EZACIC06" on page 619.

Read operations

Read operations include ACCEPT, READ, READV, RECV, RECVFROM, or RECVMSG calls. A socket is ready to be read when data has been received for it or when a connection request has occurred.

To test whether any of several sockets is ready for reading, set the appropriate bits in RSNDMSK to one before issuing the SELECT call. When the SELECT call returns, the corresponding bits in the RRETMSK indicate sockets are ready for reading.

Write operations

A socket is selected for writing (ready to be written) when:

- TCP/IP can accept additional outgoing data.

- The socket is marked nonblocking and a previous CONNECT did not complete immediately. In this case, CONNECT returned an ERRNO with a value of 36 (EINPROGRESS). This socket will be selected for write when the CONNECT completes.

A call to WRITE, SEND, or SENDTO blocks when the amount of data to be sent exceeds the amount of data TCP/IP can accept. To avoid this, you can precede the write operation with a SELECT call to ensure that the socket is ready for writing. Once a socket is selected for WRITE, the program can determine the amount of TCP/IP buffer space available by issuing the GETSOCKOPT call with the SO-SNDBUF option.

To test whether any of several sockets is ready for writing, set the WSNDMSK bits representing those sockets to 1 before issuing the SELECT call. When the SELECT call returns, the corresponding bits in the WRETMSK indicate sockets are ready for writing.

Exception operations

For each socket to be tested, the SELECT call can check for an existing exception condition. Two exception conditions are supported:

- The calling program (concurrent server) has issued a GIVESOCKET command and the target child server has successfully issued the TAKESOCKET call. When this condition is selected, the calling program (concurrent server) should issue CLOSE to dissociate itself from the socket.
- A socket has received out-of-band data. On this condition, a READ will return the out-of-band data ahead of program data.

To test whether any of several sockets have an exception condition, set the ESNDMSK bits representing those sockets to 1. When the SELECT call returns, the corresponding bits in the ERETMSK indicate sockets with exception conditions.

MAXSOC parameter

The SELECT call must test each bit in each string before returning results. For efficiency, the MAXSOC parameter can be used to specify the largest socket descriptor number that needs to be tested for any event type. The SELECT call tests only bits that are in the range 0 through the MAXSOC value minus 1.

Example: If MAXSOC is set to 50, the range would be 0 through 49.

TIMEOUT parameter

If the time specified in the TIMEOUT parameter elapses before any event is detected, the SELECT call returns, and the RETCODE is set to 0.

Figure 108 on page 572 shows an example of SELECT call instructions.

```
WORKING-STORAGE SECTION.
    01  SOC-FUNCTION    PIC X(16)  VALUE IS 'SELECT'.
    01  MAXSOC          PIC 9(8) BINARY.
    01  TIMEOUT.
        03  TIMEOUT-SECONDS   PIC 9(8) BINARY.
        03  TIMEOUT-MICROSEC  PIC 9(8) BINARY.
    01  RSNDMSK        PIC X(*).
    01  WSNDMSK        PIC X(*).
    01  ESNDMSK        PIC X(*).
    01  RRETMSK        PIC X(*).
    01  WRETMSK        PIC X(*).
    01  ERETMSK        PIC X(*).
    01  ERRNO           PIC 9(8) BINARY.
    01  RETCODE         PIC S9(8) BINARY.

PROCEDURE DIVISION.
     CALL 'EZASOKET' USING SOC-FUNCTION MAXSOC TIMEOUT
                     RSNDMSK WSNDMSK ESNDMSK
                     RRETMSK WRETMSK ERETMSK
                     ERRNO RETCODE.
```

* The bit mask lengths can be determined from the expression:

```
((maximum socket number +32)/32 (drop the remainder))*4
```

Figure 108. SELECT call instruction example

Bit masks are 32-bit fullwords with one bit for each socket. Up to 32 sockets fit into one 32-bit mask [PIC X(4)]. If you have 33 sockets, you must allocate two 32-bit masks [PIC X(8)].

For equivalent PL/I and assembler language declarations, see "Converting parameter descriptions" on page 472.

Parameter values set by the application

SOC-FUNCTION

A 16-byte character field containing SELECT. The field is left-justified and padded on the right with blanks.

MAXSOC

A fullword binary field that specifies the largest socket descriptor value that is being checked. The SELECT call tests only bits that are in the range 0 through the MAXSOC value minus 1. For example, if you set the MAXSOC value to 50, the range is 0 – 49.

TIMEOUT

If TIMEOUT is a positive value, it specifies the maximum interval to wait for the selection to complete. If TIMEOUT-SECONDS is a negative value, the SELECT call blocks until a socket becomes ready. To poll the sockets and return immediately, specify the TIMEOUT value to be 0.

TIMEOUT is specified in the two-word TIMEOUT as follows:

- TIMEOUT-SECONDS, word one of the TIMEOUT field, is the seconds component of the timeout value.
- TIMEOUT-MICROSEC, word two of the TIMEOUT field, is the microseconds component of the timeout value (0—999999).

For example, if you want SELECT to time out after 3.5 seconds, set TIMEOUT-SECONDS to 3 and TIMEOUT-MICROSEC to 500000.

RSNDMSK

A bit string sent to request read event status.

- For each socket to be checked for pending read events, the corresponding bit in the string should be set to 1.
- For sockets to be ignored, the value of the corresponding bit should be set to 0.

If this parameter is set to all zeros, the SELECT will not check for read events.

WSNDMSK
A bit string sent to request write event status.

- For each socket to be checked for pending write events, the corresponding bit in the string should be set to 1.
- For sockets to be ignored, the value of the corresponding bit should be set to 0.

If this parameter is set to all zeros, the SELECT will not check for write events.

ESNDMSK
A bit string sent to request exception event status.

- For each socket to be checked for pending exception events, the corresponding bit in the string should be set to 1.
- For each socket to be ignored, the corresponding bit should be set to 0.

If this parameter is set to all zeros, the SELECT will not check for exception events.

Parameter values returned to the application

RRETMSK
A bit string returned with the status of read events. The length of the string should be equal to the maximum number of sockets to be checked. For each socket that is ready to read, the corresponding bit in the string will be set to 1; bits that represent sockets that are not ready to read will be set to 0.

WRETMSK
A bit string returned with the status of write events. The length of the string should be equal to the maximum number of sockets to be checked. For each socket that is ready to write, the corresponding bit in the string will be set to 1; bits that represent sockets that are not ready to be written will be set to 0.

ERETMSK
A bit string returned with the status of exception events. The length of the string should be equal to the maximum number of sockets to be checked. For each socket that has an exception status, the corresponding bit will be set to 1; bits that represent sockets that do not have exception status will be set to 0.

ERRNO
A fullword binary field. If RETCODE is negative, the field contains an error number. See Appendix B, “Socket call error return codes,” on page 885 for information about ERRNO return codes.

RETCODE
A fullword binary field that returns one of the following:

Value	Description
>0	Indicates the sum of all ready sockets in the three masks.

0 Indicates that the SELECT time limit has expired.

–1 Check **ERRNO** for an error code.

SELECTEX

The SELECTEX call monitors a set of sockets, a time value, and an ECB. It completes when either one of the sockets has activity, the time value expires, or one of the ECBs is posted.

To use the SELECTEX call as a timer in your program, do either of the following:
- Set the read, write, and exception arrays to zeros.
- Specify MAXSOC ≤ 0.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.

Defining which sockets to test

The SELECTEX call monitors for read operations, write operations, and exception operations:
- When a socket is ready to read, one of the following has occurred:
  - A buffer for the specified sockets contains input data. If input data is available for a given socket, a read operation on that socket will not block.
  - A connection has been requested on that socket.
- When a socket is ready to write, TCP/IP can accommodate additional output data. If TCP/IP can accept additional output for a given socket, a write operation on that socket will not block.
- When an exception condition has occurred on a specified socket it is an indication that a TAKESOCKET has occurred for that socket.
- A timeout occurs on the SELECTEX call. The timeout period can be specified when the SELECTEX call is issued.
- The ECB (or one of the ECBs in the ECB list) passed on the SELECTEX call has been posted.

Each socket descriptor is represented by a bit in a bit string. The length of this bit-mask array is dependent on the value of the MAXSOC parameter and must be a multiple of 4 bytes.

See "Selecting requests in a concurrent server program" on page 45 for more information.

Note: To simplify string processing in COBOL, you can use the program EZACIC06 to convert each bit in the string to a character. For more information, see "EZACIC06" on page 619.

Read operations

Read operations include ACCEPT, READ, READV, RECV, RECVFROM, or RECVMSG calls. A socket is ready to be read when data has been received for it or when a connection request has occurred.

To test whether any of several sockets is ready for reading, set the appropriate bits in RSNDMSK to one before issuing the SELECTEX call. When the SELECTEX call returns, the corresponding bits in the RRETMSK indicate sockets are ready for reading.

Write operations

A socket is selected for writing (ready to be written) when:

- TCP/IP can accept additional outgoing data.
- The socket is marked nonblocking and a previous CONNECT did not complete immediately. In this case, CONNECT returned an ERRNO with a value of 36 (EINPROGRESS). This socket will be selected for write when the CONNECT completes.

A call to WRITE, SEND, or SENDTO blocks when the amount of data to be sent exceeds the amount of data TCP/IP can accept. To avoid this, you can precede the write operation with a SELECTEX call to ensure that the socket is ready for writing. Once a socket is selected for WRITE, the program can determine the amount of TCP/IP buffer space available by issuing the GETSOCKOPT call with the SO-SNDBUF option.

To test whether any of several sockets is ready for writing, set the WSNDMSK bits representing those sockets to 1 before issuing the SELECTEX call. When the SELECTEX call returns, the corresponding bits in the WRETMSK indicate sockets are ready for writing.

Exception operations

For each socket to be tested, the SELECTEX call can check for an existing exception condition. Two exception conditions are supported:

- The calling program (concurrent server) has issued a GIVESOCKET command and the target child server has successfully issued the TAKESOCKET call. When this condition is selected, the calling program (concurrent server) should issue CLOSE to dissociate itself from the socket.
- A socket has received out-of-band data. On this condition, a READ will return the out-of-band data ahead of program data.

To test whether any of several sockets have an exception condition, set the ESNDMSK bits representing those sockets to 1. When the SELECTEX call returns, the corresponding bits in the ERETMSK indicate sockets with exception conditions.

MAXSOC parameter

The SELECTEX call must test each bit in each string before returning results. For efficiency, the MAXSOC parameter can be used to specify the largest socket descriptor number that needs to be tested for any event type. The SELECTEX call tests only bits that are in the range 0 through the MAXSOC value minus 1.

Example: If MAXSOC is set to 50, the range would be 0 through 49.

TIMEOUT parameter

If the time specified in the TIMEOUT parameter elapses before any event is detected, the SELECTEX call returns, and the RETCODE is set to 0.

Figure 109 on page 577 shows an example of SELECTEX call instructions.

If an application intends to pass a single ECB on the SELECTEX call, then the corresponding working storage definitions and CALL instruction should be coded as below:

```
WORKING-STORAGE SECTION.
    01  SOC-FUNCTION    PIC X(16)  VALUE IS 'SELECTEX'.
    01  MAXSOC          PIC 9(8)   BINARY.
    01  TIMEOUT.
        03  TIMEOUT-SECONDS    PIC 9(8) BINARY.
        03  TIMEOUT-MINUTES    PIC 9(8) BINARY.
    01  RSNDMSK         PIC X(*).
    01  WSNDMSK         PIC X(*).
    01  ESNDMSK         PIC X(*).
    01  RRETMSK         PIC X(*).
    01  WRETMSK         PIC X(*).
    01  ERETMSK         PIC X(*).
    01  SELECB          PIC X(4).
    01  ERRNO           PIC 9(8)   BINARY.
    01  RETCODE         PIC S9(8)  BINARY.

Where * is the size of the select mask

 PROCEDURE DIVISION.
    CALL 'EZASOKET' USING SOC-FUNCTION MAXSOC TIMEOUT
                    RSNDMSK WSNDMSK ESNDMSK
                    RRETMSK WRETMSK ERETMSK
                    SELECB ERRNO RETCODE.
```

However, if the application intends to pass the address of an ECB list on the SELECTEX call, then the application must set the high order bit in the ECB list address and pass that address using the BY VALUE option as documented in the following example. The remaining parameters must be set back to the default by specifying BY REFERENCE before ERRNO:

```
 WORKING-STORAGE SECTION.
     01  SOC-FUNCTION    PIC X(16)  VALUE IS 'SELECTEX'.
     01  MAXSOC          PIC 9(8)   BINARY.
     01  TIMEOUT.
         03  TIMEOUT-SECONDS    PIC 9(8) BINARY.
         03  TIMEOUT-MINUTES    PIC 9(8) BINARY.
     01  RSNDMSK         PIC X(*).
     01  WSNDMSK         PIC X(*).
     01  ESNDMSK         PIC X(*).
     01  RRETMSK         PIC X(*).
     01  WRETMSK         PIC X(*).
     01  ERETMSK         PIC X(*).
     01  ECBLIST-PTR     USAGE IS POINTER.
     01  ERRNO           PIC 9(8)   BINARY.
     01  RETCODE         PIC S9(8)  BINARY.

 Where * is the size of the select mask

 PROCEDURE DIVISION.
    CALL 'EZASOKET' USING SOC-FUNCTION MAXSOC TIMEOUT
                    RSNDMSK WSNDMSK ESNDMSK
                    RRETMSK WRETMSK ERETMSK
                    BY VALUE ECBLIST-PTR
                    BY REFERENCE ERRNO RETCODE.
```

* The bit mask lengths can be determined from the expression:

```
((maximum socket number +32)/32 (drop the remainder))*4
```

Figure 109. SELECTEX call instruction example

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing SELECT. The field is left-justified and padded on the right with blanks.

MAXSOC
A fullword binary field that specifies the largest socket descriptor value that is being checked. The SELECTEX call tests only bits that are in the range 0 through the MAXSOC value minus 1. For example, if you set the MAXSOC value to 50, the range is 0 – 49.

TIMEOUT
If TIMEOUT is a positive value, it specifies a maximum interval to wait for the selection to complete. If TIMEOUT-SECONDS is a negative value, the SELECTEX call blocks until a socket becomes ready or an ECB or ECB in a list is posted. To poll the sockets and return immediately, set TIMEOUT to be zeros.

TIMEOUT is specified in the two-word TIMEOUT as follows:

- TIMEOUT-SECONDS, word one of the TIMEOUT field, is the seconds component of the timeout value.
- TIMEOUT-MICROSEC, word two of the TIMEOUT field, is the microseconds component of the timeout value (0—999999).

For example, if you want SELECTEX to time out after 3.5 seconds, set TIMEOUT-SECONDS to 3 and TIMEOUT-MICROSEC to 500000.

RSNDMSK
The bit-mask array to control checking for read interrupts. If this parameter is not specified or the specified bit-mask is zeros, the SELECT will not check for read interrupts. The length of this bit-mask array is dependent on the value in MAXSOC.

WSNDMSK
The bit-mask array to control checking for write interrupts. If this parameter is not specified or the specified bit-mask is zeros, the SELECT will not check for write interrupts. The length of this bit-mask array is dependent on the value in MAXSOC.

ESNDMSK
The bit-mask array to control checking for exception interrupts. If this parameter is not specified or the specified bit-mask is zeros, the SELECT will not check for exception interrupts. The length of this bit-mask array is dependent on the value in MAXSOC.

SELECB
An ECB which, if posted, causes completion of the SELECTEX.

ECBLIST-PTR
A pointer to an ECB list. The application must set the high order bit in the ECB list address and pass that address using the BY VALUE option. The remaining parameters must be set back to the default by specifying BY REFERENCE before ERRNO.

Parameter values returned to the application

ERRNO
A fullword binary field; if RETCODE is negative, this contains an error number. See Appendix B, “Socket call error return codes,” on page 885 for information about ERRNO return codes.

RETCODE
A fullword binary field

Value	Meaning
>0	The number of ready sockets.
0	Either the SELECTEX time limit has expired (ECB value is 0) or one of the caller's ECBs has been posted (ECB value is nonzero and the caller's descriptor sets is set to 0). The caller must initialize the ECB values to 0 before issuing the SELECTEX socket command.
-1	Check **ERRNO** for an error code.

RRETMSK
The bit-mask array returned by the SELECT if RSNDMSK is specified. The length of this bit-mask array is dependent on the value in MAXSOC.

WRETMSK
The bit-mask array returned by the SELECT if WSNDMSK is specified. The length of this bit-mask array is dependent on the value in MAXSOC.

ERETMSK
The bit-mask array returned by the SELECT if ESNDMSK is specified. The length of this bit-mask array is dependent on the value in MAXSOC.

SEND

The SEND call sends data on a specified connected socket.

The FLAGS field allows you to:

- Send out-of-band data, such as interrupts, aborts, and data marked urgent. Only stream sockets created in the AF_INET address family support out-of-band data.
- Suppress use of local routing tables. This implies that the caller takes control of routing and writing network software.

For datagram sockets, SEND transmits the entire datagram if it fits into the receiving buffer. Extra data is discarded.

For stream sockets, data is processed as streams of information with no boundaries separating the data. For example, if a program is required to send 1000 bytes, each call to this function can send any number of bytes, up to the entire 1000 bytes, with the number of bytes sent returned in RETCODE. Therefore, programs using stream sockets should place this call in a loop, reissuing the call until all data has been sent.

Note: See "EZACIC04" on page 615 for a subroutine that will translate EBCDIC input data to ASCII.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.

Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.

Figure 110 shows an example of SEND call instructions.

```
WORKING-STORAGE SECTION.
    01  SOC-FUNCTION    PIC X(16)  VALUE IS 'SEND'.
    01  S               PIC 9(4) BINARY.
    01  FLAGS           PIC 9(8) BINARY.
        88  NO-FLAG                VALUE IS 0.
        88  OOB                    VALUE IS 1.
        88  DONT-ROUTE             VALUE IS 4.
    01  NBYTE           PIC 9(8) BINARY.
    01  BUF             PIC X(length of buffer).
    01  ERRNO           PIC 9(8) BINARY.
    01  RETCODE         PIC S9(8) BINARY.

PROCEDURE DIVISION.
     CALL 'EZASOKET' USING SOC-FUNCTION S FLAGS NBYTE
                     BUF ERRNO RETCODE.
```

Figure 110. SEND call instruction example

For equivalent PL/I and assembler language declarations, see "Converting parameter descriptions" on page 472.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing SEND. The field is left-justified and padded on the right with blanks.

S A halfword binary number specifying the socket descriptor of the socket that is sending data.

FLAGS
A fullword binary field with values as follows:

Literal Value	Binary Value	Description
NO-FLAG	X'00000000'	No flag is set. The command behaves like a WRITE call.
MSG-OOB	X'00000001'	Send out-of-band data. (Stream sockets only.) Even if the OOB flag is not set, out-of-band data can be read if the SO-OOBINLINE option is set for the socket.
MSG-DONTROUTE	X'00000004'	Do not route. Routing is provided by the calling program.

NBYTE
A fullword binary number set to the number of bytes of data to be transferred.

BUF The buffer containing the data to be transmitted. BUF should be the size specified in NBYTE.

Parameter values returned to the application

ERRNO
A fullword binary field. If RETCODE is negative, the field contains an error number. See Appendix B, "Socket call error return codes," on page 885 for information about ERRNO return codes.

RETCODE
A fullword binary field that returns one of the following:

Value	Description
≥0	A successful call. The value is set to the number of bytes transmitted.
–1	Check **ERRNO** for an error code.

SENDMSG

The SENDMSG call sends messages on a socket with descriptor S passed in an array of messages.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.

Figure 111 on page 582 shows an example of SENDMSG call instructions.

```
WORKING-STORAGE SECTION.
           01  SOC-FUNCTION    PIC X(16)  VALUE IS 'SENDMSG'.
           01  S               PIC 9(4)   BINARY.
           01  MSG-HDR.
               03  MSG-NAME        USAGE IS POINTER.
               03  MSG-NAME-LEN    PIC 9(8) BINARY.
               03  IOV             USAGE IS POINTER.
               03  IOVCNT          USAGE IS POINTER.
               03  MSG-ACCRIGHTS   USAGE IS POINTER.
               03  MSG-ACCRIGHTS-LEN USAGE IS POINTER.

           01  FLAGS           PIC 9(8)   BINARY.
               88  NO-FLAG                  VALUE IS 0.
               88  OOB                      VALUE IS 1.
               88  DONTROUTE                VALUE IS 4.
           01  ERRNO           PIC 9(8)   BINARY.
           01  RETCODE         PIC S9(8)  BINARY.

           01  SENDMSG-IPV4ADDR PIC 9(8) BINARY.
           01  SENDMSG-IPV6ADDR.
               05 FILLER        PIC9(16) BINARY.
               05 FILLER        PIC9(16) BINARY.

       LINKAGE SECTION.
           01 L1.
            03 SENDMSG-IOVECTOR.
               05 IOV1A              USAGE IS POINTER.
               05 IOV1AL             PIC 9(8) COMP.
               05 IOV1L              PIC 9(8) COMP.
               05 IOV2A              USAGE IS POINTER.
               05 IOV2AL             PIC 9(8) COMP.
               05 IOV2L              PIC 9(8) COMP.
               05 IOV3A              USAGE IS POINTER.
               05 IOV3AL             PIC 9(8) COMP.
               05 IOV3L              PIC 9(8) COMP.

            03 SENDMSG-BUFFER1     PIC X(16).
            03 SENDMSG-BUFFER2     PIC X(16).
            03 SENDMSG-BUFFER3     PIC X(16).
            03 SENDMSG-BUFNO       PIC 9(8) COMP.

       * IPv4 socket address structure.

            03 NAME.
               05  FAMILY      PIC 9(4) BINARY.
               05  PORT        PIC 9(4) BINARY.
               05  IP-ADDRESS  PIC 9(8) BINARY.
               05  RESERVED    PIC X(8) BINARY.

       * IPv6 socket address structure.

            03 NAME.
               05  FAMILY      PIC 9(4) BINARY.
               05  PORT        PIC 9(4) BINARY.
               05  FLOWINFO    PIC 9(8) BINARY.
               05  IP-ADDRESS.
                   10 FILLER   PIC 9(16) BINARY.
                   10 FILLER   PIC 9(16) BINARY.
               05  SCOPE-ID    PIC 9(8) BINARY.
```

Figure 111. SENDMSG call instruction example (Part 1 of 2)

```
PROCEDURE DIVISION USING L1.

* For IPv6.
           MOVE 19 TO FAMILY.
           MOVE 1234 TO PORT.
           MOVE 0 TO FLOWINFO.
           MOVE SENDMSG-IPV6ADDR TO IP-ADDRESS.
           MOVE 0 TO SCOPE-ID.
* For IPv4.
           MOVE 2 TO FAMILY.
           MOVE 1234 TO PORT.
           MOVE SENDMSG-IPV4ADDR TO IP-ADDRESS.

           SET MSG-NAME TO ADDRESS OF NAME.
           MOVE LENGTH OF NAME TO MSG-NAME-LEN.
           SET IOV TO ADDRESS OF SENDMSG-IOVECTOR.
           MOVE 3 TO SENDMSG-BUFNO.
           SET MSG-IOVCNT TO ADDRESS OF SENDMSG-BUFNO.
           SET IOV1A TO ADDRESS OF SENDMSG-BUFFER1.
           MOVE 0 TO IOV1AL.
           MOVE LENGTH OF SENDMSG-BUFFER1 TO IOV1L.
           SET IOV2A TO ADDRESS OF SENDMSG-BUFFER2.
           MOVE 0 TO IOV2AL.
           MOVE LENGTH OF SENDMSG-BUFFER2 TO IOV2L.
           SET IOV3A TO ADDRESS OF SENDMSG-BUFFER3.
           MOVE 0 TO IOV3AL.
           MOVE LENGTH OF SENDMSG-BUFFER3 TO IOV3L.
           SET MSG-ACCRIGHTS TO NULLS.
           SET MSG-ACCRIGHTS-LEN TO NULLS.
           MOVE 0 TO FLAGS.
           MOVE 'MESSAGE TEXT 1 ' TO SENDMSG-BUFFER1.
           MOVE 'MESSAGE TEXT 2 ' TO SENDMSG-BUFFER2.
           MOVE 'MESSAGE TEXT 3 ' TO SENDMSG-BUFFER3.

      CALL 'EZASOKET' USING SOC-FUNCTION S MSG-HDR FLAGS ERRNO RETCODE.
```

Figure 111. SENDMSG call instruction example (Part 2 of 2)

For equivalent PL/I and assembler language declarations, see "Converting parameter descriptions" on page 472.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing SENDMSG. The field is left-justified and padded on the right with blanks.

S A value or the address of a halfword binary number specifying the socket descriptor.

MSG A pointer to an array of message headers from which messages are sent.

Field Description

NAME
On input, a pointer to a buffer where the sender's address is stored upon completion of the call. The storage being pointed to should be for an IPv4 socket address or an IPv6 socket address. The IPv4 socket address structure contains the following fields:

Field Description

FAMILY
Output parameter. A halfword binary number specifying

the IPv4 addressing family. The value for IPv4 socket descriptor (S parameter) is decimal 2, indicating AF_INET.

PORT Output parameter. A halfword binary number specifying the port number of the sending socket.

IP-ADDRESS
Output parameter. A fullword binary number specifying the 32-bit IPv4 IP address of the sending socket.

RESERVED
Output parameter. An 8-byte reserved field. This field is required, but is not used.

The IPv6 socket address structure contains the following fields:

Field Description

FAMILY
Output parameter. A halfword binary number specifying the IPv6 addressing family. The value for IPv6 socket descriptor (S parameter) is decimal 19, indicating AF_INET6.

PORT Output parameter. A halfword binary number specifying the port number of the sending socket.

FLOWINFO
A fullword binary field specifying the traffic class and flow label. This field must be set to 0.

IP-ADDRESS
Output parameter. A 16-byte binary field set to the 128-bit IPv6 IP address of the sending socket.

SCOPE-ID
A fullword binary field which identifies a set of interfaces as appropriate for the scope of the address carried in the IPv6-ADDRESS field. A value of 0 indicates the SCOPE-ID field does not identify the set of interfaces to be used, and may be specified for any address types and scopes. For a link scope IPv6-ADDRESS, SCOPE-ID may specify a link index which identifies a set of interfaces. For all other address scopes, SCOPE-ID must be set to 0.

NAME-LEN
On input, a pointer to the size of the address buffer.

IOV On input, a pointer to an array of three fullword structures with the number of structures equal to the value in IOVCNT and the format of the structures as follows:

Fullword 1
A pointer to the address of a data buffer.

Fullword 2
Reserved.

Fullword 3
A pointer to the length of the data buffer referenced in Fullword 1.

In COBOL, the IOV structure must be defined separately in the Linkage section, as shown in the example.

IOVCNT
On input, a pointer to a fullword binary field specifying the number of data buffers provided for this call.

ACCRIGHTS
On input, a pointer to the access rights received. This field is ignored.

ACCRIGHTS-LEN
On input, a pointer to the length of the access rights received. This field is ignored.

FLAGS
A fullword field containing the following:

Literal Value	Binary Value	Description
NO-FLAG	X'00000000'	No flag is set. The command behaves like a WRITE call.
MSG-OOB	X'00000001'	Send out-of-band data. (Stream sockets only.)
MSG-DONTROUTE	X'00000004'	Do not route. Routing is provided by the calling program.

Parameter values returned to the application

ERRNO
A fullword binary field. If RETCODE is negative, this contains an error number. See Appendix B, "Socket call error return codes," on page 885 for information about ERRNO return codes.

RETCODE
A fullword binary field that returns one of the following:

Value	Description
≥0	A successful call. The value is set to the number of bytes transmitted.
–1	Check ERRNO for an error code.

SENDTO

SENDTO is similar to SEND, except that it includes the destination address parameter. The destination address allows you to use the SENDTO call to send datagrams on a UDP socket, regardless of whether the socket is connected.

The FLAGS parameter allows you to:

- Send out-of-band data, such as interrupts, aborts, and data marked as urgent.
- Suppress use of local routing tables. This implies that the caller takes control of routing, which requires writing network software.

For datagram sockets, SENDTO transmits the entire datagram if it fits into the receiving buffer. Extra data is discarded.

For stream sockets, data is processed as streams of information with no boundaries separating the data. For example, if a program is required to send 1000 bytes, each call to this function can send any number of bytes, up to the entire 1000 bytes,

with the number of bytes sent returned in RETCODE. Therefore, programs using stream sockets should place SENDTO in a loop that repeats the call until all data has been sent.

Note: See "EZACIC04" on page 615 for a subroutine that will translate EBCDIC input data to ASCII.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.

Figure 112 on page 587 shows an example of SENDTO call instructions.

```
WORKING-STORAGE SECTION.
    01  SOC-FUNCTION    PIC X(16)  VALUE IS 'SENDTO'.
    01  S               PIC 9(4) BINARY.
    01  FLAGS.          PIC 9(8) BINARY.
        88  NO-FLAG         VALUE IS 0.
        88  OOB             VALUE IS 1.
        88  DONT-ROUTE      VALUE IS 4.
    01  NBYTE           PIC 9(8) BINARY.
    01  BUF             PIC X(length of buffer).

* IPv4 socket address structure.
    01  NAME
        03  FAMILY      PIC 9(4) BINARY.
        03  PORT        PIC 9(4) BINARY.
        03  IP-ADDRESS  PIC 9(8) BINARY.
        03  RESERVED    PIC X(8).

* IPv6 socket address structure.
    01  NAME
        03  FAMILY      PIC 9(4) BINARY.
        03  PORT        PIC 9(4) BINARY.
        03  FLOWINFO    PIC 9(8) BINARY.
        03  IP-ADDRESS.
            10 FILLER   PIC 9(16) BINARY.
            10 FILLER   PIC 9(16) BINARY.
        03  SCOPE-ID    PIC 9(8) BINARY.

    01  ERRNO           PIC 9(8) BINARY.
    01  RETCODE         PIC S9(8) BINARY.

PROCEDURE DIVISION.
     CALL 'EZASOKET' USING SOC-FUNCTION S FLAGS NBYTE
                     BUF NAME ERRNO RETCODE.
```

Figure 112. SENDTO call instruction example

For equivalent PL/I and assembler language declarations, see "Converting parameter descriptions" on page 472.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing SENDTO. The field is left-justified and padded on the right with blanks.

S A halfword binary number set to the socket descriptor of the socket sending the data.

FLAGS
A fullword field that returns one of the following:

Literal Value	Binary Value	Description
NO-FLAG	X'00000000'	No flag is set. The command behaves like a WRITE call.
MSG-OOB	X'00000001'	Send out-of-band data. (Stream sockets only.)
MSG-DONTROUTE	X'00000004'	Do not route. Routing is provided by the calling program.

NBYTE
A fullword binary number set to the number of bytes to transmit.

BUF Specifies the buffer containing the data to be transmitted. BUF should be the size specified in NBYTE.

NAME
Specifies the IPv4 socket address structure as follows:

FAMILY
A halfword binary field containing the IPv4 addressing family. For TCP/IP the value must be decimal 2, indicating AF_INET.

PORT A halfword binary field containing the port number bound to the socket.

IP-ADDRESS
A fullword binary field containing the socket's 32-bit IPv4 IP address.

RESERVED
Specifies eight-byte reserved field. This field is required, but not used.

Specifies the IPv6 socket address structure as follows:

FAMILY
A halfword binary field containing the IPv6 addressing family. For TCP/IP the value is decimal 19, indicating AF_INET6.

PORT A halfword binary field containing the port number bound to the socket.

FLOWINFO
A fullword binary field specifying the traffic class and flow label. This field must be set to 0.

IP-ADDRESS
A 16-byte binary field set to the 128-bit IPv6 IP address, in network byte order.

SCOPE-ID
A fullword binary field which identifies a set of interfaces as appropriate for the scope of the address carried in the IPv6-ADDRESS field. A value of 0 indicates the SCOPE-ID field does not identify the set of interfaces to be used, and may be specified for any address types and scopes. For a link scope IPv6-ADDRESS, SCOPE-ID may specify a link index which identifies a set of interfaces. For all other address scopes, SCOPE-ID must be set to 0.

Parameter values returned to the application

ERRNO
A fullword binary field. If RETCODE is negative, the field contains an error number. See Appendix B, "Socket call error return codes," on page 885 for information about ERRNO return codes.

RETCODE
A fullword binary field that returns one of the following:

Value	Description
≥0	A successful call. The value is set to the number of bytes transmitted.
–1	Check **ERRNO** for an error code.

SETSOCKOPT

The SETSOCKOPT call sets the options associated with a socket. SETSOCKOPT can be called only for sockets in the AF_INET or AF_INET6 domains.

The OPTVAL and OPTLEN parameters are used to pass data used by the particular set command. The OPTVAL parameter points to a buffer containing the data needed by the set command. The OPTLEN parameter must be set to the size of the data pointed to by OPTVAL.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.

Figure 113 shows an example of SETSOCKOPT call instructions.

```
WORKING-STORAGE SECTION.
    01  SOC-FUNCTION    PIC X(16)  VALUE IS 'SETSOCKOPT'.
    01  S               PIC 9(4) BINARY.
    01  OPTNAME         PIC 9(8) BINARY.
    01  OPTVAL          PIC 9(16) BINARY.
    01  OPTLEN          PIC 9(8) BINARY.
    01  ERRNO           PIC 9(8) BINARY.
    01  RETCODE         PIC S9(8) BINARY.
    01  OPTVAL          PIC 9(16) BINARY.
    01  OPTLEN          PIC 9(8)  BINARY.
    01  ERRNO           PIC 9(8)  BINARY.
    01  RETCODE         PIC S9(8) BINARY.

PROCEDURE DIVISION
     CALL 'EZASOKET' USING SOC-FUNCTION S OPTNAME
                    OPTVAL OPTLEN ERRNO RETCODE.
```

Figure 113. SETSOCKOPT call instruction example

For equivalent PL/I and assembler language declarations, see "Converting parameter descriptions" on page 472.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing SETSOCKOPT. The field is left-justified and padded to the right with blanks.

S A halfword binary number set to the socket whose options are to be set.

OPTNAME
Input parameter. See the table below for a list of the options and their unique requirements.

See Appendix D, "GETSOCKOPT/SETSOCKOPT command values," on page 917 for the numeric values of OPTNAME.

Note: COBOL programs cannot contain field names with the underbar character. Fields representing the option name should contain dashes instead.

OPTVAL
Contains data which further defines the option specified in OPTNAME. For the SETSOCKOPT API, OPTVAL will be an input parameter. See the table below for a list of the options and their unique requirements.

OPTLEN
Input parameter. A fullword binary field containing the length of the data returned in OPTVAL. See the table below for determining on what to base the value of OPTLEN.

Parameter values returned to the application

ERRNO
A fullword binary field. If RETCODE is negative, the field contains an error number. See Appendix B, "Socket call error return codes," on page 885 for information about ERRNO return codes.

RETCODE
A fullword binary field that returns one of the following:

Value	Description
0	Successful call.
–1	Check ERRNO for an error code.

Table 20. OPTNAME options for GETSOCKOPT and SETSOCKOPT

OPTNAME options (input)	SETSOCKOPT, OPTVAL (input)	GETSOCKOPT, OPTVAL (output)
IP_ADD_MEMBERSHIP Use this option to enable an application to join a multicast group on a specific interface. An interface has to be specified with this option. Only applications that want to receive multicast datagrams need to join multicast groups. This is an IPv4-only socket option.	Contains the IP_MREQ structure as defined in SYS1.MACLIB(BPXYSOCK). The IP_MREQ structure contains a 4-byte IPv4 multicast address followed by a 4-byte IPv4 interface address. See SEZAINST(CBLOCK) for the PL/I example of IP_MREQ. See SEZAINST(EZACOBOL) for the COBOL example of IP-MREQ.	N/A

Table 20. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

OPTNAME options (input)	SETSOCKOPT, OPTVAL (input)	GETSOCKOPT, OPTVAL (output)
IP_ADD_SOURCE_MEMBERSHIP Use this option to enable an application to join a source multicast group on a specific interface and a specific source address. You must specify an interface and a source address with this option. Applications that want to receive multicast datagrams need to join source multicast groups. This is an IPv4-only socket option.	Contains the IP_MREQ_SOURCE structure as defined in SYS1.MACLIB(BPXYSOCK). The IP_MREQ_SOURCE structure contains a 4-byte IPv4 multicast address followed by a 4-byte IPv4 source address and a 4-byte IPv4 interface address. See SEZAINST(CBLOCK) for the PL/I example of IP_MREQ_SOURCE. See SEZAINST(EZACOBOL) for the COBOL example of IP-MREQ-SOURCE.	N/A
IP_BLOCK_SOURCE Use this option to enable an application to block multicast packets that have a source address that matches the given IPv4 source address. You must specify an interface and a source address with this option. The specified multicast group must have been joined previously. This is an IPv4-only socket option.	Contains the IP_MREQ_SOURCE structure as defined in SYS1.MACLIB(BPXYSOCK). The IP_MREQ_SOURCE structure contains a 4-byte IPv4 multicast address followed by a 4-byte IPv4 source address and a 4-byte IPv4 interface address. See SEZAINST(CBLOCK) for the PL/I example of IP_MREQ_SOURCE. See SEZAINST(EZACOBOL) for the COBOL example of IP-MREQ-SOURCE.	N/A
IP_DROP_MEMBERSHIP Use this option to enable an application to exit a multicast group or to exit all sources for a multicast group. This is an IPv4-only socket option.	Contains the IP_MREQ structure as defined in SYS1.MACLIB(BPXYSOCK). The IP_MREQ structure contains a 4-byte IPv4 multicast address followed by a 4-byte IPv4 interface address. See SEZAINST(CBLOCK) for the PL/I example of IP_MREQ. See SEZAINST(EZACOBOL) for the COBOL example of IP-MREQ.	N/A

Table 20. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

OPTNAME options (input)	SETSOCKOPT, OPTVAL (input)	GETSOCKOPT, OPTVAL (output)
IP_DROP_SOURCE_MEMBERSHIP Use this option to enable an application to exit a source multicast group. This is an IPv4-only socket option.	Contains the IP_MREQ_SOURCE structure as defined in SYS1.MACLIB(BPXYSOCK). The IP_MREQ_SOURCE structure contains a 4-byte IPv4 multicast address followed by a 4-byte IPv4 source address and a 4-byte IPv4 interface address. See SEZAINST(CBLOCK) for the PL/I example of IP_MREQ_SOURCE. See SEZAINST(EZACOBOL) for the COBOL example of IP-MREQ-SOURCE.	N/A
IP_MULTICAST_IF Use this option to set or obtain the IPv4 interface address used for sending outbound multicast datagrams from the socket application. This is an IPv4-only socket option. **Note:** Multicast datagrams can be transmitted only on one interface at a time.	A 4-byte binary field containing an IPv4 interface address.	A 4-byte binary field containing an IPv4 interface address.
IP_MULTICAST_LOOP Use this option to control or determine whether a copy of multicast datagrams are looped back for multicast datagrams sent to a group to which the sending host itself belongs. The default is to loop the datagrams back. This is an IPv4-only socket option.	A 1-byte binary field. To enable, set to 1. To disable, set to 0.	A 1-byte binary field. If enabled, will contain a 1. If disabled, will contain a 0.
IP_MULTICAST_TTL Use this option to set or obtain the IP time-to-live of outgoing multicast datagrams. The default value is '01'x meaning that multicast is available only to the local subnet. This is an IPv4-only socket option.	A 1-byte binary field containing the value of '00'x to 'FF'x.	A 1-byte binary field containing the value of '00'x to 'FF'x.

Table 20. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

OPTNAME options (input)	SETSOCKOPT, OPTVAL (input)	GETSOCKOPT, OPTVAL (output)
IP_UNBLOCK_SOURCE Use this option to enable an application to unblock a previously blocked source for a given IPv4 multicast group. You must specify an interface and a source address with this option. This is an IPv4-only socket option.	Contains the IP_MREQ_SOURCE structure as defined in SYS1.MACLIB(BPXYSOCK). The IP_MREQ_SOURCE structure contains a 4-byte IPv4 multicast address followed by a 4-byte IPv4 source address and a 4-byte IPv4 interface address. See SEZAINST(CBLOCK) for the PL/I example of IP_MREQ_SOURCE. See SEZAINST(EZACOBOL) for the COBOL example of IP-MREQ-SOURCE.	

Table 20. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

OPTNAME options (input)	SETSOCKOPT, OPTVAL (input)	GETSOCKOPT, OPTVAL (output)
IPV6_ADDR_PREFERENCES Use this option to query or set IPv6 address preferences of a socket. The default source address selection algorithm considers these preferences when it selects an IP address that is appropriate to communicate with a given destination address. This is an AF_INET6-only socket option. **Result:** These flags are only preferences. The stack could assign a source IP address that does not conform to the IPV6_ADDR_PREFERENCES flags that you specify. **Guideline:** Use the INET6_IS_SRCADDR function to test whether the source IP address matches one or more IPV6_ADDR_PREFERENCES flags.	Contains the 4-byte flags field IPV6_ADDR_PREFERENCES_ FLAGS that is defined in SYS1.MACLIB(BPXYSOCK) with the following flags: **IPV6_PREFER_SRC_HOME (X'00000001')** Prefer home address **IPV6_PREFER_SRC_COA (X'00000002')** Prefer care-of address **IPV6_PREFER_SRC_TMP (X'00000004')** Prefer temporary address **IPV6_PREFER_SRC_PUBLIC (X'00000008')** Prefer public address **IPV6_PREFER_SRC_CGA (X'00000010')** Prefer cryptographically generated address **IPV6_PREFER_SRC_NONCGA (X'00000020')** Prefer non-cryptographically generated address Some of these flags are contradictory. Combining contradictory flags, such as IPV6_PREFER_SRC_CGA and IPV6_PREFER_SRC_NONCGA, results in error code EINVAL. See IPV6_ADDR_PREFERENCES and Mapping of GAI_HINTS/GAI_ADDRINFO EFLAGS in SEZAINST(CBLOCK) for the PL/I example of the OPTNAME and flag definitions. See IPV6_ADDR_PREFERENCES and AI_EFLAGS mappings in SEZAINST(EZACOBOL) for the COBOL example of the OPTNAME and flag definitions.	Contains the 4-byte flags field IPV6_ADDR_PREFERENCES_ FLAGS that is defined in SYS1.MACLIB(BPXYSOCK) with the following flags: **IPV6_PREFER_SRC_HOME (X'00000001')** Prefer home address **IPV6_PREFER_SRC_COA (X'00000002')** Prefer care-of address **IPV6_PREFER_SRC_TMP (X'00000004')** Prefer temporary address **IPV6_PREFER_SRC_PUBLIC (X'00000008')** Prefer public address **IPV6_PREFER_SRC_CGA (X'00000010')** Prefer cryptographically generated address **IPV6_PREFER_SRC_ NONCGA (X'00000020')** Prefer non-cryptographically generated address See IPV6_ADDR_ PREFERENCES and Mapping of GAI_HINTS/GAI_ADDRINFO EFLAGS in SEZAINST(CBLOCK) for the PL/I example of the OPTNAME and flag definitions. See IPV6_ADDR_PREFERENCES and AI_EFLAGS mappings in SEZAINST(EZACOBOL) for the COBOL example of the OPTNAME and flag definitions.

Table 20. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

OPTNAME options (input)	SETSOCKOPT, OPTVAL (input)	GETSOCKOPT, OPTVAL (output)
IPV6_JOIN_GROUP Use this option to control the reception of multicast packets and specify that the socket join a multicast group. This is an IPv6-only socket option.	Contains the IPV6_MREQ structure as defined in SYS1.MACLIB(BPXYSOCK). The IPV6_MREQ structure contains a 16-byte IPv6 multicast address followed by a 4-byte IPv6 interface index number. If the interface index number is 0, then the stack chooses the local interface. See the SEZAINST(CBLOCK) for the PL/I example of IPV6_MREQ. See SEZAINST(EZACOBOL) for the COBOL example of IPV6-MREQ.	N/A
IPV6_LEAVE_GROUP Use this option to control the reception of multicast packets and specify that the socket leave a multicast group. This is an IPv6-only socket option.	Contains the IPV6_MREQ structure as defined in SYS1.MACLIB(BPXYSOCK). The IPV6_MREQ structure contains a 16-byte IPv6 multicast address followed by a 4-byte IPv6 interface index number. If the interface index number is 0, then the stack chooses the local interface. See the SEZAINST(CBLOCK) for the PL/I example of IPV6_MREQ. See SEZAINST(EZACOBOL) for the COBOL example of IPV6-MREQ.	N/A
IPV6_MULTICAST_HOPS Use to set or obtain the hop limit used for outgoing multicast packets. This is an IPv6-only socket option.	Contains a 4-byte binary value specifying the multicast hops. If not specified, then the default is 1 hop. -1 indicates use stack default. 0 – 255 is the valid hop limit range. **Note:** An application must be APF authorized to enable it to set the hop limit value above the system defined hop limit value. CICS applications cannot execute as APF authorized.	Contains a 4-byte binary value in the range 0 – 255 indicating the number of multicast hops.

Table 20. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

OPTNAME options (input)	SETSOCKOPT, OPTVAL (input)	GETSOCKOPT, OPTVAL (output)
IPV6_MULTICAST_IF Use this option to set or obtain the index of the IPv6 interface used for sending outbound multicast datagrams from the socket application. This is an IPv6-only socket option.	Contains a 4-byte binary field containing an IPv6 interface index number.	Contains a 4-byte binary field containing an IPv6 interface index number.
IPV6_MULTICAST_LOOP Use this option to control or determine whether a multicast datagram is looped back on the outgoing interface by the IP layer for local delivery when datagrams are sent to a group to which the sending host itself belongs. The default is to loop multicast datagrams back. This is an IPv6-only socket option.	A 4-byte binary field. To enable, set to 1. To disable, set to 0.	A 4-byte binary field. If enabled, contains a 1. If disabled, contains a 0.
IPV6_UNICAST_HOPS Use this option to set or obtain the hop limit used for outgoing unicast IPv6 packets. This is an IPv6-only socket option.	Contains a 4-byte binary value specifying the unicast hops. If not specified, then the default is 1 hop. -1 indicates use stack default. 0 – 255 is the valid hop limit range. **Note:** APF authorized applications are permitted to set a hop limit that exceeds the system configured default. CICS applications cannot execute as APF authorized.	Contains a 4-byte binary value in the range 0 – 255 indicating the number of unicast hops.
IPV6_V6ONLY Use this option to set or determine whether the socket is restricted to send and receive only IPv6 packets. The default is to not restrict the sending and receiving of only IPv6 packets. This is an IPv6-only socket option.	A 4-byte binary field. To enable, set to 1. To disable, set to 0.	A 4-byte binary field. If enabled, contains a 1. If disabled, contains a 0.

Table 20. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

OPTNAME options (input)	SETSOCKOPT, OPTVAL (input)	GETSOCKOPT, OPTVAL (output)
MCAST_BLOCK_SOURCE Use this option to enable an application to block multicast packets that have a source address that matches the given source address. You must specify an interface index and a source address with this option. The specified multicast group must have been joined previously.	Contains the GROUP_SOURCE_REQ structure as defined in SYS1.MACLIB(BPXYSOCK). The GROUP_SOURCE_REQ structure contains a 4-byte interface index number followed by a socket address structure of the multicast address and a socket address structure of the source address. See SEZAINST(CBLOCK) for the PL/I example of GROUP_SOURCE_REQ. See SEZAINST(EZACOBOL) for the COBOL example of GROUP-SOURCE-REQ.	N/A
MCAST_JOIN_GROUP Use this option to enable an application to join a multicast group on a specific interface. You must specify an interface index. Applications that want to receive multicast datagrams must join multicast groups.	Contains the GROUP_REQ structure as defined in SYS1.MACLIB(BPXYSOCK). The GROUP_REQ structure contains a 4-byte interface index number followed by a socket address structure of the multicast address. See SEZAINST(CBLOCK) for the PL/I example of GROUP_REQ. See SEZAINST(EZACOBOL) for the COBOL example of GROUP-REQ.	N/A
MCAST_JOIN_SOURCE_GROUP Use this option to enable an application to join a source multicast group on a specific interface and a source address. You must specify an interface index and the source address. Applications that want to receive multicast datagrams only from specific source addresses need to join source multicast groups.	Contains the GROUP_SOURCE_REQ structure as defined in SYS1.MACLIB(BPXYSOCK). The GROUP_SOURCE_REQ structure contains a 4-byte interface index number followed by a socket address structure of the multicast address and a socket address structure of the source address. See SEZAINST(CBLOCK) for the PL/I example of GROUP_SOURCE_REQ. See SEZAINST(EZACOBOL) for the COBOL example of GROUP-SOURCE-REQ.	N/A

Table 20. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

OPTNAME options (input)	SETSOCKOPT, OPTVAL (input)	GETSOCKOPT, OPTVAL (output)
MCAST_LEAVE_GROUP Use this option to enable an application to exit a multicast group or exit all sources for a given multicast groups.	Contains the GROUP_REQ structure as defined in SYS1.MACLIB(BPXYSOCK). The GROUP_REQ structure contains a 4-byte interface index number followed by a socket address structure of the multicast address. See SEZAINST(CBLOCK) for the PL/I example of GROUP_REQ. See SEZAINST(EZACOBOL) for the COBOL example of GROUP-REQ.	N/A
MCAST_LEAVE_SOURCE_GROUP Use this option to enable an application to exit a source multicast group.	Contains the GROUP_SOURCE_REQ structure as defined in SYS1.MACLIB(BPXYSOCK). The GROUP_SOURCE_REQ structure contains a 4-byte interface index number followed by a socket address structure of the multicast address and a socket address structure of the source address. See SEZAINST(CBLOCK) for the PL/I example of GROUP_SOURCE_REQ. See SEZAINST(EZACOBOL) for the COBOL example of GROUP-SOURCE-REQ.	N/A
MCAST_UNBLOCK_SOURCE Use this option to enable an application to unblock a previously blocked source for a given multicast group. You must specify an interface index and a source address with this option.	Contains the GROUP_SOURCE_REQ structure as defined in SYS1.MACLIB(BPXYSOCK). The GROUP_SOURCE_REQ structure contains a 4-byte interface index number followed by a socket address structure of the multicast address and a socket address structure of the source address. See SEZAINST(CBLOCK) for the PL/I example of GROUP_SOURCE_REQ. See SEZAINST(EZACOBOL) for the COBOL example of GROUP-SOURCE-REQ.	N/A

Table 20. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

OPTNAME options (input)	SETSOCKOPT, OPTVAL (input)	GETSOCKOPT, OPTVAL (output)
SO_ASCII Use this option to set or determine the translation to ASCII data option. When SO_ASCII is set, data is translated to ASCII. When SO_ASCII is not set, data is not translated to or from ASCII. **Note:** This is a REXX-only socket option.	To enable, set to ON. To disable, set to OFF. **Note:** The *optvalue* is returned and is optionally followed by the name of the translation table that is used if translation is applied to the data.	If enabled, contains ON. If disabled, contains OFF. **Note:** The *optvalue* is returned and is optionally followed by the name of the translation table that is used if translation is applied to the data.
SO_BROADCAST Use this option to set or determine whether a program can send broadcast messages over the socket to destinations that can receive datagram messages. The default is disabled. **Note:** This option has no meaning for stream sockets.	A 4-byte binary field. To enable, set to 1 or a positive value. To disable, set to 0.	A 4-byte field. If enabled, contains a 1. If disabled, contains a 0.
SO_DEBUG Use SO_DEBUG to set or determine the status of the debug option. The default is *disabled*. The debug option controls the recording of debug information. **Notes:** 1. This is a REXX-only socket option. 2. This option has meaning only for stream sockets.	To enable, set to ON. To disable, set to OFF.	If enabled, contains ON. If disabled, contains OFF.
SO_EBCDIC Use this option to set or determine the translation to EBCDIC data option. When SO_EBCDIC is set, data is translated to EBCDIC. When SO_EBCDIC is not set, data is not translated to or from EBCDIC. This option is ignored by EBCDIC hosts. **Note:** This is a REXX-only socket option.	To enable, set to ON. To disable, set to OFF. **Note:** The *optvalue* is returned and is optionally followed by the name of the translation table that is used if translation is applied to the data.	If enabled, contains ON. If disabled, contains OFF. **Note:** The *optvalue* is returned and is optionally followed by the name of the translation table that is used if translation is applied to the data.
SO_ERROR Use this option to request pending errors on the socket or to check for asynchronous errors on connected datagram sockets or for other errors that are not explicitly returned by one of the socket calls. The error status is clear afterwards.	N/A	A 4-byte binary field containing the most recent ERRNO for the socket.

Table 20. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

OPTNAME options (input)	SETSOCKOPT, OPTVAL (input)	GETSOCKOPT, OPTVAL (output)
SO_KEEPALIVE Use this option to set or determine whether the keep alive mechanism periodically sends a packet on an otherwise idle connection for a stream socket. The default is disabled. When activated, the keep alive mechanism periodically sends a packet on an otherwise idle connection. If the remote TCP does not respond to the packet or to retransmissions of the packet, the connection is terminated with the error ETIMEDOUT.	A 4-byte binary field. To enable, set to 1 or a positive value. To disable, set to 0.	A 4-byte binary field. If enabled, contains a 1. If disabled, contains a 0.

SO_LINGER
 	
Use this option to control or determine how TCP/IP processes data that has not been transmitted when a CLOSE is issued for the socket. The default is disabled.
 	
Notes:
1. This option has meaning only for stream sockets.
2. If you set a zero linger time, the connection cannot close in an orderly manner, but stops, resulting in a RESET segment being sent to the connection partner. Also, if the aborting socket is in nonblocking mode, the close call is treated as though no linger option had been set.
 	
When SO_LINGER is set and CLOSE is called, the calling program is blocked until the data is successfully transmitted or the connection has timed out.
 	
When SO_LINGER is not set, the CLOSE returns without blocking the caller, and TCP/IP continues to attempt to send data for a specified time. This usually allows sufficient time to complete the data transfer.
 	
Use of the SO_LINGER option does not guarantee successful completion because TCP/IP only waits the amount of time specified in OPTVAL for SO_LINGER.
	Contains an 8-byte field containing two 4-byte binary fields.
	
	Assembler coding:
	`ONOFF  DS F`
	`LINGER  DS F`
	
	COBOL coding:
	`ONOFF  PIC 9(8) BINARY.`
	`LINGER PIC 9(8) BINARY.`
	
	Set ONOFF to a nonzero value to enable and set to 0 to disable this option. Set LINGER to the number of seconds that TCP/IP lingers after the CLOSE is issued.
		Contains an 8-byte field containing two 4-byte binary fields.
		
		Assembler coding:
		`ONOFF  DS F`
		`LINGER  DS F`
		
		COBOL coding:
		`ONOFF  PIC 9(8) BINARY.`
		`LINGER PIC 9(8) BINARY.`
		
		A nonzero value returned in ONOFF indicates enabled, a 0 indicates disabled. LINGER indicates the number of seconds that TCP/IP will try to send data after the CLOSE is issued.

Table 20. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

OPTNAME options (input)	SETSOCKOPT, OPTVAL (input)	GETSOCKOPT, OPTVAL (output)
SO_OOBINLINE Use this option to control or determine whether out-of-band data is received. **Note:** This option has meaning only for stream sockets. When this option is set, out-of-band data is placed in the normal data input queue as it is received and is available to a RECV or a RECVFROM even if the OOB flag is not set in the RECV or the RECVFROM. When this option is disabled, out-of-band data is placed in the priority data input queue as it is received and is available to a RECV or a RECVFROM only when the OOB flag is set in the RECV or the RECVFROM.	A 4-byte binary field. To enable, set to 1 or a positive value. To disable, set to 0.	A 4-byte binary field. If enabled, contains a 1. If disabled, contains a 0.
SO_RCVBUF Use this option to control or determine the size of the data portion of the TCP/IP receive buffer. The size of the data portion of the receive buffer is protocol-specific, based on the following values prior to any SETSOCKOPT call: • TCPRCVBufrsize keyword on the TCPCONFIG statement in the PROFILE.TCPIP data set for a TCP Socket • UDPRCVBufrsize keyword on the UDPCONFIG statement in the PROFILE.TCPIP data set for a UDP Socket • The default of 65 535 for a raw socket	A 4-byte binary field. To enable, set to a positive value specifying the size of the data portion of the TCP/IP receive buffer. To disable, set to a 0.	A 4-byte binary field. If enabled, contains a positive value indicating the size of the data portion of the TCP/IP receive buffer. If disabled, contains a 0.

Table 20. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

OPTNAME options (input)	SETSOCKOPT, OPTVAL (input)	GETSOCKOPT, OPTVAL (output)
SO_RCVTIMEO Use this option to control or determine the maximum length of time that a receive-type function can wait before it completes. If a receive-type function has blocked for the maximum length of time that was specified without receiving data, control is returned with an errno set to EWOULDBLOCK. The default value for this option is 0, which indicates that a receive-type function does not time out. When the MSG_WAITALL flag (stream sockets only) is specified, the timeout takes precedence. The receive-type function can return the partial count. See the explanation of that operation's MSG_WAITALL flag parameter. The following receive-type functions are supported: • READ • READV • RECV • RECVFROM • RECVMSG	This option requires a TIMEVAL structure, which is defined in SYS1.MACLIB(BPXYRLIM) macro. The TIMEVAL structure contains the number of seconds and microseconds specified as fullword binary numbers. The seconds can be a value in the range 0 - 2 678 400 (equal to 31 days), and the microseconds can be a value in the range 0 - 1 000 000 (equal to 1 second). Although TIMEVAL value can be specified using microsecond granularity, the internal TCP/IP timers that are used to implement this function have a granularity of approximately 100 milliseconds.	This option stores a TIMEVAL structure that is defined in the SYS1.MACLIB(BPXYRLIM) macro. The TIMEVAL structure contains the number of seconds and microseconds, which are specified as fullword binary numbers. The number of seconds value that is returned is in the range 0 - 2 678 400 (equal to 31 days). The number of microseconds value that is returned is in the range 0 - 1 000 000.

Table 20. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

OPTNAME options (input)	SETSOCKOPT, OPTVAL (input)	GETSOCKOPT, OPTVAL (output)
SO_REUSEADDR Use this option to control or determine whether local addresses are reused. The default is disabled. This alters the normal algorithm used with BIND. The normal BIND algorithm allows each Internet address and port combination to be bound only once. If the address and port have been already bound, then a subsequent BIND will fail and result error will be EADDRINUSE. When this option is enabled, the following situations are supported: • A server can BIND the same port multiple times as long as every invocation uses a different local IP address and the wildcard address INADDR_ANY is used only one time per port. • A server with active client connections can be restarted and can bind to its port without having to close all of the client connections. • For datagram sockets, multicasting is supported so multiple bind() calls can be made to the same class D address and port number. • If you require multiple servers to BIND to the same port and listen on INADDR_ANY, see the SHAREPORT option on the PORT statement in TCPIP.PROFILE.	A 4-byte binary field. To enable, set to 1 or a positive value. To disable, set to 0.	A 4-byte binary field. If enabled, contains a 1. If disabled, contains a 0.
SO_SNDBUF Use this option to control or determine the size of the data portion of the TCP/IP send buffer. The size is of the TCP/IP send buffer is protocol specific and is based on the following: • The TCPSENDBufrsize keyword on the TCPCONFIG statement in the PROFILE.TCPIP data set for a TCP socket • The UDPSENDBufrsize keyword on the UDPCONFIG statement in the PROFILE.TCPIP data set for a UDP socket • The default of 65 535 for a raw socket	A 4-byte binary field. To enable, set to a positive value specifying the size of the data portion of the TCP/IP send buffer. To disable, set to a 0.	A 4-byte binary field. If enabled, contains a positive value indicating the size of the data portion of the TCP/IP send buffer. If disabled, contains a 0.

Table 20. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

OPTNAME options (input)	SETSOCKOPT, OPTVAL (input)	GETSOCKOPT, OPTVAL (output)
SO_SNDTIMEO Use this option to control or determine the maximum length of time that a send-type function can remain blocked before it completes. If a send-type function has blocked for this length of time, it returns with a partial count or, if no data is sent, with an errno set to EWOULDBLOCK. The default value for this is 0, which indicates that a send-type function does not time out. For a SETSOCKOPT, the following send-type functions are supported: • SEND • SENDMSG • SENDTO • WRITE • WRITEV	This option requires a TIMEVAL structure, which is defined in the SYS1.MACLIB(BPXYRLIM) macro. The TIMEVAL structure contains the number of seconds and microseconds specified as fullword binary numbers. The seconds value is in the range 0 - 2 678 400 (equal to 31 days), and the microseconds value is in the range 0 - 1 000 000 (equal to 1 second). Although the TIMEVAL value can be specified using microsecond granularity, the internal TCP/IP timers that are used to implement this function have a granularity of approximately 100 milliseconds.	This option stores a TIMEVAL structure that is defined in SYS1.MACLIB(BPXYRLIM). The TIMEVAL structure contains the number of seconds and microseconds, which are specified as fullword binary numbers. The number of seconds value that is returned is in the range 0 - 2 678 400 (equal to 31 days). The microseconds value that is returned is in the range 0 - 1 000 000.
SO_TYPE Use this option to return the socket type.	N/A	A 4-byte binary field indicating the socket type: X'1' indicates SOCK_STREAM. X'2' indicates SOCK_DGRAM. X'3' indicates SOCK_RAW.
TCP_KEEPALIVE Use this option to set or determine whether a socket-specific timeout value (in seconds) is to be used in place of a configuration-specific value whenever keep alive timing is active for that socket. When activated, the socket-specified timer value remains in effect until respecified by SETSOCKOPT or until the socket is closed. See the *z/OS Communications Server: IP Programmer's Guide and Reference* for more information about the socket option parameters.	A 4-byte binary field. To enable, set to a value in the range of 1 – 2 147 460. To disable, set to a value of 0.	A 4-byte binary field. If enabled, contains the specific timer value (in seconds) that is in effect for the given socket. If disabled, contains a 0 indicating keep alive timing is not active.

Table 20. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

OPTNAME options (input)	SETSOCKOPT, OPTVAL (input)	GETSOCKOPT, OPTVAL (output)

TCP_NODELAY
 	
Use this option to set or determine whether data sent over the socket is subject to the Nagle algorithm (RFC 896).
 	
Under most circumstances, TCP sends data when it is presented. When this option is enabled, TCP will wait to send small amounts of data until the acknowledgment for the previous data sent is received. When this option is disabled, TCP will send small amounts of data even before the acknowledgment for the previous data sent is received.
Note: Use the following to set **TCP_NODELAY OPTNAME** value for COBOL programs:
`01 TCP-NODELAY-VAL PIC 9(10) COMP VALUE 2147483649.`
`01 TCP-NODELAY-REDEF REDEFINES TCP-NODELAY-VAL.`
`05 FILLER PIC 9(6) BINARY.`
`05 TCP-NODELAY PIC 9(8) BINARY.`
	A 4-byte binary field.
	
	To enable, set to a 0.
	
	To disable, set to a 1 or nonzero.
		A 4-byte binary field.
		
		If enabled, contains a 0.
		
		If disabled, contains a 1.

SHUTDOWN

One way to terminate a network connection is to issue the CLOSE call which attempts to complete all outstanding data transmission requests prior to breaking the connection. The SHUTDOWN call can be used to close one-way traffic while completing data transfer in the other direction. The HOW parameter determines the direction of traffic to shutdown.

When the CLOSE call is used, the SETSOCKOPT OPTVAL LINGER parameter determines the amount of time the system will wait before releasing the connection. For example, with a LINGER value of 30 seconds, system resources (including the IMS or CICS transaction) will remain in the system for up to 30 seconds after the CLOSE call is issued. In high volume, transaction-based systems like CICS and IMS, this can impact performance severely.

If the SHUTDOWN call is issued when the CLOSE call is received, the connection can be closed immediately, rather than waiting for the 30-second delay.

If you issue SHUTDOWN for a socket that currently has outstanding socket calls pending, see Table 3 on page 37 to determine the effects of this operation on the outstanding socket calls.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.

Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.

Figure 114 shows an example of SHUTDOWN call instructions.

```
WORKING-STORAGE SECTION.
    01  SOC-FUNCTION    PIC X(16)  VALUE IS 'SHUTDOWN'.
    01  S               PIC 9(4) BINARY.
    01  HOW             PIC 9(8) BINARY.
        88  END-FROM      VALUE  0.
        88  END-TO        VALUE  1.
        88  END-BOTH      VALUE  2.
    01  ERRNO           PIC 9(8) BINARY.
    01  RETCODE         PIC S9(8) BINARY.

PROCEDURE DIVISION.
     CALL 'EZASOKET' USING SOC-FUNCTION S HOW ERRNO RETCODE.
```

Figure 114. SHUTDOWN call instruction example

For equivalent PL/I and assembler language declarations, see "Converting parameter descriptions" on page 472.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing SHUTDOWN. The field is left-justified and padded on the right with blanks.

S A halfword binary number set to the socket descriptor of the socket to be shutdown.

HOW A fullword binary field. Set to specify whether all or part of a connection is to be shut down. The following values can be set:

Value	Description
0 (END-FROM)	Ends further receive operations.
1 (END-TO)	Ends further send operations.
2 (END-BOTH)	Ends further send and receive operations.

Parameter values returned to the application

ERRNO
A fullword binary field. If RETCODE is negative, the field contains an error number. See Appendix B, "Socket call error return codes," on page 885 for information about ERRNO return codes.

RETCODE
A fullword binary field that returns one of the following:

Value	Description
0	Successful call.
–1	Check **ERRNO** for an error code.

SOCKET

The SOCKET call creates an endpoint for communication and returns a socket descriptor representing the endpoint.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.

Figure 115 shows an example of SOCKET call instructions.

```
WORKING-STORAGE SECTION.
    01  SOC-FUNCTION    PIC X(16)  VALUE IS 'SOCKET'.
* AF_INET
    01  AF              PIC 9(8) COMP VALUE 2.

* AF_INET6
    01  AF              PIC 9(8) COMP VALUE 19.
    01  SOCTYPE         PIC 9(8) BINARY.
        88  STREAM        VALUE  1.
        88  DATAGRAM      VALUE  2.
        88  RAW           VALUE  3.
    01  PROTO           PIC 9(8) BINARY.
    01  ERRNO           PIC 9(8) BINARY.
    01  RETCODE         PIC S9(8) BINARY.

PROCEDURE DIVISION.
     CALL 'EZASOKET' USING SOC-FUNCTION AF SOCTYPE
                           PROTO ERRNO RETCODE.
```

Figure 115. SOCKET call instruction example

For equivalent PL/I and assembler language declarations, see "Converting parameter descriptions" on page 472.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing SOCKET. The field is left-justified and padded on the right with blanks.

AF A fullword binary field set to the addressing family. For TCP/IP the value is set to decimal 2 for AF_INET, or decimal 19, indicating AF_INET6.

SOCTYPE
A fullword binary field set to the type of socket required. The types are:

Value	Description
1	Stream sockets provide sequenced, two-way byte streams that are reliable and connection-oriented. They support a mechanism for out-of-band data.
2	Datagram sockets provide datagrams, which are connectionless messages of a fixed maximum length whose reliability is not guaranteed. Datagrams can be corrupted, received out of order, lost, or delivered multiple times.
3	Raw sockets provide the interface to internal protocols (such as IP and ICMP).

PROTO
A fullword binary field set to the protocol to be used for the socket. If this field is set to 0, the default protocol is used. For streams, the default is TCP; for datagrams, the default is UDP.

PROTO numbers are found in the *hlq*.etc.proto data set. For IPv6 raw sockets, PROTO cannot be set to the following:

Protocol name	Numeric value
IPROTO_HOPOPTS	0
IPPROTO_TCP	6
IPPROTO_UDP	17
IPPROTO_IPV6	41
IPPROTO_ROUTING	43
IPPROTO_FRAGMENT	44
IPPROTO_ESP	50
IPPROTO_AH	51
IPPROTO_NONE	59
IPPROTO_DSTOPTS	60

Parameter values returned to the application

ERRNO
A fullword binary field. If RETCODE is negative, the field contains an error number. See Appendix B, “Socket call error return codes,” on page 885 for information about ERRNO return codes.

RETCODE
A fullword binary field that returns one of the following:

Value	Description
> or = 0	Contains the new socket descriptor.
–1	Check **ERRNO** for an error code.

TAKESOCKET

The TAKESOCKET call acquires a socket from another program and creates a new socket. Typically, a child server issues this call using client ID and socket descriptor

data that it obtained from the concurrent server. See “GIVESOCKET” on page 533 for a discussion of the use of GETSOCKET and TAKESOCKET calls.

Note: When TAKESOCKET is issued, a new socket descriptor is returned in RETCODE. You should use this new socket descriptor in subsequent calls such as GETSOCKOPT, which require the S (socket descriptor) parameter.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See “Addressability mode (Amode) considerations” under “CALL instruction API environmental restrictions and programming requirements” on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.

Figure 116 shows an example of TAKESOCKET call instructions.

```
WORKING-STORAGE SECTION.
    01  SOC-FUNCTION    PIC X(16)  VALUE IS 'TAKESOCKET'.
    01  SOCRECV         PIC 9(4) BINARY.
    01  CLIENT.
        03  DOMAIN      PIC 9(8) BINARY.
        03  NAME        PIC X(8).
        03  TASK        PIC X(8).
        03  RESERVED    PIC X(20).
    01  ERRNO           PIC 9(8) BINARY.
    01  RETCODE         PIC S9(8) BINARY.

PROCEDURE DIVISION.
     CALL 'EZASOKET' USING SOC-FUNCTION  SOCRECV CLIENT
                     ERRNO RETCODE.
```

Figure 116. TAKESOCKET call instruction example

For equivalent PL/I and assembler language declarations, see “Converting parameter descriptions” on page 472.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing TAKESOCKET. The field is left-justified and padded to the right with blanks.

SOCRECV
A halfword binary field set to the descriptor of the socket to be taken. The socket to be taken is passed by the concurrent server.

CLIENT
Specifies the client ID of the program that is giving the socket. In CICS and IMS, these parameters are passed by the Listener program to the program that issues the TAKESOCKET call.

- In CICS, the information is obtained using EXEC CICS RETRIEVE.
- In IMS, the information is obtained by issuing GU TIM.

DOMAIN
A fullword binary field set to the domain of the program giving the socket. It is decimal 2, indicating AF_INET, or decimal 19, indicating AF_INET6.

Note: The TAKESOCKET can only acquire a socket of the same address family from a GIVESOCKET.

NAME
Specifies an 8-byte character field set to the MVS address space identifier of the program that gave the socket.

TASK Specifies an 8-byte field set to the task identifier of the task that gave the socket.

RESERVED
A 20-byte reserved field. This field is required, but not used.

Parameter values returned to the application

ERRNO
A fullword binary field. If the value of RETCODE is negative, the field contains an error number. See Appendix B, "Socket call error return codes," on page 885 for information about ERRNO return codes.

RETCODE
A fullword binary field that returns one of the following:

Value	Description
≥ 0	Contains the new socket descriptor.
–1	Check **ERRNO** for an error code.

TERMAPI

This call terminates the session created by INITAPI.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.

Figure 117 shows an example of TERMAPI call instructions.

```
WORKING-STORAGE SECTION.
    01  SOC-FUNCTION    PIC X(16)  VALUE IS 'TERMAPI'.

PROCEDURE DIVISION.
     CALL 'EZASOKET' USING SOC-FUNCTION.
```

Figure 117. TERMAPI call instruction example

For equivalent PL/I and assembler language declarations, see "Converting parameter descriptions" on page 472.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing TERMAPI. The field is left-justified and padded to the right with blanks.

WRITE

The WRITE call writes data on a connected socket. This call is similar to SEND, except that it lacks the control flags available with SEND.

For datagram sockets the WRITE call writes the entire datagram if it fits into the receiving buffer.

Stream sockets act like streams of information with no boundaries separating data. For example, if a program wishes to send 1000 bytes, each call to this function can send any number of bytes, up to the entire 1000 bytes. The number of bytes sent will be returned in RETCODE. Therefore, programs using stream sockets should place this call in a loop, calling this function until all data has been sent.

See "EZACIC04" on page 615 for a subroutine that will translate EBCDIC output data to ASCII.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.

Figure 118 on page 612 shows an example of WRITE call instructions.

```
WORKING-STORAGE SECTION.
    01  SOC-FUNCTION    PIC X(16)  VALUE IS 'WRITE'.
    01  S               PIC 9(4) BINARY.
    01  NBYTE           PIC 9(8) BINARY.
    01  BUF             PIC X(length of buffer).
    01  ERRNO           PIC 9(8) BINARY.
    01  RETCODE         PIC S9(8) BINARY.

PROCEDURE DIVISION.
     CALL 'EZASOKET' USING SOC-FUNCTION S NBYTE BUF
                     ERRNO RETCODE.
```

Figure 118. WRITE call instruction example

For equivalent PL/I and assembler language declarations, see "Converting parameter descriptions" on page 472.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing WRITE. The field is left-justified and padded on the right with blanks.

S A halfword binary field set to the socket descriptor.

NBYTE
A fullword binary field set to the number of bytes of data to be transmitted.

BUF Specifies the buffer containing the data to be transmitted.

Parameter values returned to the application

ERRNO
A fullword binary field. If RETCODE is negative, the field contains an error number. See Appendix B, "Socket call error return codes," on page 885 for information about ERRNO return codes.

RETCODE
A fullword binary field that returns one of the following:

Value	Description
≥0	A successful call. A return code greater than 0 indicates the number of bytes of data written.
–1	Check **ERRNO** for an error code.

WRITEV

The WRITEV function writes data on a socket from a set of buffers.

The following requirements apply to this call:

Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See "Addressability mode (Amode) considerations" under "CALL instruction API environmental restrictions and programming requirements" on page 469.
ASC mode:	Primary address space control (ASC) mode.

Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.

Figure 119 shows an example of WRITEV call instructions.

```
WORKING-STORAGE SECTION.
01  SOC-FUNCTION         PIC X(16) VALUE 'WRITEV'.
01  S                      PIC 9(4)  BINARY.
01  IOVCNT                 PIC 9(8)  BINARY.

01  IOV.
    03 BUFFER-ENTRY OCCURS N TIMES.
      05 BUFFER-POINTER    USAGE IS POINTER.
      05 RESERVED          PIC X(4).
      05 BUFFER-LENGTH     PIC 9(8) USAGE IS BINARY.

01  ERRNO                  PIC 9(8) BINARY.
01  RETCODE                PIC 9(8) BINARY.

PROCEDURE DIVISION.

    SET BUFFER-POINTER(1) TO ADDRESS OF BUFFER1.
    SET BUFFER-LENGTH(1)  TO LENGTH OF BUFFER1.
    SET BUFFER-POINTER(2) TO ADDRESS OF BUFFER2.
    SET BUFFER-LENGTH(2)  TO LENGTH OF BUFFER2.
    "   "                 "  "          "
    "   "                 "  "          "
    SET BUFFER-POINTER(n) TO ADDRESS OF BUFFERn.
    SET BUFFER-LENGTH(n) TO LENGTH OF BUFFERn.

    CALL 'EZASOKET' USING SOC-FUNCTION S IOV IOVCNT ERRNO RETCODE.
```

Figure 119. WRITEV call instruction example

For equivalent PL/I and assembler language declarations, see "Converting parameter descriptions" on page 472.

Parameter values set by the application

S A value or the address of a halfword binary number specifying the descriptor of the socket from which the data is to be written.

IOV An array of tripleword structures with the number of structures equal to the value in IOVCNT and the format of the structures as follows:

Fullword 1
The address of a data buffer.

Fullword 2
Reserved.

Fullword 3
The length of the data buffer referenced in Fullword 1.

IOVCNT
A fullword binary field specifying the number of data buffers provided for this call.

Parameters returned by the application

ERRNO

A fullword binary field. If RETCODE is negative, this contains an error number. See Appendix B, "Socket call error return codes," on page 885 for information about ERRNO return codes.

RETCODE

A fullword binary field.

Value	Meaning
<0	Check **ERRNO** for an error code.
0	Connection partner has closed connection.
>0	Number of bytes sent.

Using data translation programs for socket call interface

In addition to the socket calls, you can use utility programs to translate data.

Assembler language utility programs call format

The following example shows the assembler language call format for utility programs:

```
>>__CALL EZACIC04,(Inbuf, Inbuf_Length),VL__><
```

Data translation

TCP/IP hosts and networks use ASCII data notation; MVS TCP/IP and its subsystems use EBCDIC data notation. In situations where data must be translated from one notation to the other, you can use the following utility programs:

- EZACIC04 translates EBCDIC data to ASCII data using the translation table documented in the *z/OS Communications Server: IP Configuration Reference*.
- EZACIC05 translates ASCII data to EBCDIC data using the translation table documented in the *z/OS Communications Server: IP Configuration Reference*.
- EZACIC14 provides an alternative to EZACIC04 and translates EBCDIC data to ASCII data using the translation table documented in Figure 127 on page 629.
- EZACIC15 provides an alternative to EZACIC05 and translates ASCII data to EBCDIC data using the translation table documented in Figure 129 on page 631.

Bit-string processing

In C-language, bit strings are often used to convey flags, switch settings, and so on; TCP/IP makes frequent uses of bit strings. However, since bit strings are difficult to decode in COBOL, TCP/IP includes the following:

- EZACIC06 translates bit-masks into character arrays and character arrays into bit-masks.
- EZACIC08 interprets the variable length address list in the HOSTENT structure returned by GETHOSTBYNAME or GETHOSTBYADDR.
- EZACIC09 interprets the ADDRINFO structure returned by GETADDRINFO.

EZACIC04

The EZACIC04 program is used to translate EBCDIC data to ASCII data. Figure 120 shows how EZACIC04 translates a byte of EBCDIC data.

ASCII output by EZACIC04	second hex digit of byte of EBCDIC data														
	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
first hex digit of byte of EBCDIC data	0	00	01	02	03	1A	09	1A	7F	1A	1A	1A	0B	0C	0D	0E	0F
	1	10	11	12	13	1A	0A	08	1A	18	19	1A	1A	1C	1D	1E	1F
	2	1A	1A	1C	1A	1A	0A	17	1B	1A	1A	1A	1A	1A	05	06	07
	3	1A	1A	16	1A	1A	1E	1A	04	1A	1A	1A	1A	14	15	1A	1A
	4	20	A6	E1	80	EB	90	9F	E2	AB	8B	9B	2E	3C	28	2B	7C
	5	26	A9	AA	9C	DB	A5	99	E3	A8	9E	21	24	2A	29	3B	5E
	6	2D	2F	DF	DC	9A	DD	DE	98	9D	AC	BA	2C	25	5F	3E	3F
	7	D7	88	94	B0	B1	B2	FC	D6	FB	60	3A	23	40	27	3D	22
	8	F8	61	62	63	64	65	66	67	68	69	96	A4	F3	AF	AE	C5
	9	8C	6A	6B	6C	6D	6E	6F	70	71	72	97	87	CE	93	F1	FE
	A	C8	7E	73	74	75	76	77	78	79	7A	EF	C0	DA	5B	F2	AE
	B	B5	B6	FD	B7	B8	B9	E6	BB	BC	BD	8D	D9	BF	5D	D8	C4
	C	7B	41	42	43	44	45	46	47	48	49	CB	CA	BE	E8	EC	ED
	D	7D	4A	4B	4C	4D	4E	4F	50	51	52	A1	AD	F5	F4	A3	8F
	E	5C	E7	53	54	55	56	57	58	59	5A	A0	85	8E	E9	E4	D1
	F	30	31	32	33	34	35	36	37	38	39	B3	F7	F0	FA	A7	FF

Figure 120. EZACIC04 EBCDIC-to-ASCII table

Figure 121 shows an example of EZACIC04 call instructions.

```
WORKING-STORAGE SECTION.
    01  OUT-BUFFER   PIC X(length of output).
    01  LENGTH       PIC 9(8) BINARY.

PROCEDURE DIVISION.
     CALL 'EZACIC04' USING OUT-BUFFER LENGTH.
```

Figure 121. EZACIC04 call instruction example

For equivalent PL/I and assembler language declarations, see “Converting parameter descriptions” on page 472.

OUT-BUFFER

A buffer that contains the following:

- When called, EBCDIC data
- Upon return, ASCII data

LENGTH
Specifies the length of the data to be translated.

EZACIC05

The EZACIC05 program is used to translate ASCII data to EBCDIC data. EBCDIC data is required by COBOL, PL/I, and assembler language programs. Figure 122 shows how EZACIC05 translates a byte of ASCII data.

EBCDIC output by EZACIC05	second hex digit of byte of ASCII data														
	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
first hex digit of byte of ASCII data	0	00	01	02	03	37	2D	2E	2F	16	05	25	0B	0C	0D	0E	0F
	1	10	11	12	13	3C	3D	32	26	18	19	3F	27	22	1D	35	1F
	2	40	5A	7F	7B	5B	6C	50	7D	4D	5D	5C	4E	6B	60	4B	61
	3	F0	F1	F2	F3	F4	F5	F6	F7	F8	F9	7A	5E	4C	7E	6E	6F
	4	7C	C1	C2	C3	C4	C5	C6	C7	C8	C9	D1	D2	D3	D4	D5	D6
	5	D7	D8	D9	E2	E3	E4	E5	E6	E7	E8	E9	AD	E0	BD	5F	6D
	6	79	81	82	83	84	85	86	87	88	89	91	92	93	94	95	96
	7	97	98	99	A2	A3	A4	A5	A6	A7	A8	A9	C0	4F	D0	A1	07
	8	00	01	02	03	37	2D	2E	2F	16	05	25	0B	0C	0D	0E	0F
	9	10	11	12	13	3C	3D	32	26	18	19	3F	27	22	1D	35	1F
	A	40	5A	7F	7B	5B	6C	50	7D	4D	5D	5C	4E	6B	60	AF	61
	B	F0	F1	F2	F3	F4	F5	F6	F7	F8	F9	7A	5E	4C	7E	6E	6F
	C	7C	C1	C2	C3	C4	C5	C6	C7	C8	C9	D1	D2	D3	D4	D5	D6
	D	D7	D8	D9	E2	E3	E4	E5	E6	E7	E8	E9	AD	E0	BD	5F	6D
	E	79	81	82	83	84	85	86	87	88	89	91	92	93	94	95	96
	F	97	98	99	A2	A3	A4	A5	A6	A7	A8	A9	C0	4F	D0	A1	07

Figure 122. EZACIC05 ASCII-to-EBCDIC table

Figure 123 shows an example of EZACIC05 call instructions.

```
WORKING-STORAGE SECTION.
    01  IN-BUFFER    PIC X(length of output)
    01  LENGTH       PIC 9(8) BINARY VALUE

PROCEDURE DIVISION.
     CALL 'EZACIC05' USING IN-BUFFER LENGTH.
```

Figure 123. EZACIC05 call instruction example

For equivalent PL/I and assembler language declarations, see "Converting parameter descriptions" on page 472.

IN-BUFFER

A buffer that contains the following:

- When called, ASCII data
- Upon return, EBCDIC data

LENGTH
Specifies the length of the data to be translated.

EZACIC06

The SELECT call uses bit strings to specify the sockets to test and to return the results of the test. Because bit strings are difficult to manage in COBOL, you might want to use the assembler language program EZACIC06 to translate them to character strings to be used with the SELECT call.

Figure 124 shows an example of EZACIC06 call instructions.

```
WORKING-STORAGE SECTION.
    01  CHAR-MASK.
        05 CHAR-STRING              PIC X(nn).

    01  CHAR-ARRAY                 REDEFINES CHAR-MASK.
        05  CHAR-ENTRY-TABLE       OCCURS nn TIMES.
            10  CHAR-ENTRY         PIC X(1).
    01  BIT-MASK.
        05 BIT-ARRAY-FWDS          OCCURS (nn+31)/32 TIMES.
           10  BIT_ARRAY_WORD      PIC 9 (8) COMP.

    01  BIT-FUNCTION-CODES.
        05  CTOB                   PIC X(4) VALUE 'CTOB'.
        05  BTOC                   PIC X(4) VALUE 'BTOC'.

    01  CHAR-MASK-LENGTH           PIC 9(8) COMP VALUE nn.


   PROCEDURE CALL (to convert from character to binary)
     CALL 'EZACIC06' USING CTOB
                           BIT-MASK
                           CHAR-MASK
                           CHAR-MASK-LENGTH
                           RETCODE.


   PROCEDURE CALL (to convert from binary to character)
     CALL 'EZACIC06' USING BTOC
                           BIT-MASK
                           CHAR-MASK
                           CHAR-MASK-LENGTH
                           RETCODE.
```

Figure 124. EZACIC06 call instruction example

For equivalent PL/I and assembler language declarations, see "Converting parameter descriptions" on page 472.

TOKEN
Specifies a 16-character identifier. This identifier is required and it must be the first parameter in the list.

CHAR-MASK
Specifies the character array where *nn* is the maximum number of sockets in the array. The first character in the array represents socket 0, the second represents socket 1, and so on. Note that the index is 1 greater than the socket number [for example, CHAR-ENTRY(1) represents socket 0, CHAR-ENTRY (2) represents socket 1, and so on.]

BIT-MASK
Specifies the bit string to be translated for the SELECT call. Within each fullword of the bit string, the bits are ordered right to left. The right-most bit in the first fullword represents socket 0 and the left-most bit represents

socket 31. The right-most bit in the second fullword represents socket 32 and the left-most bit represents socket 63. The number of fullwords in the bit string should be calculated by dividing the sum of 31 and the character array length by 32 (truncate the remainder).

COMMAND
BTOC specifies bit string to character array translation.

CTOB specifies character array to bit string translation.

CHAR-MASK-LENGTH
Specifies the length of the character array. This field should be no greater than 1 plus the MAXSNO value returned on the INITAPI (which is usually the same as the MAXSOC value specified on the INITAPI).

RETCODE
A binary field that returns one of the following:

Value	Description
0	Successful call.
–1	Check **ERRNO** for an error code.

Example: If you want to use the SELECT call to test sockets 0, 5, and 32, and you are using a character array to represent the sockets, you must set the appropriate characters in the character array to 1. In this example, index positions 1, 6 and 33 in the character array are set to 1. Then you can call EZACIC06 with the COMMAND parameter set to CTOB. When EZACIC06 returns, the first fullword of BIT-MASK contains B'00000000000000000000000000100001' to indicate that sockets 0 and 5 will be checked. The second word of BIT-MASK contains B'00000000000000000000000000000001' to indicate that socket 32 will be checked. These instructions process the bit string shown in the following example:

```
MOVE ZEROS TO CHAR-STRING.
MOVE '1' TO CHAR-ENTRY(1), CHAR-ENTRY(6), CHAR-ENTRY(33).
CALL 'EZACIC06' USING TOKEN CTOB BIT-MASK CH-MASK
      CHAR-MASK-LENGTH RETCODE.
MOVE BIT-MASK TO ....
```

When the select call returns and you want to check the bit-mask string for socket activity, enter the following instructions.

```
MOVE ..... TO BIT-MASK.
CALL 'EZACIC06' USING TOKEN BTOC BIT-MASK CH-MASK
         CHAR-MASK-LENGTH RETCODE.
PERFORM TEST-SOCKET THRU TEST-SOCKET-EXIT  VARYING IDX
     FROM 1 BY 1 UNTIL IDX EQUAL CHAR-MASK-LENGTH.

TEST-SOCKET.
      IF CHAR-ENTRY(IDX) EQUAL '1'
           THEN PERFORM SOCKET-RESPONSE THRU SOCKET-RESPONSE-EXIT
           ELSE NEXT SENTENCE.
TEST-SOCKET-EXIT.
      EXIT.
```

EZACIC08

The GETHOSTBYNAME and GETHOSTBYADDR calls were derived from C socket calls that return a structure known as HOSTENT. A given TCP/IP host can have multiple alias names and host IP addresses.

TCP/IP uses indirect addressing to connect the variable number of alias names and IP addresses in the HOSTENT structure that are returned by the GETHOSTBYADDR AND GETHOSTBYNAME calls.

If you are coding in PL/I or assembler language, the HOSTENT structure can be processed in a relatively straight-forward manner. However, if you are coding in COBOL, HOSTENT can be more difficult to process and you should use the EZACIC08 subroutine to process it for you.

It works as follows:

1. GETHOSTBYADDR or GETHOSTBYNAME returns a HOSTENT structure that indirectly addresses the lists of alias names and IP addresses.
2. Upon return from GETHOSTBYADDR or GETHOSTBYNAME, your program calls EZACIC08 and passes it the address of the HOSTENT structure. EZACIC08 processes the structure and returns the following:
   - The length of host name, if present
   - The host name
   - The number of alias names for the host
   - The alias name sequence number
   - The length of the alias name
   - The alias name
   - The host IP address type, always 2 for AF_INET
   - The host IP address length, always 4 for AF_INET
   - The number of host IP addresses for this host
   - The host IP address sequence number
   - The host IP address
3. If the GETHOSTBYADDR or GETHOSTBYNAME call returns more than one alias name or host IP address, the application program should repeat the call to EZACIC08 until all alias names and host IP addresses have been retrieved.

Figure 125 on page 622 shows an example of EZACIC08 call instructions.

```
WORKING-STORAGE SECTION.

    01  HOSTENT-ADDR       PIC 9(8) BINARY.
    01  HOSTNAME-LENGTH    PIC 9(4) BINARY.
    01  HOSTNAME-VALUE     PIC X(255).
    01  HOSTALIAS-COUNT    PIC 9(4) BINARY.
    01  HOSTALIAS-SEQ      PIC 9(4) BINARY.
    01  HOSTALIAS-LENGTH   PIC 9(4) BINARY.
    01  HOSTALIAS-VALUE    PIC X(255).
    01  HOSTADDR-TYPE      PIC 9(4) BINARY.
    01  HOSTADDR-LENGTH    PIC 9(4) BINARY.
    01  HOSTADDR-COUNT     PIC 9(4) BINARY.
    01  HOSTADDR-SEQ       PIC 9(4) BINARY.
    01  HOSTADDR-VALUE     PIC 9(8) BINARY.
    01  RETURN-CODE        PIC 9(8) BINARY.

PROCEDURE DIVISION.

   CALL 'EZASOKET' USING 'GETHOSTBYADDR'
                   HOSTADDR HOSTENT-ADDR
                   RETCODE.

   CALL 'EZASOKET' USING 'GETHOSTBYNAME'
                   NAMELEN NAME HOSTENT-ADDR
                   RETCODE.

   CALL 'EZACIC08' USING HOSTENT-ADDR HOSTNAME-LENGTH
                   HOSTNAME-VALUE HOSTALIAS-COUNT HOSTALIAS-SEQ
                   HOSTALIAS-LENGTH HOSTALIAS-VALUE
                   HOSTADDR-TYPE HOSTADDR-LENGTH HOSTADDR-COUNT
                   HOSTADDR-SEQ HOSTADDR-VALUE RETURN-CODE.
```

Figure 125. EZAZIC08 call instruction example

For equivalent PL/I and assembler language declarations, see "Converting parameter descriptions" on page 472.

Parameter values set by the application

HOSTENT-ADDR
This fullword binary field must contain the address of the HOSTENT structure (as returned by the GETHOSTBY*xxxx* call). This variable is the same as the variable HOSTENT in the GETHOSTBYADDR and GETHOSTBYNAME socket calls.

HOSTALIAS-SEQ
This halfword field is used by EZACIC08 to index the list of alias names. When EZACIC08 is called, it adds 1 to the current value of HOSTALIAS-SEQ and uses the resulting value to index into the table of alias names. Therefore, for a given instance of GETHOSTBYxxxx, this field should be set to 0 for the initial call to EZACIC08. For all subsequent calls to EZACIC08, this field should contain the HOSTALIAS-SEQ number returned by the previous invocation.

HOSTADDR-SEQ
This halfword field is used by EZACIC08 to index the list of IP addresses. When EZACIC08 is called, it adds 1 to the current value of HOSTADDR-SEQ and uses the resulting value to index into the table of IP addresses. Therefore, for a given instance of GETHOSTBYxxxx, this field should be set to 0 for the initial call to EZACIC08. For all subsequent calls to EZACIC08, this field should contain the HOSTADDR-SEQ number returned by the previous call.

Parameter values returned to the application

HOSTNAME-LENGTH
This halfword binary field contains the length of the host name (if host name was returned).

HOSTNAME-VALUE
This 255-byte character string contains the host name (if host name was returned).

HOSTALIAS-COUNT
This halfword binary field contains the number of alias names returned.

HOSTALIAS-SEQ
This halfword binary field is the sequence number of the alias name currently found in HOSTALIAS-VALUE.

HOSTALIAS-LENGTH
This halfword binary field contains the length of the alias name currently found in HOSTALIAS-VALUE.

HOSTALIAS-VALUE
This 255-byte character string contains the alias name returned by this instance of the call. The length of the alias name is contained in HOSTALIAS-LENGTH.

HOSTADDR-TYPE
This halfword binary field contains the type of host address. For FAMILY type AF_INET, HOSTADDR-TYPE is always 2.

HOSTADDR-LENGTH
This halfword binary field contains the length of the host IP address currently found in HOSTADDR-VALUE. For FAMILY type AF_INET, HOSTADDR-LENGTH is always set to 4.

HOSTADDR-COUNT
This halfword binary field contains the number of host IP addresses returned by this instance of the call.

HOSTADDR-SEQ
This halfword binary field contains the sequence number of the host IP address currently found in HOSTADDR-VALUE.

HOSTADDR-VALUE
This fullword binary field contains a host IP address.

RETURN-CODE
This fullword binary field contains the EZACIC08 return code:

Value	Description
0	Successful completion.
-1	HOSTENT address is not valid.
-2	A value of HOSTALIAS-SEQ is not valid.
-3	A value of HOSTADDR-SEQ is not valid.

EZACIC09

The GETADDRINFO call was derived from the C socket call that return a structure known as RES. A given TCP/IP host can have multiple sets of NAMES. TCP/IP uses indirect addressing to connect the variable number of NAMES in the RES structure that is returned by the GETADDRINFO call. If you are coding in PL/I or assembler language, the RES structure can be processed in a relatively straight-forward manner. However, if you are coding in COBOL, RES can be more difficult to process and you should use the EZACIC09 subroutine to process it for you. It works as follows:

1. GETADDRINFO returns a RES structure that indirectly addresses the lists of socket address structures.
2. Upon return from GETADDRINFO, your program calls EZACIC09 and passes it the address of the next address information structure as referenced by the NEXT argument. EZACIC09 processes the structure and returns the following: a. The socket address structure b. The next address information structure.
3. If the GETADDRINFO call returns more than one socket address structure the application program should repeat the call to EZACIC09 until all socket address structures have been retrieved.

Figure 126 on page 625 shows an example of EZACIC09 call instructions.

```
WORKING-STORAGE SECTION.
      *
      * Variables used for the GETADDRINFO call
      *
       01 getaddrinfo-parms.
          02 node-name pic x(255).
          02 node-name-len pic 9(8) binary.
          02 service-name pic x(32).
          02 service-name-len pic 9(8) binary.
          02 canonical-name-len pic 9(8) binary.
          02 ai-passive pic 9(8) binary value 1.
          02 ai-canonnameok pic 9(8) binary value 2.
          02 ai-numerichost pic 9(8) binary value 4.
          02 ai-numericserv pic 9(8) binary value 8.
          02 ai-v4mapped pic 9(8) binary value 16.
          02 ai-all pic 9(8) binary value 32.
          02 ai-addrconfig pic 9(8) binary value 64.
      *
      * Variables used for the EZACIC09 call
      *
       01 ezacic09-parms.
          02 res usage is pointer.
          02 res-name-len pic 9(8) binary.
          02 res-canonical-name pic x(256).
          02 res-name usage is pointer.
          02 res-next-addrinfo usage is pointer.
      *
      * Socket address structure
      *
       01 server-socket-address.
          05 server-family pic 9(4) Binary Value 19.
          05 server-port pic 9(4) Binary Value 9997.
          05 server-flowinfo pic 9(8) Binary Value 0.
          05 server-ipaddr.
             10 filler pic 9(16) binary value 0.
             10 filler pic 9(16) binary value 0.
          05 server-scopeid pic 9(8) Binary Value 0.
```

Figure 126. EZACIC09 call instruction example (Part 1 of 3)

```
LINKAGE SECTION.
  01 L1.
     03 HINTS-ADDRINFO.
        05 HINTS-AI-FLAGS PIC 9(8) BINARY.
        05 HINTS-AI-FAMILY PIC 9(8) BINARY.
        05 HINTS-AI-SOCKTYPE PIC 9(8) BINARY.
        05 HINTS-AI-PROTOCOL PIC 9(8) BINARY.
        05 FILLER PIC 9(8) BINARY.
        05 FILLER PIC 9(8) BINARY.
        05 FILLER PIC 9(8) BINARY.
        05 FILLER PIC 9(8) BINARY.
     03 HINTS-ADDRINFO-PTR USAGE IS POINTER.
     03 RES-ADDRINFO-PTR USAGE IS POINTER.
 *
 * RESULTS ADDRESS INFO
 *
  01 RESULTS-ADDRINFO.
     05 RESULTS-AI-FLAGS PIC 9(8) BINARY.
     05 RESULTS-AI-FAMILY PIC 9(8) BINARY.
     05 RESULTS-AI-SOCKTYPE PIC 9(8) BINARY.
     05 RESULTS-AI-PROTOCOL PIC 9(8) BINARY.
     05 RESULTS-AI-ADDR-LEN PIC 9(8) BINARY.
     05 RESULTS-AI-CANONICAL-NAME USAGE IS POINTER.
     05 RESULTS-AI-ADDR-PTR USAGE IS POINTER.
     05 RESULTS-AI-NEXT-PTR USAGE IS POINTER.
 *
 * SOCKET ADDRESS STRUCTURE FROM EZACIC09.
 *
  01 OUTPUT-NAME-PTR USAGE IS POINTER.
  01 OUTPUT-IP-NAME.
     03 OUTPUT-IP-FAMILY PIC 9(4) BINARY.
     03 OUTPUT-IP-PORT PIC 9(4) BINARY.
     03 OUTPUT-IP-SOCK-DATA PIC X(24).
     03 OUTPUT-IPV4-SOCK-DATA REDEFINES OUTPUT-IP-SOCK-DATA.
        05 OUTPUT-IPV4-IPADDR PIC 9(8) BINARY.
        05 FILLER PIC X(20).
     03 OUTPUT-IPV6-SOCK-DATA REDEFINES OUTPUT-IP-SOCK-DATA.
        05 OUTPUT-IPV6-FLOWINFO PIC 9(8) BINARY.
        05 OUTPUT-IPV6-IPADDR.
           10 FILLER PIC 9(16) BINARY.
           10 FILLER PIC 9(16) BINARY.
        05 OUTPUT-IPV6-SCOPEID PIC 9(8) BINARY.
```

Figure 126. EZACIC09 call instruction example (Part 2 of 3)

```
 PROCEDURE DIVISION USING L1.
*
* Get and address from the resolver.
*
     move 'yournodename' to node-name.
     move 12 to node-name-len.
     move spaces to service-name.
     move 0 to service-name-len.
     move af-inet6 to hints-ai-family.
     move 49 to hints-ai-flags
     move 0 to hints-ai-socktype.
     move 0 to hints-ai-protocol.
     set address of results-addrinfo to res-addrinfo-ptr.
     set hints-addrinfo-ptr to address of hints-addrinfo.
     call 'EZASOKET' using soket-getaddrinfo
                           node-name node-name-len
                           service-name service-name-len
                           hints-addrinfo-ptr
                           res-addrinfo-ptr
                           canonical-name-len
                           errno retcode.
*
* Use EZACIC09 to extract the IP address
*
     set address of results-addrinfo to res-addrinfo-ptr.
     set res to address of results-addrinfo.
     move zeros to res-name-len.
     move spaces to res-canonical-name.
     set res-name to nulls.
     set res-next-addrinfo to nulls.
     call 'EZACIC09' using res
                           res-name-len
                           res-canonical-name
                           res-name
                           res-next-addrinfo
                           retcode.
     set address of output-ip-name to res-name.
     move output-ipv6-ipaddr to server-ipaddr.
```

Figure 126. EZACIC09 call instruction example (Part 3 of 3)

For equivalent PL/I and assembler language declarations, see "Converting parameter descriptions" on page 472.

Parameter values set by the application:

RES This fullword binary field must contain the address of the ADDRINFO structure (as returned by the GETADDRINFO call). This variable is the same as the RES variable in the GETADDRINFO socket call.

RES-NAME-LEN
A fullword binary field that will contain the length of the socket address structure as returned by the GETADDRINFO call.

Parameter values returned to the application:
Description

RES-CANONICAL-NAME
A field large enough to hold the canonical name. The maximum field size is 256 bytes. The canonical name length field will indicate the length of the canonical name as returned by the GETADDRINFO call.

RES-NAME The address of the subsequent socket address structure.

RES-NEXT The address of the next address information structure.

RETURN-CODE

CODE This fullword binary field contains the EZACIC09 return code:

Value	Description
0	Successful call.
−1	Invalid RES address.

EZACIC14

The EZACIC14 program is an alternative to EZACIC04, which translates EBCDIC data to ASCII data. Figure 127 shows how EZACIC14 translates a byte of EBCDIC data.

ASCII output by EZACIC14	second hex digit of byte of EBCDIC data														
	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
first hex digit of byte of EBCDIC data	0	00	01	02	03	9C	09	86	7F	97	8D	8E	0B	0C	0D	0E	0F
	1	10	11	12	13	9D	85	08	87	18	19	92	8F	1C	1D	1E	1F
	2	80	81	82	83	84	0A	17	1B	88	89	8A	8B	8C	05	06	07
	3	90	91	16	93	94	95	96	04	98	99	9A	9B	14	15	9E	1A
	4	20	A0	E2	E4	E0	E1	E3	E5	E7	F1	A2	2E	3C	28	2B	7C
	5	26	E9	EA	EB	E8	ED	EE	EF	EC	DF	21	24	2A	29	3B	5E
	6	2D	2F	C2	C4	C0	C1	C3	C5	C7	D1	A6	2C	25	5F	3E	3F
	7	F8	C9	CA	CB	C8	CD	CE	CF	CC	60	3A	23	40	27	3D	22
	8	D8	61	62	63	64	65	66	67	68	69	AB	BB	F0	FD	FE	B1
	9	B0	6A	6B	6C	6D	6E	6F	70	71	72	AA	BA	E6	B8	C6	A4
	A	B5	7E	73	74	75	76	77	78	79	7A	A1	BF	D0	5B	DE	AE
	B	AC	A3	A5	B7	A9	A7	B6	BC	BD	BE	DD	A8	AF	5D	B4	D7
	C	7B	41	42	43	44	45	46	47	48	49	AD	F4	F6	F2	F3	F5
	D	7D	4A	4B	4C	4D	4E	4F	50	51	52	B9	FB	FC	F9	FA	FF
	E	5C	F7	53	54	55	56	57	58	59	5A	B2	D4	D6	D2	D3	D5
	F	30	31	32	33	34	35	36	37	38	39	B4	DB	DC	D9	DA	9F

Figure 127. EZACIC14 EBCDIC-to-ASCII table

Figure 128 shows an example of EZACIC14 call instructions.

```
WORKING-STORAGE SECTION.
    01  OUT-BUFFER   PIC X(length of output).
    01  LENGTH       PIC 9(8) BINARY.

PROCEDURE DIVISION.
     CALL 'EZACIC14' USING OUT-BUFFER LENGTH.
```

Figure 128. EZACIC14 call instruction example

For equivalent PL/I and assembler language declarations, see "Converting parameter descriptions" on page 472.

OUT-BUFFER

A buffer that contains the following:

- When called, EBCDIC data
- Upon return, ASCII data

LENGTH
Specifies the length of the data to be translated.

EZACIC15

The EZACIC15 program is an alternative to EZACIC05, which translates ASCII data to EBCDIC data. Figure 129 shows how EZACIC15 translates a byte of ASCII data.

EBCDIC output by EZACIC15	second hex digit of byte of ASCII data														
	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
first hex digit of byte of ASCII data	0	00	01	02	03	37	2D	2E	2F	16	05	25	0B	0C	0D	0E	0F
	1	10	11	12	13	3C	3D	32	26	18	19	3F	27	1C	1D	1E	1F
	2	40	5A	7F	7B	5B	6C	50	7D	4D	5D	5C	4E	6B	60	4B	61
	3	F0	F1	F2	F3	F4	F5	F6	F7	F8	F9	7A	5E	4C	7E	6E	6F
	4	7C	C1	C2	C3	C4	C5	C6	C7	C8	C9	D1	D2	D3	D4	D5	D6
	5	D7	D8	D9	E2	E3	E4	E5	E6	E7	E8	E9	AD	E0	BD	5F	6D
	6	79	81	82	83	84	85	86	87	88	89	91	92	93	94	95	96
	7	97	98	99	A2	A3	A4	A5	A6	A7	A8	A9	C0	4F	D0	A1	07
	8	20	21	22	23	24	15	06	17	28	29	2A	2B	2C	09	0A	1B
	9	30	31	1A	33	34	35	36	08	38	39	3A	3B	04	14	3E	FF
	A	41	AA	4A	B1	9F	B2	6A	B5	BB	B4	9A	8A	B0	CA	AF	BC
	B	90	8F	EA	FA	BE	A0	B6	B3	9D	DA	9B	8B	B7	B8	B9	A9
	C	64	65	62	66	63	67	9E	68	74	71	72	73	78	75	76	77
	D	AC	69	ED	EE	EB	EF	EC	BF	80	FD	FE	FB	FC	BA	AE	59
	E	44	45	42	46	43	47	9C	48	54	51	52	53	58	55	56	57
	F	8C	49	CD	CE	CB	CF	CC	E1	70	DD	DE	DB	DC	8D	8E	DF

Figure 129. EZACIC15 ASCII-to-EBCDIC table

Figure 130 shows an example of EZACIC15 call instructions.

```
WORKING-STORAGE SECTION.
    01  OUT-BUFFER   PIC X(length of output).
    01  LENGTH       PIC 9(8) BINARY.

PROCEDURE DIVISION.
     CALL 'EZACIC15' USING OUT-BUFFER LENGTH.
```

Figure 130. EZACIC15 call instruction example

For equivalent PL/I and assembler language declarations, see "Converting parameter descriptions" on page 472.

OUT-BUFFER

A buffer that contains the following:

- When called, ASCII data
- Upon return, EBCDIC data

LENGTH
Specifies the length of the data to be translated.

Call interface sample programs

This information provides sample programs for the call interface that you can use for a PL/I or COBOL application program.

The following are the sample programs that are available in the SEZAINST data set:

Program	Description
EZASOKPS	PL/I call interface sample IPv4 server program
EZASOKPC	PL/I call interface sample IPv4 client program
EZASO6PS	PL/I call interface sample IPv6 server program
EZASO6PC	PL/I call interface sample IPv6 client program
CBLOCK	PL/I common variables
EZACOBOL	COBOL common variables
EZASO6CS	COBOL call interface sample IPv6 server program
EZASO6CC	COBOL call interface sample IPv6 client program

Sample code for IPv4 server program

The EZASOKPS PL/I sample program is a server program that shows you how to use the following calls:

- ACCEPT
- BIND
- CLOSE
- GETSOCKNAME
- INITAPI
- LISTEN
- READ
- SOCKET
- TERMAPI
- WRITE

```
/*********************************************************************/
/*                                                                   */
/*   MODULE NAME:  EZASOKPS - THIS IS A VERY SIMPLE IPV4 SERVER      */
/*                                                                   */
/* Copyright:    Licensed Materials - Property of IBM                */
/*                                                                   */
/*               "Restricted Materials of IBM"                       */
/*                                                                   */
/*               5694-A01                                            */
/*                                                                   */
/*               (C) Copyright IBM Corp. 1994, 2005                  */
/*                                                                   */
/*               US Government Users Restricted Rights -             */
/*               Use, duplication or disclosure restricted by        */
/*               GSA ADP Schedule Contract with IBM Corp.            */
/*                                                                   */
/* Status:       CSV1R7                                              */
/*                                                                   */
/*********************************************************************/
EZASOKPS: PROC OPTIONS(MAIN);

/* INCLUDE CBLOCK - common variables                                 */
% include CBLOCK;


ID.TCPNAME = 'TCPIP';                 /* Set TCP to use              */
ID.ADSNAME = 'EZASOKPS';              /* and address space name      */
open file(driver);

/*********************************************************************/
/*                                                                   */
/* Execute INITAPI                                                   */
/*                                                                   */
/*********************************************************************/

/*********************************************************************/
/*                                                                   */
/* Uncomment this code to set max sockets to the maximum.            */
/*                                                                   */
/* MAXSOC_INPUT = 65535;                                             */
/* MAXSOC_FWD = MAXSOC_INPUT;                                        */
/*********************************************************************/

call ezasoket(INITAPI, MAXSOC, ID, SUBTASK,
                      MAXSNO, ERRNO, RETCODE);
if retcode < 0 then do;
   msg = 'FAIL: initapi' || errno;
   write file(driver) from (msg);
   goto getout;
end;

/*********************************************************************/
/*                                                                   */
/* Execute SOCKET                                                    */
```

Figure 131. EZASOKPS PL/1 sample server program for IPv4 (Part 1 of 4)

```
/*                                                                  */
/********************************************************************/

call ezasoket(SOCKET, AF_INET, TYPE_STREAM, PROTO,
                    ERRNO, RETCODE);
if retcode < 0 then do;
   msg = blank;                       /* clear field               */
   msg = 'FAIL: socket, stream, internet' || errno;
   write file(driver) from (msg);
   goto getout;
end;
else sock_stream = retcode;

/********************************************************************/
/*                                                                  */
/* Execute BIND                                                     */
/*                                                                  */
/********************************************************************/

name_id.port = 8888;
name_id.address = '01234567'BX;       /* internet address           */
call ezasoket(BIND, SOCK_STREAM, NAME_ID,
                    ERRNO, RETCODE);
if retcode < 0 then do;
   msg = blank;                       /* clear field               */
   msg = 'FAIL: bind' || errno;
   write file(driver) from (msg);
   goto getout;
end;

/********************************************************************/
/*                                                                  */
/* Execute GETSOCKNAME                                              */
/*                                                                  */
/********************************************************************/

name_id.port = 8888;
name_id.address = '01234567'BX;       /* internet address           */
call ezasoket(GETSOCKNAME, SOCK_STREAM,
                     NAME_ID, ERRNO, RETCODE);
msg = blank;                          /* clear field               */
if retcode < 0 then do;
   msg = 'FAIL: getsockname, stream, internet' || errno;
   write file(driver) from (msg);
end;
else do;
   msg = 'getsockname = ' || name_id.address;
   write file(driver) from (msg);
end;

/********************************************************************/
/*                                                                  */
/* Execute LISTEN                                                   */
/*                                                                  */
/********************************************************************/
```

Figure 131. EZASOKPS PL/1 sample server program for IPv4 (Part 2 of 4)

```
backlog = 5;
call ezasoket(LISTEN, SOCK_STREAM, BACKLOG,
                    ERRNO, RETCODE);
if retcode < 0 then do;
   msg = blank;                         /* clear field                */
   msg = 'FAIL: listen w/ backlog = 5' || errno;
   write file(driver) from (msg);
   goto getout;
end;

/*********************************************************************/
/*                                                                   */
/* Execute ACCEPT                                                    */
/*                                                                   */
/*********************************************************************/

name_id.port = 8888;
name_id.address = '01234567'BX;       /* internet address            */
call ezasoket(ACCEPT, SOCK_STREAM,
                    NAME_ID, ERRNO, RETCODE);
msg = blank;                            /* clear field                */
if retcode < 0 then do;
   msg = 'FAIL: accept' || errno;
   write file(driver) from (msg);
end;
else do;
   accpsock = retcode;
   msg = 'accept socket = ' || accpsock;
   write file(driver) from (msg);
end;

/*********************************************************************/
/*                                                                   */
/* Execute READ                                                      */
/*                                                                   */
/*********************************************************************/

nbyte = length(bufin);
call ezasoket(READ, ACCPSOCK,
                    NBYTE, BUFIN, ERRNO, RETCODE);
msg = blank;                            /* clear field                */
if retcode < 0 then do;
   msg = 'FAIL: read' || errno;
   write file(driver) from (msg);
end;
else do;
   msg = 'read = ' || bufin;
   write file(driver) from (msg);
   bufout = bufin;
   nbyte = retcode;
end;

/*********************************************************************/
/*                                                                   */
```

Figure 131. EZASOKPS PL/1 sample server program for IPv4 (Part 3 of 4)

```
/* Execute WRITE                                                      */
/*                                                                    */
/**********************************************************************/

call ezasoket(WRITE, ACCPSOCK, NBYTE, BUFOUT,
                     ERRNO, RETCODE);
msg = blank;                          /* clear field                  */
if retcode < 0 then do;
   msg = 'FAIL: write' || errno;
   write file(driver) from (msg);
end;
else do;
   msg = 'write = ' || bufout;
   write file(driver) from (msg);
end;

/**********************************************************************/
/*                                                                    */
/* Execute CLOSE accept socket                                        */
/*                                                                    */
/**********************************************************************/

call ezasoket(CLOSE, ACCPSOCK,
                     ERRNO, RETCODE);
if retcode < 0 then do;
   msg = blank;                       /* clear field                  */
   msg = 'FAIL: close, accept sock' || errno;
   write file(driver) from (msg);
end;

/**********************************************************************/
/*                                                                    */
/* Execute TERMAPI                                                    */
/*                                                                    */
/**********************************************************************/

getout:
call ezasoket(TERMAPI);

close file(driver);
end ezasokps;
```

Figure 131. EZASOKPS PL/1 sample server program for IPv4 (Part 4 of 4)

Sample program for IPv4 client program

The EZASOKPC PL/I sample program is a client program that shows you how to use the following calls provided by the call socket interface:

- CONNECT
- GETPEERNAME
- INITAPI
- READ
- SHUTDOWN
- SOCKET
- TERMAPI
- WRITE

```
/*********************************************************************/
/*                                                                   */
/*   MODULE NAME:  EZASOKPC - THIS IS A VERY SIMPLE IPV4 CLIENT      */
/*                                                                   */
/* Copyright:    Licensed Materials - Property of IBM                */
/*                                                                   */
/*               "Restricted Materials of IBM"                       */
/*                                                                   */
/*               5694-A01                                            */
/*                                                                   */
/*               (C) Copyright IBM Corp. 1994, 2002                  */
/*                                                                   */
/*               US Government Users Restricted Rights -             */
/*               Use, duplication or disclosure restricted by        */
/*               GSA ADP Schedule Contract with IBM Corp.            */
/*                                                                   */
/* Status:       CSV1R4                                              */
/*                                                                   */
/*********************************************************************/
EZASOKPC: PROC OPTIONS(MAIN);

/* INCLUDE CBLOCK - common variables                                 */
% include CBLOCK;

ID.TCPNAME = 'TCPIP';                 /* Set TCP to use              */
ID.ADSNAME = 'EZASOKPC';              /* and address space name      */
open file(driver);

/*********************************************************************/
/*                                                                   */
/* Execute INITAPI                                                   */
/*                                                                   */
/*********************************************************************/

call ezasoket(INITAPI, MAXSOC, ID, SUBTASK,
                     MAXSNO, ERRNO, RETCODE);
if retcode < 0 then do;
   msg = 'FAIL: initapi' || errno;
   write file(driver) from (msg);
   goto getout;
end;

/*********************************************************************/
/*                                                                   */
/* Execute SOCKET                                                    */
/*                                                                   */
/*********************************************************************/

call ezasoket(SOCKET, AF_INET, TYPE_STREAM, PROTO,
                    ERRNO, RETCODE);
if retcode < 0 then do;
   msg = blank;                       /* clear field                */
   msg = 'FAIL: socket, stream, internet' || errno;
   write file(driver) from (msg);
```

Figure 132. EZASOKPC PL/1 sample client program for IPv4 (Part 1 of 3)

```
   goto getout;
end;
sock_stream = retcode;                /* save socket descriptor      */

/*********************************************************************/
/* Execute CONNECT                                                   */
/*                                                                   */
/*********************************************************************/

name_id.port = 8888;
name_id.address = '01234567'BX;       /* internet address            */
call ezasoket(CONNECT, SOCK_STREAM, NAME_ID,
                     ERRNO, RETCODE);
if retcode < 0 then do;
   msg = blank;                       /* clear field                 */
   msg = 'FAIL: connect, stream, internet' || errno;
   write file(driver) from (msg);
   goto getout;
end;

/*********************************************************************/
/*                                                                   */
/*   Execute GETPEERNAME                                             */
/*                                                                   */
/*********************************************************************/

call ezasoket(GETPEERNAME, SOCK_STREAM,
                     NAME_ID, ERRNO, RETCODE);
msg = blank;                          /* clear field                 */
if retcode < 0 then do;
   msg = 'FAIL: getpeername' || errno;
   write file(driver) from (msg);
end;
else do;
   msg = 'getpeername =' || name_id.address;
   write file(driver) from (msg);
end;

/*********************************************************************/
/*                                                                   */
/* Execute WRITE                                                     */
/*                                                                   */
/*********************************************************************/

bufout = message;
nbyte = length(message);
call ezasoket(WRITE, SOCK_STREAM, NBYTE, BUFOUT,
                     ERRNO, RETCODE);
msg = blank;                          /* clear field                 */
if retcode < 0 then do;
   msg = 'FAIL: write' || errno;
   write file(driver) from (msg);
end;
else do;
   msg = 'write = ' || bufout;
```

Figure 132. EZASOKPC PL/1 sample client program for IPv4 (Part 2 of 3)

```
   write file(driver) from (msg);
end;

/*********************************************************************/
/*                                                                   */
/* Execute READ                                                      */
/*                                                                   */
/*********************************************************************/

nbyte = length(bufin);
call ezasoket(READ, SOCK_STREAM,
                    NBYTE, BUFIN, ERRNO, RETCODE);
msg = blank;                           /* clear field                */
if retcode < 0 then do;
   msg = 'FAIL: read' || errno;
   write file(driver) from (msg);
end;
else do;
   msg = 'read = ' || bufin;
   write file(driver) from (msg);
end;

/*********************************************************************/
/*                                                                   */
/* Execute SHUTDOWN from/to                                          */
/*                                                                   */
/*********************************************************************/

getout:
how = 2;
call ezasoket(SHUTDOWN, SOCK_STREAM, HOW,
                     ERRNO, RETCODE);
if retcode < 0 then do;
   msg = blank;                        /* clear field                */
   msg = 'FAIL: shutdown' || errno;
   write file(driver) from (msg);
end;

/*********************************************************************/
/*                                                                   */
/* Execute TERMAPI                                                   */
/*                                                                   */
/*********************************************************************/

call ezasoket(TERMAPI);

close file(driver);
end ezasokpc;
```

Figure 132. EZASOKPC PL/1 sample client program for IPv4 (Part 3 of 3)

Sample code for IPv6 server program

The EZASO6PS PL/I sample program is a server program that shows you how to use the following calls provided by the call socket interface:

- ACCEPT
- BIND
- CLOSE
- EZACIC09
- FREEADDRINFO
- GETADDRINFO
- GETHOSTNAME
- GETSOCKNAME

- INITAPI
- LISTEN
- NTOP
- PTON
- READ
- SOCKET
- TERMAPI
- WRITE

```
/*********************************************************************/
/*                                                                   */
/*   MODULE NAME:  EZASO6PS - THIS IS A VERY SIMPLE IPV6 SERVER      */
/*                                                                   */
/* Copyright:    Licensed Materials - Property of IBM                */
/*                                                                   */
/*               "Restricted Materials of IBM"                       */
/*                                                                   */
/*               5694-A01                                            */
/*                                                                   */
/*               (C) Copyright IBM Corp. 2002, 2005                  */
/*                                                                   */
/*               US Government Users Restricted Rights -             */
/*               Use, duplication or disclosure restricted by        */
/*               GSA ADP Schedule Contract with IBM Corp.            */
/*                                                                   */
/* Status:       CSV1R7                                              */
/*                                                                   */
/*********************************************************************/
EZASO6PS: PROC OPTIONS(MAIN);

/* INCLUDE CBLOCK - common variables                                 */
% include CBLOCK;

ID.TCPNAME = 'TCPCS';                 /* Set TCP to use              */
ID.ADSNAME = 'EZASO6PS';              /* and address space name      */
open file(driver);

/*********************************************************************/
/*                                                                   */
/* Execute INITAPI                                                   */
/*                                                                   */
/*********************************************************************/

/*********************************************************************/
/*                                                                   */
/* Uncomment this code to set max sockets to the maximum.            */
/*                                                                   */
/* MAXSOC_INPUT = 65535;                                             */
/* MAXSOC_FWD = MAXSOC_INPUT;                                        */
/*********************************************************************/

call ezasoket(INITAPI, MAXSOC, ID, SUBTASK,
                      MAXSNO, ERRNO, RETCODE);
if retcode < 0 then do;
   msg = 'FAIL: initapi' || errno;
   write file(driver) from (msg);
   goto getout;
end;

/*********************************************************************/
/*                                                                   */
/* Execute SOCKET                                                    */
/*                                                                   */
```

Figure 133. EZASO6PS PL/1 sample server program for IPv6 (Part 1 of 6)

```
/*********************************************************************/

call ezasoket(SOCKET, AF_INET6, TYPE_STREAM, PROTO,
                    ERRNO, RETCODE);
if retcode < 0 then do;
   msg = blank;                        /* clear field                */
   msg = 'FAIL: socket, stream, internet' || errno;
   write file(driver) from (msg);
   goto getout;
end;
else sock_stream = retcode;
/*********************************************************************/
/*                                                                   */
/* Execute PTON                                                      */
/*                                                                   */
/*********************************************************************/
PRESENTABLE_ADDR = IPV6_LOOPBACK;     /* Set IP address to use       */
PRESENTABLE_ADDR_LEN = LENGTH(PRESENTABLE_ADDR) ;  /* and its length */
call ezasoket(PTON, AF_INET6, PRESENTABLE_ADDR,
                    PRESENTABLE_ADDR_LEN, NUMERIC_ADDR,
                    ERRNO, RETCODE);
if retcode < 0 then do;
   msg = blank;                        /* clear field                */
   msg = 'FAIL: pton' || errno;
   write file(driver) from (msg);
   goto getout;
end;
name6_id.address = NUMERIC_ADDR;      /* IPV6 internet address       */
/*********************************************************************/
/*                                                                   */
/* Execute GETHOSTNAME                                               */
/*                                                                   */
/*********************************************************************/
call ezasoket(GETHOSTNAME, HOSTNAME_LEN, HOSTNAME,
                    ERRNO, RETCODE);
msg = blank;                          /* clear field                */
if retcode < 0 then do;
   msg = 'FAIL: gethostname' || errno;
   write file(driver) from (msg);
   goto getout;
end;
else do;
   msg = 'gethostname = ' || HOSTNAME;
   write file(driver) from (msg);
   GAI_NODE = HOSTNAME;      /* Set host name for getaddrinfo to use */
end;

/*********************************************************************/
/*                                                                   */
/* Execute GETADDRINFO                                               */
/*                                                                   */
/*********************************************************************/
GAI_SERVLEN = 0;                     /* set service length           */
GAI_HINTS.FLAGS = ai_CANONNAMEOK;    /* Request canonical name       */
HINTS = ADDR(GAI_HINTS);             /* Set results pointer          */
```

Figure 133. EZASO6PS PL/1 sample server program for IPv6 (Part 2 of 6)

```
call ezasoket(GETADDRINFO,
                     GAI_NODE, GAI_NODELEN,
                     GAI_SERVICE, GAI_SERVLEN,
                     HINTS, RES,
                     CANONNAME_LEN,
                     ERRNO, RETCODE);
msg = blank;                          /* clear field                */
if retcode < 0 then do;
   msg = 'FAIL: getaddrinfo' || errno;
   write file(driver) from (msg);
end;
else do;                             /* process returned RES        */

/*********************************************************************/
/*                                                                   */
/* Call EZACIC09 to format the returned result address information   */
/*                                                                   */
/*********************************************************************/

call  ezacic09(RES, OPNAMELEN, OPCANON, OPNAME, OPNEXT,
                RETCODE);
msg = blank;                          /* clear field                */
if retcode ^= 0 then do;
   msg = 'FAIL: EZACIC09' || RETCODE;
   write file(driver) from (msg);
end;
else do;
   msg = 'OPCANON = ' || OPCANON;
   write file(driver) from (msg);
end;

/*********************************************************************/
/*                                                                   */
/* Execute FREEADDRINFO                                              */
/*                                                                   */
/*********************************************************************/
call ezasoket(FREEADDRINFO, RES,
                     ERRNO, RETCODE);
msg = blank;                          /* clear field                */
if retcode < 0 then do;
   msg = 'FAIL: freeaddrinfo' || errno;
   write file(driver) from (msg);
end;

end;   /* end from getaddrinfo */
/*********************************************************************/
/*                                                                   */
/* Execute BIND                                                      */
/*                                                                   */
/*********************************************************************/

name6_id.port = 8888;
call ezasoket(BIND, SOCK_STREAM, NAME6_ID,
                    ERRNO, RETCODE);
if retcode < 0 then do;
```

Figure 133. EZASO6PS PL/1 sample server program for IPv6 (Part 3 of 6)

```
   msg = blank;                       /* clear field                */
   msg = 'FAIL: bind' || errno;
   write file(driver) from (msg);
   goto getout;
end;

/*********************************************************************/
/*                                                                   */
/* Execute GETSOCKNAME                                               */
/*                                                                   */
/*********************************************************************/

call ezasoket(GETSOCKNAME, SOCK_STREAM,
                     NAME6_ID, ERRNO, RETCODE);
msg = blank;                          /* clear field                */
if retcode < 0 then do;
   msg = 'FAIL: getsockname, stream, internet' || errno;
   write file(driver) from (msg);
end;

/*********************************************************************/
/*                                                                   */
/* Execute LISTEN                                                    */
/*                                                                   */
/*********************************************************************/

backlog = 5;
call ezasoket(LISTEN, SOCK_STREAM, BACKLOG,
                     ERRNO, RETCODE);
if retcode < 0 then do;
   msg = blank;                       /* clear field                */
   msg = 'FAIL: listen w/ backlog = 5' || errno;
   write file(driver) from (msg);
   goto getout;
end;

/*********************************************************************/
/*                                                                   */
/* Execute ACCEPT                                                    */
/*                                                                   */
/*********************************************************************/

call ezasoket(ACCEPT, SOCK_STREAM,
                     NAME6_ID, ERRNO, RETCODE);
msg = blank;                          /* clear field                */
if retcode < 0 then do;
   msg = 'FAIL: accept' || errno;
   write file(driver) from (msg);
end;
else do;
   accpsock = retcode;
   msg = 'accept socket = ' || accpsock;
   write file(driver) from (msg);
end;
```

Figure 133. EZASO6PS PL/1 sample server program for IPv6 (Part 4 of 6)

```
/*********************************************************************/
/*                                                                   */
/* Execute NTOP                                                      */
/*                                                                   */
/*********************************************************************/
call ezasoket(NTOP, AF_INET6, NUMERIC_ADDR,
                    PRESENTABLE_ADDR, PRESENTABLE_ADDR_LEN,
                    ERRNO, RETCODE);
msg = blank;                           /* clear field                */
if retcode < 0 then do;
   msg = 'FAIL: ntop' || errno;
   write file(driver) from (msg);
   goto getout;
end;
else do;
   msg = 'presentable address = ' || PRESENTABLE_ADDR;
   write file(driver) from (msg);
end;                                    /*                           */

/*********************************************************************/
/*                                                                   */
/* Execute READ                                                      */
/*                                                                   */
/*********************************************************************/

nbyte = length(bufin);
call ezasoket(READ, ACCPSOCK,
                     NBYTE, BUFIN, ERRNO, RETCODE);
msg = blank;                           /* clear field                */
if retcode < 0 then do;
   msg = 'FAIL: read' || errno;
   write file(driver) from (msg);
end;
else do;
   msg = 'read = ' || bufin;
   write file(driver) from (msg);
   bufout = bufin;
   nbyte = retcode;
end;

/*********************************************************************/
/*                                                                   */
/* Execute WRITE                                                     */
/*                                                                   */
/*********************************************************************/

call ezasoket(WRITE, ACCPSOCK, NBYTE, BUFOUT,
                     ERRNO, RETCODE);
msg = blank;                           /* clear field                */
if retcode < 0 then do;
   msg = 'FAIL: write' || errno;
   write file(driver) from (msg);
end;
else do;
   msg = 'write = ' || bufout;
```

Figure 133. EZASO6PS PL/1 sample server program for IPv6 (Part 5 of 6)

```
   write file(driver) from (msg);
end;

/*********************************************************************/
/*                                                                   */
/* Execute CLOSE accept socket                                       */
/*                                                                   */
/*********************************************************************/

call ezasoket(CLOSE, ACCPSOCK,
                     ERRNO, RETCODE);
if retcode < 0 then do;
   msg = blank;                       /* clear field                 */
   msg = 'FAIL: close, accept sock' || errno;
   write file(driver) from (msg);
end;

/*********************************************************************/
/*                                                                   */
/* Execute TERMAPI                                                   */
/*                                                                   */
/*********************************************************************/

getout:
call ezasoket(TERMAPI);

close file(driver);
end EZASO6PS;
```

Figure 133. EZASO6PS PL/1 sample server program for IPv6 (Part 6 of 6)

Sample program for IPv6 client program

The EZASO6PC PL/I sample program is a client program that shows you how to use the following calls provided by the call socket interface:

- CONNECT
- GETNAMEINFO
- GETPEERNAME
- INITAPI
- PTON
- READ
- SHUTDOWN
- SOCKET
- TERMAPI
- WRITE

```
/*********************************************************************/
/*                                                                   */
/*   MODULE NAME:  EZASO6PC - THIS IS A VERY SIMPLE IPV6 CLIENT      */
/*                                                                   */
/* Copyright:    Licensed Materials - Property of IBM                */
/*                                                                   */
/*               "Restricted Materials of IBM"                       */
/*                                                                   */
/*               5694-A01                                            */
/*                                                                   */
/*               (C) Copyright IBM Corp. 2002                        */
/*                                                                   */
/*               US Government Users Restricted Rights -             */
/*               Use, duplication or disclosure restricted by        */
/*               GSA ADP Schedule Contract with IBM Corp.            */
/*                                                                   */
/* Status:       CSV1R4                                              */
/*                                                                   */
/*********************************************************************/
EZASO6PC: PROC OPTIONS(MAIN);

/* INCLUDE CBLOCK - common variables                                 */
% include CBLOCK;

ID.TCPNAME = 'TCPCS';                 /* Set TCP to use              */
ID.ADSNAME = 'EZASO6PS';              /* and address space name      */
open file(driver);

/*********************************************************************/
/*                                                                   */
/* Execute INITAPI                                                   */
/*                                                                   */
/*********************************************************************/

call ezasoket(INITAPI, MAXSOC, ID, SUBTASK,
                     MAXSNO, ERRNO, RETCODE);
if retcode < 0 then do;
   msg = 'FAIL: initapi' || errno;
   write file(driver) from (msg);
   goto getout;
end;

/*********************************************************************/
/*                                                                   */
/* Execute SOCKET                                                    */
/*                                                                   */
/*********************************************************************/

call ezasoket(SOCKET, AF_INET6, TYPE_STREAM, PROTO,
                    ERRNO, RETCODE);
if retcode < 0 then do;
   msg = blank;                       /* clear field                */
   msg = 'FAIL: socket, stream, internet' || errno;
   write file(driver) from (msg);
```

Figure 134. EZASO6PC PL/1 sample client program for IPv6 (Part 1 of 4)

```
   goto getout;
end;
sock_stream = retcode;               /* save socket descriptor      */

/*********************************************************************/
/* Execute PTON                                                      */
/*                                                                   */
/*********************************************************************/
PRESENTABLE_ADDR = IPV6_LOOPBACK;  /* Set the address to use         */
PRESENTABLE_ADDR_LEN = LENGTH(PRESENTABLE_ADDR) ; /* and it's length */
call ezasoket(PTON, AF_INET6, PRESENTABLE_ADDR,
                    PRESENTABLE_ADDR_LEN, NUMERIC_ADDR,
                    ERRNO, RETCODE);
msg = blank;                         /* clear field                 */
if retcode < 0 then do;
   msg = 'FAIL: pton' || errno;
   write file(driver) from (msg);
   goto getout;
end;
msg = 'SUCCESS: pton converted ' || PRESENTABLE_ADDR;
name6_id.address = NUMERIC_ADDR;     /* IPV6 internet address       */

/*********************************************************************/
/* Execute CONNECT                                                   */
/*                                                                   */
/*********************************************************************/

name6_id.port = 8888;
call ezasoket(CONNECT, SOCK_STREAM, NAME6_ID,
                     ERRNO, RETCODE);
if retcode < 0 then do;
   msg = blank;                      /* clear field                 */
   msg = 'FAIL: connect, stream, internet' || errno;
   write file(driver) from (msg);
   goto getout;
end;

/*********************************************************************/
/*                                                                   */
/*   Execute GETPEERNAME                                             */
/*                                                                   */
/*********************************************************************/

call ezasoket(GETPEERNAME, SOCK_STREAM,
                     NAME6_ID, ERRNO, RETCODE);
msg = blank;                         /* clear field                 */
if retcode < 0 then do;
   msg = 'FAIL: getpeername' || errno;
   write file(driver) from (msg);
end;

/*********************************************************************/
/*                                                                   */
/*   Execute GETNAMEINFO                                             */
/*                                                                   */
```

Figure 134. EZASO6PC PL/1 sample client program for IPv6 (Part 2 of 4)

```
/*********************************************************************/

NAMELEN = 28 ;                 /* Set length of NAME                 */
GNI_HOST = blank;              /* Clear Host name                    */
GNI_HOSTLEN = LENGTH(GNI_HOST); /* Set Host name length              */
GNI_SERVICE = blank;           /* Clear Service name                 */
GNI_SERVLEN = LENGTH(GNI_SERVICE); /* Set Service name length        */
GNI_FLAGS = NI_NAMEREQD;       /* Set an error if name is not found  */
call ezasoket(GETNAMEINFO, NAME6_ID, NAMELEN,
                     GNI_HOST, GNI_HOSTLEN,
                     GNI_SERVICE, GNI_SERVLEN,
                     GNI_FLAGS,
                     ERRNO, RETCODE);
msg = blank;                           /* clear field                */
if retcode < 0 then do;
   msg = 'FAIL: getnameinfo' || errno;
   write file(driver) from (msg);
end;
else do;
   msg = 'getnameinfo host=' || GNI_HOST ;
   write file(driver) from (msg);
   msg = 'getnameinfo service=' || GNI_SERVICE ;
   write file(driver) from (msg);
end;

/*********************************************************************/
/*                                                                   */
/* Execute WRITE                                                     */
/*                                                                   */
/*********************************************************************/

bufout = message;
nbyte = length(message);
call ezasoket(WRITE, SOCK_STREAM, NBYTE, BUFOUT,
                     ERRNO, RETCODE);
msg = blank;                           /* clear field                */
if retcode < 0 then do;
   msg = 'FAIL: write' || errno;
   write file(driver) from (msg);
end;
else do;
   msg = 'write = ' || bufout;
   write file(driver) from (msg);
end;

/*********************************************************************/
/*                                                                   */
/* Execute READ                                                      */
/*                                                                   */
/*********************************************************************/

nbyte = length(bufin);
call ezasoket(READ, SOCK_STREAM,
                    NBYTE, BUFIN, ERRNO, RETCODE);
msg = blank;                           /* clear field                */
```

Figure 134. EZASO6PC PL/1 sample client program for IPv6 (Part 3 of 4)

```
if retcode < 0 then do;
   msg = 'FAIL: read' || errno;
   write file(driver) from (msg);
end;
else do;
   msg = 'read = ' || bufin;
   write file(driver) from (msg);
end;

/*********************************************************************/
/*                                                                   */
/* Execute SHUTDOWN from/to                                          */
/*                                                                   */
/*********************************************************************/

getout:
how = 2;
call ezasoket(SHUTDOWN, SOCK_STREAM, HOW,
                     ERRNO, RETCODE);
if retcode < 0 then do;
   msg = blank;                        /* clear field               */
   msg = 'FAIL: shutdown' || errno;
   write file(driver) from (msg);
end;

/*********************************************************************/
/*                                                                   */
/* Execute TERMAPI                                                   */
/*                                                                   */
/*********************************************************************/

call ezasoket(TERMAPI);

close file(driver);
end ezaso6pc;
```

Figure 134. EZASO6PC PL/1 sample client program for IPv6 (Part 4 of 4)

Common variables used in PL/I sample programs

The CBLOCK common storage area contains the variables that are used in the PL/I programs in this section.

```
/*********************************************************************/
/*                                                                   */
/*   MODULE NAME:  CBLOCK - SOKET COMMON VARIABLES                   */
/*                                                                   */
/* Copyright:    Licensed Materials - Property of IBM                */
/*                                                                   */
/*               "Restricted Materials of IBM"                       */
/*                                                                   */
/*               5694-A01                                            */
/*                                                                   */
|  /*               Copyright IBM Corp. 1994, 2010                      */
/*                                                                   */
/*               US Government Users Restricted Rights -             */
/*               Use, duplication or disclosure restricted by        */
/*               GSA ADP Schedule Contract with IBM Corp.            */
/*                                                                   */
|  /* Part Type:    Enterprise PL/1 for z/OS                          */
|  /*                                                                 */
|  /* Status:       CSV1R12                                           */
/*                                                                   */
/*********************************************************************/
/*********************************************************************/
/*                                                                   */
/* SOKET COMMON VARIABLES                                            */
/*                                                                   */
/*********************************************************************/
DCL ABS     BUILTIN;
DCL ADDR    BUILTIN;
DCL ACCEPT  CHAR(16) INIT('ACCEPT');
DCL ACCPSOCK FIXED BIN(15);           /* temporary ACCEPT socket    */
DCL AF_INET FIXED BIN(31) INIT(2);    /* internet domain            */
DCL AF_INET6 FIXED BIN(31) INIT(19);  /* internet v6 domain         */
DCL AF_IUCV FIXED BIN(31) INIT(17);   /* iucv domain                */
|  /* Mapping of GAI_HINTS/GAI_ADDRINFO FLAGS                        */
DCL ai_PASSIVE     BIT(32) INIT('00000001'BX);
                                      /* flag: getaddrinfo hints    */
DCL ai_CANONNAMEOK BIT(32) INIT('00000002'BX);
                                      /* flag: getaddrinfo hints    */
DCL ai_NUMERICHOST BIT(32) INIT('00000004'BX);
                                      /* flag: getaddrinfo hints    */
DCL ai_NUMERICSERV BIT(32) INIT('00000008'BX);
                                      /* flag: getaddrinfo hints    */
DCL ai_V4MAPPED    BIT(32) INIT('00000010'BX);
                                      /* flag: getaddrinfo hints    */
DCL ai_ALL         BIT(32) INIT('00000020'BX);
                                      /* flag: getaddrinfo hints    */
DCL ai_ADDRCONFIG  BIT(32) INIT('00000040'BX);
```

Figure 135. CBLOCK PL/1 common variables (Part 1 of 13)

```
                                     /* flag: getaddrinfo hints    */
|   DCL ai_EXTFLAGS    BIT(32) INIT('00000080'BX);
|                                    /* flag: getaddrinfo hints    */
|   DCL ai_ALLFLAGMASK BIT(32) INIT('FFFFFF00'BX);
    DCL ALIAS   CHAR(255);           /* alternate NAME             */
    DCL APITYPE FIXED BIN(15) INIT(2);  /* default API type        */
    DCL BACKLOG FIXED BIN(31);       /* max length of pending queue*/
    DCL BADNAME CHAR(20);            /* temporary name             */
    DCL BIND    CHAR(16) INIT('BIND');
|   DCL BIND2ADDRSEL CHAR(16) INIT('BIND2ADDRSEL');
    DCL BIT     BUILTIN;
    DCL BITZERO BIT(1);              /* bit zero value             */
    DCL BLANK255 CHAR(255) INIT(' ');   /*                         */
    DCL BLANK   CHAR(100) INIT(' ');    /*                         */
    DCL BUF     CHAR(80) INIT(' ');     /* macro READ/WRITE buffer */
    DCL BUFF  CHAR(15)         INIT(' '); /* short buffer          */
    DCL BUFFER   CHAR(32767) INIT(' ');  /* BUFFER                */
    DCL BUFIN    CHAR(32767) INIT(' ');  /* Read buffer           */
    DCL BUFOUT   CHAR(32767) INIT(' ');  /* WRITE buffer          */
    DCL NCHBUFF  CHAR(3200) INIT(' ');   /* BUFFER                */
    DCL CANONNAME_LEN FIXED BIN(31);/* getaddrinfo canonical name length*/
    DCL 1 CLIENT,                    /* socket addr of connection peer */
          2 DOMAIN FIXED BIN(31) INIT(2), /* domain of client (AF_INET) */
          2 NAME   CHAR(8) INIT(' '),    /* addr identifier for client */
          2 TASK   CHAR(8) INIT(' '),    /* task identifier for client */
          2 RESERVED CHAR(20) INIT(' '); /* reserved                */
    DCL CLOSE   CHAR(16) INIT('CLOSE');
    DCL COMMAND FIXED BIN(31) INIT(3);   /* Query FNDELAY flag      */
    DCL CONNECT CHAR(16) INIT('CONNECT');
    DCL COUNT FIXED BIN(31) INIT(100);   /* elements in GRP_IOCTL_TABLE*/
    DCL DATA_SOCK FIXED BIN(15);         /* temporary datagram socket  */
    DCL DEF     FIXED BIN(31) INIT(0);   /* default protocol        */
    DCL DONE_SENDING CHAR(1);            /* ready flag              */
    DCL DRIVER  FILE OUTPUT UNBUF ENV(FB RECSIZE(100)) RECORD;
    DCL ERETMSK CHAR(4);                 /* indicate exception events  */
    DCL ERR     FIXED BIN(31);           /* error number variable   */
    DCL ERRNO   FIXED BIN(31) INIT(0);   /*  error number           */
    DCL ESNDMSK CHAR(4);                 /* check for pending       */
                                         /*   exception events      */
    DCL EXIT    LABEL;                   /* common exit point       */
    DCL EZACIC05 ENTRY OPTIONS(ASM,INTER) EXT; /* translate ascii>ebcdic*/
    DCL EZACIC09 ENTRY OPTIONS(ASM,INTER) EXT; /* format getaddrinfo res*/
    DCL EZASOKET ENTRY OPTIONS(ASM,INTER) EXT;         /* socket call   */
    DCL FCNTL  CHAR(16) INIT('FCNTL');
    DCL FIONBIO BIT(32) INIT('8004A77E'BX); /* flag: nonblocking       */
    DCL FIONREAD BIT(32) INIT('4004A77F'BX);/* flag:#readable bytes    */
    DCL FLAGS   FIXED BIN(31) INIT(0);   /* default: no flags       */
                                         /*   1 = OOB, SEND OUT-OF-BAND*/
                                         /*   4 = DON'T ROUTE         */
    DCL FREEADDRINFO  CHAR(16) INIT('FREEADDRINFO');
    DCL GAI_NODE CHAR(255) INIT(' ');    /* getaddrinfo node        */
```

Figure 135. CBLOCK PL/1 common variables (Part 2 of 13)

```
    DCL GAI_NODELEN FIXED BIN(31) INIT(255);/* getaddrinfo node length  */
    DCL GAI_SERVICE CHAR(32) INIT(' ');  /* getaddrinfo service         */
    DCL GAI_SERVLEN FIXED BIN(31) INIT(32); /* getaddrinfo service      */
                                        /* length                      */
    DCL 1 GAI_HINTS,                    /* getaddrinfo hints addrinfo */
|         2 FLAGS     FIXED BIN(31) INIT(0),  /* hints flags, see defns */
|                                       /* starting at ai_PASSIVE */
          2 AF        FIXED BIN(31) INIT(0),  /* hints family           */
          2 SOCTYPE   FIXED BIN(31) INIT(0),  /* hints socket type      */
          2 PROTO     FIXED BIN(31) INIT(0),  /* hints protocol         */
          2 NAMELEN   FIXED BIN(31) INIT(0),
          2 *         CHAR(4),
          2 *         CHAR(4),
          2 CANONNAME FIXED BIN(31) INIT(0),
          2 *         CHAR(4),
          2 NAME      FIXED BIN(31) INIT(0),
          2 *         CHAR(4),
|         2 NEXT      FIXED BIN(31) INIT(0),
|         2 EFLAGS    FIXED BIN(31) INIT(0);  /* see definitions after  */
|                                       /* IPV6_ADDR_PREFERENCES  */
    DCL 1 GAI_ADDRINFO BASED(RES),   /* getaddrinfo RES addrinfo        */
|         2 FLAGS     FIXED BIN(31), /* see ai_PASSIVE & following defns*/
          2 AF        FIXED BIN(31),
          2 SOCTYPE   FIXED BIN(31),
          2 PROTO     FIXED BIN(31),
          2 NAMELEN   FIXED BIN(31), /* RES socket address struct length*/
          2 *         CHAR(4),
          2 *         CHAR(4),
          2 CANONNAME POINTER,       /* RES canonical name              */
          2 *         CHAR(4),
          2 NAME      POINTER,       /* RES socket address structure    */
          2 *         CHAR(4),
|         2 NEXT      POINTER,       /* RES next addrinfo, zero if none.*/
|         2 EFLAGS    FIXED BIN(31); /* see definitions that follow the */
|                                    /* IPV6_ADDR_PREFERENCES definition*/
    DCL 1 GAI_NAME_ID BASED(GAI_ADDRINFO.NAME),
          2 LEN    BIT(8),
          2 FAMILY BIT(8),
          2 PORT   BIT(16),
          2 ADDRESS BIT(32),
          2 RESERVED1 CHAR(8);
    DCL 1 GAI_NAME6_ID BASED(GAI_ADDRINFO.NAME),
          2 LEN    BIT(8),
          2 FAMILY BIT(8),
          2 PORT   BIT(16),
          2 FLOWINFO FIXED BIN(31),
          2 ADDRESS CHAR(16),
```

Figure 135. CBLOCK PL/1 common variables (Part 3 of 13)

```
      2 SCOPEID FIXED BIN(31);
 DCL GETADDRINFO  CHAR(16) INIT('GETADDRINFO');
 DCL GETCLIENTID  CHAR(16) INIT('GETCLIENTID');
 DCL GETHOSTBYADDR  CHAR(16) INIT('GETHOSTBYADDR');
 DCL GETHOSTBYNAME CHAR(16) INIT('GETHOSTBYNAME');
 DCL GETHOSTNAME CHAR(16) INIT('GETHOSTNAME');
 DCL GETHOSTID CHAR(16) INIT('GETHOSTID');
 DCL GETIBMOPT CHAR(16) INIT('GETIBMOPT');
 DCL GETNAMEINFO  CHAR(16) INIT('GETNAMEINFO');
 DCL GETPEERNAME CHAR(16) INIT('GETPEERNAME');
 DCL GETSOCKNAME CHAR(16) INIT('GETSOCKNAME');
 DCL GETSOCKOPT CHAR(16) INIT('GETSOCKOPT');
 DCL GIVESOCKET  CHAR(16) INIT('GIVESOCKET');
 DCL GLOBAL CHAR(16) INIT('GLOBAL');
 DCL GNI_FLAGS FIXED BIN(31);   /* getnameinfo flags                */
 DCL GNI_HOST CHAR(255);        /* getnameinfo host                 */
 DCL GNI_HOSTLEN FIXED BIN(31); /* getnameinfo host length          */
 DCL GNI_SERVICE CHAR(32);      /* getnameinfo service              */
 DCL GNI_SERVLEN FIXED BIN(31);        /* getnameinfo service length */
 DCL 1 GROUP_FILTER4 BASED,            /* Group_Filter for IPv4      */
       2 GF4_HEADER,                   /* Header portion             */
         3 GF4_INTERFACE FIXED BIN(31),  /* Interface index          */
         3 *                   CHAR(4),  /* Padding                  */
         3 GF4_GROUP,                    /* Group Multi Address      */
           4 GF4_SOCK_LEN        BIT(8),   /* Socket len             */
           4 GF4_SOCK_FAMILY     BIT(8),   /* Socket family          */
           4 GF4_SOCK_SIN_PORT   BIT(16),  /* Socket port            */
           4 GF4_SOCK_SIN_ADDR BIT(32),    /* Socket address         */
           4 GF4_RESERVED1 CHAR(8),        /* Unused                 */
           4 *             CHAR(112),      /*                        */
         3 GF4_FMODE     FIXED BIN(31),    /* Filter mode            */
         3 GF4_NUMSRC    FIXED BIN(31),    /* Num of sources         */
       2 GF4_SLIST     CHAR(0);          /* Source list              */
 DCL 1 GF4_SRCENTRY BASED,             /* Source Entry               */
       2 GF4_SRCADDR,                  /* Source IP address          */
         3 GF4_SOCK_LEN        BIT(8),   /* Socket len               */
         3 GF4_SOCK_FAMILY     BIT(8),   /* Socket family            */
         3 GF4_SOCK_SIN_PORT   BIT(16),  /* Socket port              */
         3 GF4_SOCK_SIN_ADDR BIT(32),    /* Socket address           */
         3 GF4_RESERVED1 CHAR(8),        /* Unused                   */
         3 *             CHAR(112);      /*                          */
 DCL 1 GROUP_FILTER6 BASED,            /* Group_Filter for IPv6      */
       2 GF6_HEADER,                   /* Header portion             */
         3 GF6_INTERFACE FIXED BIN(31),  /* Interface index          */
         3 *                   CHAR(4),  /* Padding                  */
         3 GF6_GROUP,                    /* Group Multi Address      */
           4 GF6_SOCK_LEN      BIT(8),   /* Socket len               */
           4 GF6_SOCK_FAMILY   BIT(8),   /* Socket family            */
           4 GF6_SOCK_SIN6_PORT BIT(16), /* Socket port              */
           4 GF6_SOCK_SIN6_FLOWINFO FIXED BIN(31), /* flow info      */
           4 GF6_SOCK_SIN6_ADDRESS CHAR(16), /* Socket address       */
           4 GF6_SOCK_SIN6_SCOPEID FIXED BIN(31), /* Socket scopeid  */
           4 *             CHAR(100),      /*                        */
         3 GF6_FMODE     FIXED BIN(31),    /* Filter mode            */
         3 GF6_NUMSRC    FIXED BIN(31),    /* Num of sources         */
```

Figure 135. CBLOCK PL/1 common variables (Part 4 of 13)

```
      2 GF6_SLIST     CHAR(0);          /* Source list             */
 DCL 1 GF6_SRCENTRY BASED,             /* Source Entry            */
      2 GF6_SRCADDR,                   /* Source IP address       */
        3 GF6_SOCK_LEN      BIT(8),    /* Socket len              */
        3 GF6_SOCK_FAMILY   BIT(8),    /* Socket family           */
        3 GF6_SOCK_SIN6_PORT BIT(16), /* Socket port             */
        3 GF6_SOCK_SIN6_FLOWINFO FIXED BIN(31), /* flow info     */
        3 GF6_SOCK_SIN6_ADDRESS CHAR(16), /* Socket address      */
        3 GF6_SOCK_SIN6_SCOPEID FIXED BIN(31), /* Socket scopeid  */
        3 *             CHAR(100);     /*                         */
 DCL 1 GROUP_REQ4 BASED,               /* Group_Req for IPv4      */
      2 GR4_INTERFACE FIXED BIN(31),   /* Interface index         */
      2 *                  CHAR(4),    /* Padding                 */
      2 GR4_SOCK_LEN       BIT(8),     /* Socket len              */
      2 GR4_SOCK_FAMILY    BIT(8),     /* Socket family           */
      2 GR4_SOCK_SIN_PORT  BIT(16),    /* Socket port             */
      2 GR4_SOCK_SIN_ADDR BIT(32),     /* Socket address          */
      2 GR4_RESERVED1 CHAR(8),         /* Unused                  */
      2 *             CHAR(112);       /*                         */
 DCL 1 GROUP_REQ6 BASED,               /* Group_Req for IPv6      */
      2 GR6_INTERFACE FIXED BIN(31),   /* Interface index         */
      2 *                  CHAR(4),    /* Padding                 */
      2 GR6_SOCK_LEN       BIT(8),     /* Socket len              */
      2 GR6_SOCK_FAMILY    BIT(8),     /* Socket family           */
      2 GR6_SOCK_SIN6_PORT  BIT(16),   /* Socket port             */
      2 GR6_SOCK_SIN6_FLOWINFO FIXED BIN(31), /* flow info       */
      2 GR6_SOCK_SIN6_ADDRESS CHAR(16), /* Socket address         */
      2 GR6_SOCK_SIN6_SCOPEID FIXED BIN(31), /* Socket scopeid    */
      2 *             CHAR(100);       /*                         */
 DCL 1 GROUP_SOURCE_REQ4 BASED,        /* Group_Source_Req for IPv4  */
      2 GSR4_INTERFACE FIXED BIN(31), /* Interface index          */
      2 *                  CHAR(4),    /* Padding                 */
      2 GSR4_GROUP,                    /* Multicast group addr    */
        3 GSR4_SOCK_LEN       BIT(8),  /* Socket len             */
        3 GSR4_SOCK_FAMILY    BIT(8),   /* Socket family         */
        3 GSR4_SOCK_SIN_PORT   BIT(16), /* Socket port           */
        3 GSR4_SOCK_SIN_ADDR BIT(32),   /* Socket address        */
        3 GSR4_RESERVED1 CHAR(8),       /* Unused                */
        3 *              CHAR(112),   /*                         */
      2 GSR4_SOURCE,                   /* Source IP address       */
        3 GSR4_SOCK_LEN       BIT(8),  /* Socket len             */
        3 GSR4_SOCK_FAMILY    BIT(8),   /* Socket family         */
        3 GSR4_SOCK_SIN_PORT   BIT(16), /* Socket port           */
        3 GSR4_SOCK_SIN_ADDR BIT(32),    /* Socket address       */
        3 GSR4_RESERVED1 CHAR(8),        /* Unused               */
        3 *              CHAR(112);   /*                         */
 DCL 1 GROUP_SOURCE_REQ6 BASED,        /* Group_Source_Req for IPv6  */
      2 GSR6_INTERFACE FIXED BIN(31), /* Interface index          */
      2 *                  CHAR(4),    /* Padding                 */
      2 GSR6_GROUP,                    /* Multicast group addr    */
        3 GSR6_SOCK_LEN       BIT(8),   /* Socket len            */
        3 GSR6_SOCK_FAMILY    BIT(8),   /* Socket family         */
        3 GSR6_SOCK_SIN6_PORT  BIT(16), /* Socket port           */
        3 GSR6_SOCK_SIN6_FLOWINFO FIXED BIN(31), /* flow info    */
        3 GSR6_SOCK_SIN6_ADDRESS CHAR(16), /* Socket address      */
```

Figure 135. CBLOCK PL/1 common variables (Part 5 of 13)

```
        3 GSR6_SOCK_SIN6_SCOPEID FIXED BIN(31), /* Socket scopeid   */
        3 *             CHAR(100),    /*                           */
      2 GSR6_SOURCE,                  /* Source IP address         */
        3 GSR6_SOCK_LEN        BIT(8),   /* Socket len             */
        3 GSR6_SOCK_FAMILY     BIT(8),   /* Socket family          */
        3 GSR6_SOCK_SIN6_PORT  BIT(16), /* Socket port              */
        3 GSR6_SOCK_SIN6_FLOWINFO FIXED BIN(31), /* flow info       */
        3 GSR6_SOCK_SIN6_ADDRESS CHAR(16), /* Socket address       */
        3 GSR6_SOCK_SIN6_SCOPEID FIXED BIN(31), /* Socket scopeid   */
        3 *             CHAR(100);    /*                           */
DCL HINTS POINTER;              /*getaddrinfo hints addrinfo pointer*/
DCL 1 HOMEIF,                         /* Home Interface Structure   */
  2 ADDRESS CHAR(16);                 /* Home Interface Address     */
DCL HOSTADDR BIT(32);                 /* host internet address      */
DCL HOSTNAME CHAR(24);                /* host name from GETHOSTNAME */
DCL HOSTNAME_LEN FIXED BIN(31) INIT(24);
                                    /* host name length GETHOSTNAME */
DCL HOW     FIXED BIN(31) INIT(2);    /* how shutdown is to be done */
Dcl 1 HOSTENT      Based,             /* Host entry                 */
     3 H_NAME      POINTER,           /* Official name of host      */
     3 H_ALIASES   POINTER,           /* Alias list address         */
     3 H_ADDRTYPE  BIT(32),           /* Host address type          */
     3 H_LENGTH    FIXED BIN(31),     /* Length of address          */
     3 H_ADDR_LIST POINTER;           /* List of addresses from     */
                                      /* name server                */
DCL I       FIXED BIN(15);            /* loop index                 */
DCL ICMP    FIXED BIN(31) INIT(2);    /* prototype icmp  ???        */
DCL 1 ID,                             /*                            */
      2 TCPNAME CHAR(8) INIT('TCPIP'), /* remote address space      */
      2 ADSNAME CHAR(8) INIT('USER9'); /* local address space       */
DCL IDENT   POINTER;                  /* TCP/IP Addr Space          */
DCL IFCONF  CHAR(255);                /* configuration structure    */
DCL 1 IF_NAMEINDEX,
  2 IF_NIHEADER,
    3 IF_NITOTALIF FIXED BIN(31), /*Total Active Interfaces on Sys. */
    3 IF_NIENTRIES FIXED BIN(31),     /* Number of entries returned */
  2 IF_NITABLE(10) CHAR(24);
DCL 1 IF_NAMEINDEXENTRY,
  2 IF_NIINDEX FIXED BIN(31),         /* Interface Index            */
  2 IF_NINAME  CHAR(16),            /* Interface Name, blank padded */
  2 IF_NIEXT,
    3 IF_NINAMETERM CHAR(1),          /* Null for C for Name len=16 */
    3 IF_RESERVED  CHAR(3);           /* Reserved                   */
DCL 1 IFREQ,                          /* Interface Structure        */
  2 IFR_NAME  CHAR(16),             /* Interface Name, blank padded */
  2 IFR_IFR UNION,
    3 IFR_ADDR,                       /* Interface IP Address       */
      4 IFR_ADDR_LEN    BIT(8),       /*     Socket Len             */
      4 IFR_ADDR_FAMILY BIT(8),       /*     Socket Family          */
      4 IFR_ADDR_PORT   BIT(16),      /*     Socket Port            */
      4 IFR_ADDR_ADDR   BIT(32),      /*     Socket Address         */
      4 IFR_ADDR_RSVD   CHAR(8),      /*     Socket Reserved        */
    3 IFR_DSTADDR,                    /* Interface Dest IP Addr     */
      4 IFR_DSTADDR_LEN    BIT(8),    /*     Socket Len             */
      4 IFR_DSTADDR_FAMILY BIT(8),    /*     Socket Family          */
```

Figure 135. CBLOCK PL/1 common variables (Part 6 of 13)

```
      4 IFR_DSTADDR_PORT   BIT(16),   /*   Socket Port              */
      4 IFR_DSTADDR_ADDR   BIT(32),   /*     Socket Address         */
      4 IFR_DSTADDR_RSVD   CHAR(8),   /*     Socket Reserved        */
    3 IFR_BROADADDR,                  /* Interface Broadcast IP Addr*/
      4 IFR_BROADADDR_LEN    BIT(8),  /*     Socket Len             */
      4 IFR_BROADADDR_FAMILY BIT(8),  /*     Socket Family          */
      4 IFR_BROADADDR_PORT   BIT(16), /* Socket Port                */
      4 IFR_BROADADDR_ADDR   BIT(32), /*     Socket Address         */
      4 IFR_BROADADDR_RSVD   CHAR(8), /*     Socket Reserved        */
    3 IFR_FLAGS   BIT(16),            /* Interface Flags            */
    3 IFR_METRIC  FIXED BIN(31),      /* Interface Metric           */
    3 IFR_DATA    FIXED BIN(31),      /* Interface Data             */
    3 IFR_MTU     FIXED BIN(31);      /* Interface MTU              */
  /* The following constants are for use with the IFR_FLAGS field     */
  /* in structure IFREQ.                                              */
  DCL IFF_UP          BIT(16) INIT('0001'BX); /* interface is UP      */
  DCL IFF_BROADCAST   BIT(16) INIT('0002'BX); /* broadcast addr valid */
  DCL IFF_DEBUG       BIT(16) INIT('0004'BX); /* turn on debugging    */
  DCL IFF_LOOPBACK    BIT(16) INIT('0008'BX); /* software loopback    */
  DCL IFF_POINTOPOINT BIT(16) INIT('0010'BX); /* point-to-point link  */
  DCL IFF_NOTRAILERS  BIT(16) INIT('0020'BX); /* avoid use trailers   */
  DCL IFF_RUNNING     BIT(16) INIT('0040'BX); /* resources allocated  */
  DCL IFF_NOARP       BIT(16) INIT('0080'BX); /* no ARP               */
  DCL IFF_PROMISC     BIT(16) INIT('0100'BX); /* receive all packets  */
  DCL IFF_ALLMULTI    BIT(16) INIT('0200'BX); /* multicast packets    */
  DCL IFF_MULTICAST   BIT(16) INIT('0400'BX); /* multicast capable    */
  DCL IFF_POINTOMULTIPT BIT(16) INIT('0800'BX);/* pt-to-multipt       */
  DCL IFF_BRIDGE      BIT(16) INIT('1000'BX); /* support token ring   */
  DCL IFF_SNAP        BIT(16) INIT('2000'BX); /* support extended SAP */
  DCL IFF_VIRTUAL     BIT(16) INIT('4000'BX); /* virtual interface    */
  DCL IFF_SAMEHOST    BIT(16) INIT('8000'BX); /* Samehost             */
  DCL INDEX   BUILTIN;
  DCL IOCTL  CHAR(16) INIT('IOCTL');
  DCL IOCTL_CMD FIXED BIN(31);          /* ioctl command              */
  DCL IOCTL_REQARG  POINTER ;           /* send   pointer to data area*/
  DCL IOCTL_RETARG  POINTER ;           /* return pointer to data area*/
  DCL IOCTL_REQ00   FIXED BIN(31);      /* command request argument   */
  DCL IOCTL_REQ04   FIXED BIN(31);      /* command request argument   */
  DCL IOCTL_REQ08   FIXED BIN(31);      /* command request argument   */
  DCL IOCTL_REQ32   CHAR(32) INIT(' '); /* command request argument   */
  DCL IOCTL_RET00   FIXED BIN(31);      /* command return  argument   */
  DCL IOCTL_RET04   FIXED BIN(31);      /* command return  argument   */
| DCL INET6_IS_SRCADDR CHAR(16) INIT('INET6_IS_SRCADDR');
  DCL INITAPI CHAR(16) INIT('INITAPI'); /*                            */
  DCL IP      FIXED BIN(31) INIT(1);    /* prototype ip   ???         */
  DCL 1 IP_MREQ,
    2 IMR_MULTIADDR BIT(32),            /* IP multicast addr of group */
    2 IMR_INTERFACE BIT(32);            /* local IP addr of interface */
  DCL 1 IPV6_MREQ,
    2 IPV6MR_MULTIADDR CHAR(16),
    2 IPV6MR_INTERFACE FIXED BIN(31);
  DCL 1 IP_MREQ_SOURCE BASED,           /* Multi source API structure */
        2 IMRS_MULTIADDR BIT(32),       /* IP multicast addr of grp   */
```

Figure 135. CBLOCK PL/1 common variables (Part 7 of 13)

```
      2 IMRS_SOURCEADDR BIT(32),      /* IP source addr            */
      2 IMRS_INTERFACE BIT(32);       /* local IP addr of intf     */
 DCL 1 IP_MSFILTER BASED,             /* IP_MsFilter               */
      2 IMSF_HEADER,                  /* Header portion            */
        3 IMSF_MULTIADDR BIT(32),     /* Multicast address         */
        3 IMSF_INTERFACE BIT(32),     /* Interface address         */
        3 IMSF_FMODE     FIXED BIN(31), /* Filter mode            */
        3 IMSF_NUMSRC    FIXED BIN(31), /* Num of sources         */
      2 IMSF_SLIST     CHAR(0);         /* Source list            */
 DCL 1 IMSF_SRCENTRY BASED,           /* Source Entry              */
      2 IMSF_SRCADDR BIT(32);         /* Source IP address         */
 DCL IP_MULTICAST_TTL BIT(32) INIT('00100003'BX);
|                                    /* getsockopt/setsockopt OPTNAME */
 DCL IP_MULTICAST_LOOP BIT(32) INIT('00100004'BX);
|                                    /* getsockopt/setsockopt OPTNAME */
 DCL IP_MULTICAST_IF BIT(32) INIT('00100007'BX);
|                                    /* getsockopt/setsockopt OPTNAME */
 DCL IP_ADD_MEMBERSHIP BIT(32) INIT('00100005'BX);
|                                    /* getsockopt/setsockopt OPTNAME */
 DCL IP_DROP_MEMBERSHIP BIT(32) INIT('00100006'BX);
|                                    /* getsockopt/setsockopt OPTNAME */
 DCL IP_BLOCK_SOURCE BIT(32) INIT('0010000A'BX);
|                                    /* getsockopt/setsockopt OPTNAME */
 DCL IP_UNBLOCK_SOURCE BIT(32) INIT('0010000B'BX);
|                                    /* getsockopt/setsockopt OPTNAME */
 DCL IP_ADD_SOURCE_MEMBERSHIP BIT(32) INIT('0010000C'BX);
|                                    /* getsockopt/setsockopt OPTNAME */
 DCL IP_DROP_SOURCE_MEMBERSHIP BIT(32) INIT('0010000D'BX);
 DCL IPRES   POINTER;                /* EZACIC09 RES addrinfo ptr    */
| DCL IPV6_ADDR_PREFERENCES BIT(32) INIT('00010020'BX);
|                                    /* getsockopt/setsockopt OPTNAME */
| /*********************************************************************/
| /* Mapping of GAI_HINTS/GAI_ADDRINFO EFLAGS flags and               */
| /* IPV6_ADDR_PREFERENCES getsockopt, setsockopt OPTVAL flags, and   */
| /* inet6_is_srcaddr flags                                           */
| /*********************************************************************/
| /* Prefer home IPv6 address over care-of IPv6 address               */
| DCL IPV6_PREFER_SRC_HOME   BIT(32) INIT('00000001'BX);
```

Figure 135. CBLOCK PL/1 common variables (Part 8 of 13)

```
|   /* Prefer care-of IPv6 address over home IPv6 address              */
|   DCL IPV6_PREFER_SRC_COA    BIT(32) INIT('00000002'BX);
|   /* Prefer temporary IPv6 address over public IPv6 address          */
|   DCL IPV6_PREFER_SRC_TMP    BIT(32) INIT('00000004'BX);
|   /* Prefer public IPv6 address over temporary IPv6 address          */
|   DCL IPV6_PREFER_SRC_PUBLIC BIT(32) INIT('00000008'BX);
|   /* Prefer cryptographic address over non-cryptographic address     */
|   DCL IPV6_PREFER_SRC_CGA    BIT(32) INIT('00000010'BX);
|   /* Prefer non-cryptographic address over cryptographic address     */
|   DCL IPV6_PREFER_SRC_NONCGA BIT(32) INIT('00000020'BX);
|   /* Invalid EFLAGS or IPV6_ADDR_PREFERENCES OPTVAL flags            */
|   DCL IPV6_PREFERENCES_FLAGS_MASKINVALID BIT(32) INIT('FFFFFFC0'BX);
|   /*****************************************************************/
    DCL IPV6_JOIN_GROUP BIT(32) INIT('00010005'BX);
|                                   /* getsockopt/setsockopt OPTNAME */
    DCL IPV6_LEAVE_GROUP BIT(32) INIT('00010006'BX);
|                                   /* getsockopt/setsockopt OPTNAME */
    DCL IPV6_LOOPBACK CHAR(3) INIT('::1');
    DCL IPV6_MULTICAST_HOPS BIT(32) INIT('00010009'BX);
|                                   /* getsockopt/setsockopt OPTNAME */
    DCL IPV6_MULTICAST_IF BIT(32) INIT('00010007'BX);
|                                   /* getsockopt/setsockopt OPTNAME */
    DCL IPV6_MULTICAST_LOOP BIT(32) INIT('00010004'BX);
|                                   /* getsockopt/setsockopt OPTNAME */
    DCL IPV6_UNICAST_HOPS BIT(32) INIT('00010003'BX);
|                                   /* getsockopt/setsockopt OPTNAME */
    DCL IPV6_V6ONLY BIT(32) INIT('0001000A'BX);
    DCL J       FIXED BIN(15);            /* loop index                */
    DCL K       FIXED BIN(15);            /* loop index                */
    DCL LENGTH  BUILTIN;
    DCL LABL    CHAR(9);
    DCL LISTEN  CHAR(16) INIT('LISTEN');
    DCL MAXSNO  FIXED BIN(31) INIT(0);    /* max descriptor assigned    */
    DCL 1 MAXSOC_INPUT FIXED BIN(31) INIT(0);
    DCL 1 MAXSOC_FWD,
        2 MAXSOC_IGNORE FIXED BIN(15) INIT(0),
        2 MAXSOC  FIXED BIN(15) INIT(255); /* largest sock # checked    */
    DCL MCAST_JOIN_GROUP BIT(32) INIT('00100028'BX);
|                                   /* getsockopt/setsockopt OPTNAME */
    DCL MCAST_LEAVE_GROUP BIT(32) INIT('00100029'BX);
```

Figure 135. CBLOCK PL/1 common variables (Part 9 of 13)

```
|                                    /* getsockopt/setsockopt OPTNAME */
   DCL MCAST_JOIN_SOURCE_GROUP BIT(32) INIT('0010002A'BX);
|                                    /* getsockopt/setsockopt OPTNAME */
   DCL MCAST_LEAVE_SOURCE_GROUP BIT(32) INIT('0010002B'BX);
|                                    /* getsockopt/setsockopt OPTNAME */
   DCL MCAST_BLOCK_SOURCE BIT(32) INIT('0010002C'BX);
|                                    /* getsockopt/setsockopt OPTNAME */
   DCL MCAST_UNBLOCK_SOURCE BIT(32) INIT('0010002D'BX);
|                                    /* getsockopt/setsockopt OPTNAME */
   DCL MCAST_EXCLUDE BIT(32) INIT('00000001'BX);
   DCl MCAST_INCLUDE BIT(32) INIT('00000000'BX);
   DCl MCAST_NUMSRC_MAX BIT(32)INIT('00000040'BX);
   DCL MESSAGE CHAR(50) INIT('I love my 1 @ Rottweiler!'); /* message  */
   DCL MSG     CHAR(100) INIT(' ');      /*   message text             */
   DCL 1 NAME_ID,                     /* socket addr of connection peer */
         2 FAMILY FIXED BIN(15) INIT(2), /*addr'g family  TCP/IP def   */
         2 PORT   BIT(16),             /* system assigned port #     */
         2 ADDRESS BIT(32),            /* 32-bit internet            */
         2 RESERVED CHAR(8);           /* reserved                   */
   DCL 1 NAME6_ID,                   /* socket addr of connection peer */
         2 FAMILY  FIXED BIN(15) INIT(19),  /* NAMELN IGNORED & FAMILY */
         2 PORT    BIT(16),            /* port #                     */
         2 FLOWINFO FIXED BIN(31),     /* Flow info                  */
         2 ADDRESS CHAR(16),           /* IPv6 internet address      */
         2 SCOPEID FIXED BIN(31);      /* Scope ID                   */
   DCL NAMEL   CHAR(255)    VARYING;   /* name field, long           */
   DCL NAMES   CHAR(24);               /* name field, short          */
   DCL NAMELEN FIXED BIN(31);          /* length of name/alias field */
   DCL NBYTE   FIXED BIN(31);          /* Number of bytes in buffer  */
   DCL 1 NETCONFHDR,                   /* Network Configuration Hdr  */
     2 NCHEYECATCHER CHAR(4) INIT('6NCH'), /* Eye Catcher '6NCH'       */
     2 NCHIOCTL BIT(32) INIT('C014F608'BX),
                                       /* The IOCTL being processed  */
                                       /* with this instance of the  */
                                       /* NetConfHdr. (RAS item)     */
     2 NCHBUFFERLENGTH FIXED BIN(31) INIT(3200), /* Buffer Length      */
     2 NCHBUFFERPTR    POINTER,        /* Buffer Pointer             */
     2 NCHNUMENTRYRET FIXED BIN(31);  /* Number of HomeIF returned via */
                                      /*  SIOCGHOMEIF6 or the number of*/
                                      /*  GRT6RtEntry's returned via   */
                                      /*  SIOCGRT6TABLE.               */
   DCL NI_NOFQDN FIXED BIN(31) INIT(1);
                                       /* flag: getnameinfo          */
   DCL NI_NUMERICHOST FIXED BIN(31) INIT(2);
                                       /* flag: getnameinfo          */
```

Figure 135. CBLOCK PL/1 common variables (Part 10 of 13)

```
DCL NI_NAMEREQD FIXED BIN(31) INIT(4);
                                  /* flag: getnameinfo          */
DCL NI_NUMERICSERV FIXED BIN(31) INIT(8);
                                  /* flag: getnameinfo          */
DCL NI_DGRAM FIXED BIN(31) INIT(16);
                                  /* flag: getnameinfo          */
DCL NI_NUMERICSCOPE FIXED BIN(31) INIT(32);
                                  /* flag: getnameinfo          */
DCL NOTE(3) CHAR(25) INIT('Now is the time for 198 g',
                          'ood people to come to the',
                          ' aid of their parties!');
DCL NS      FIXED BIN(15);        /* socket descriptor, new     */
DCL NTOP    CHAR(16) INIT('NTOP');    /* Numeric to Presentation    */
DCL NULL    BUILTIN;
DCL 1 NUMERIC_ADDR CHAR(16);          /* NTOP/PTON Numeric address  */
DCL OPNAMELEN FIXED BIN(31);     /* Socket address structure length */
DCL OPCANON CHAR(256);                /* Canonical name             */
DCL OPNAME  POINTER;                  /* Socket address structure   */
DCL OPNEXT  POINTER;           /* Next result address info in chain */
DCL OPTL    FIXED BIN(31);            /* length of OPTVAL string    */
DCL OPTLEN  FIXED BIN(31);            /* length of OPTVAL string    */
DCL OPTN    CHAR(15);                 /* OPTNAME value (macro)      */
DCL OPTNAME FIXED BIN(31);            /* OPTNAME value (call)       */
DCL OPTVAL  CHAR(255);                /* GETSOCKOPT option data     */
DCL OPTVALD FIXED BIN(31);            /* SETSOCKOPT option data     */
DCL 1 OPT_STRUC,                      /* structure for option       */
      2 ON_OFF FIXED BIN(31) INIT(1), /* enable option              */
      2 TIME   FIXED BIN(31) INIT(5); /* time-out in seconds        */
DCL 1 OPT_STRUCT,                     /* structure for option       */
      2 ON     FIXED BIN(31),         /* used for getsockopt        */
      2 TIMEOUT FIXED BIN(31);        /* time-out in seconds        */
DCL PLITEST BUILTIN;                  /* debug tool                 */
DCL PRESENTABLE_ADDR CHAR(45);     /* NTOP/PTON presentable address */
DCL PRESENTABLE_ADDR_LEN FIXED BIN(15);
                           /* NTOP/PTON presentable address length*/
DCL PROTO   FIXED BIN(31) INIT(0);    /* prototype default          */
DCL PTON    CHAR(16) INIT('PTON');    /* Presentation to numeric    */
DCL READ    CHAR(16) INIT('READ');
DCL READV   CHAR(16) INIT('READV');
DCL RECV    CHAR(16) INIT('RECV');
DCL RECVFROM CHAR(16) INIT('RECVFROM');
DCL RECVMSG CHAR(16) INIT('RECVMSG');
DCL REUSE   FIXED BIN(31) INIT('4');  /* toggle, reuse local addr   */
DCL REQARG  FIXED BIN(31);            /* command request argument   */
DCL RES     POINTER;                 /* getaddrinfo RES addrinfo ptr */
DCL RETC    FIXED BIN(31);            /* return code variable       */
DCL RETARG  CHAR(255);                /* return argument data area  */
DCL RETCODE FIXED BIN(31) INIT(0);    /* return code                */
DCL RETLEN  FIXED BIN(31);            /* return area data length    */
DCL RRETMSK CHAR(4);                  /* indicate READ EVENTS       */
DCL RSNDMSK CHAR(4);                /* check for pending read events */
DCL RTENTRY CHAR(50) INIT('dummy table'); /* router entry           */
DCL SAVEFAM  FIXED BIN(15);           /* temporary family name      */
DCL SELECB CHAR(4) INIT('1');
DCL SELECT CHAR(16) INIT('SELECT');
```

Figure 135. CBLOCK PL/1 common variables (Part 11 of 13)

```
    DCL SELECTEX CHAR(16) INIT('SELECTEX');
    DCL SEND CHAR(16) INIT('SEND');
    DCL SENDMSG CHAR(16) INIT('SENDMSG');
    DCL SENDTO CHAR(16) INIT('SENDTO');
    DCL SETADEYE1     CHAR(8) INIT('SETAPPLD');
    DCL SETADVER      FIXED BIN(15) INIT(1);
    DCL SETADCONTLEN  FIXED BIN(15) INIT(48);
    DCL SETADBUFLEN   FIXED BIN(15) INIT(40);
    DCL 1 SETAPPLDATA,
         2 SETAD_EYE1  CHAR(8),
         2 SETAD_VER   FIXED BIN(15),
         2 SETAD_LEN   FIXED BIN(15),
         2 *           CHAR(4),
         2 SETAD_PTR64 ,
          3 SETAD_PTRHW CHAR(4),
          3 SETAD_PTR  POINTER;
    DCL SETADEYE2 CHAR(8) INIT('APPLDATA');
    DCL 1 SETADCONTAINER,
         2 SETAD_EYE2 CHAR(8),
         2 SETAD_BUFFER CHAR(40);
    DCL SETSOCKOPT CHAR(16) INIT('SETSOCKOPT');
    DCL SHUTDOWN CHAR(16) INIT('SHUTDOWN');
    DCL SIOCADDRT BIT(32) INIT('8030A70A'BX); /* flag: add routing entry*/
    DCL SIOCATMARK BIT(32) INIT('4004A707'BX); /* flag: out-of-band data*/
    DCL SIOCDELRT BIT(32) INIT('8030A70B'BX); /* flag: delete routing   */
    DCL SIOCGIFADDR BIT(32) INIT('C020A70D'BX); /*flag: network int addr*/
    DCL SIOCGHOMEIF6 BIT(32) INIT('C014F608'BX); /* flag netw int config*/
    DCL SIOCGIFBRDADDR BIT(32) INIT('C020A712'BX); /* flag net broadcast*/
    DCL SIOCGIFCONF BIT(32) INIT('C008A714'BX); /* flag: netw int config*/
    DCL SIOCGIFDSTADDR BIT(32) INIT('C020A70F'BX); /* flag: net des addr*/
    DCL SIOCGIFFLAGS BIT(32) INIT('C020A711'BX); /* flag: net intf flags*/
    DCL SIOCGIFMETRIC BIT(32) INIT('C020A717'BX); /* flag: get rout metr*/
    DCL SIOCGIFMTU BIT(32) INIT('C020A726'BX); /* flag: get intf mtu    */
    DCL SIOCGIFNAMEINDEX BIT(32) INIT('4000F603'BX);
                                       /* flag: name and indexes     */
    DCL SIOCGIFNETMASK BIT(32) INIT('C020A715'BX); /* flag: network mask*/
    DCL SIOCGIFNONSENSE BIT(32) INIT('B669FD2E'BX); /* flag: nonsense   */
    DCL SIOCSIFMETRIC BIT(32) INIT('8020A718'BX); /* flag: set rout metr*/
    DCL SIOCSAPPLDATA BIT(32) INIT('8018D90C'BX); /* Set APPLDATA       */
    DCL SIOCGIPMSFILTER  BIT(32) INIT('C000A724'BX);
                                    /* flag: get multicast src filter  */
    DCL SIOCSIPMSFILTER  BIT(32) INIT('8000A725'BX);
                                    /* flag: set multicast src filter  */
    DCL SIOCGMSFILTER  BIT(32) INIT('C000F610'BX);
                                    /* flag: get multicast src filter  */
    DCL SIOCSMSFILTER  BIT(32) INIT('8000F611'BX);
                                    /* flag: set multicast src filter  */
    /* The following constant is defined in EZBZTLS1, but is also       */
    /* included here for completeness.                                  */
    /* DCL SIOCTTLSCTL  BIT(32) INIT('C038D90B'BX)                      */
                                              /* flag: ttls             */
|   /* The following constants are defined in EZBPINF1, but is also     */
|   /* included here for completeness.                                  */
|   /* DCL SIOCSPARTNERINFO  BIT(32) INIT('8004F613'BX);                */
```

Figure 135. CBLOCK PL/1 common variables (Part 12 of 13)

```
|   /* DCL SIOCGPARTNERINFO  BIT(32) INIT('C000F612'BX);               */
|                                              /* flag: PartnerInfo  */
    DCL SOCK     FIXED BIN(15);          /* socket descriptor          */
    DCL SOCKET  CHAR(16) INIT('SOCKET');
    DCL SOCK_DATAGRAM FIXED BIN(15);     /* socket descriptor datagram */
    DCL SOCK_RAW FIXED BIN(15);          /* socket descriptor raw      */
    DCL SOCK_STREAM FIXED BIN(15);       /* stream socket descriptor   */
    DCL SOCK_STREAM_1 FIXED BIN(15);     /* stream socket descriptor   */
    DCL SO_BROADCAST FIXED BIN(31) INIT(32); /* toggle, broadcast msg  */
    DCL SO_ERROR FIXED BIN(31) INIT(4103); /* check/clear async error  */
    DCL SO_KEEPALIVE FIXED BIN(31) INIT(8); /* request status of stream*/
    DCL SO_LINGER  FIXED BIN(31) INIT(128); /* toggle, linger on close */
    DCL SO_OOBINLINE FIXED BIN(31) INIT(256);/*toggle, out-of-bound data*/
    DCL SO_RCVTIMEO BIT(32) INIT('00001006'BX);
    DCL SO_REUSEADDR FIXED
                   BIN(31) INIT(4);      /* toggle, local address reuse*/
    DCL SO_SNDBUF  FIXED BIN(31) INIT(4097);
    DCL SO_SNDTIMEO BIT(32) INIT('00001005'BX);
    DCL SO_TYPE FIXED BIN(31) INIT(4104); /* return type of socket     */
    DCL STRING  BUILTIN;
    DCL SUBSTR  BUILTIN;
    DCL SUBTASK CHAR(8) INIT('ANYNAME');  /* task/path identifier      */
    DCL SYNC    CHAR(16) INIT('SYNC');
    DCL TAKESOCKET CHAR(16) INIT('TAKESOCKET');
    DCL TASK    CHAR(16) INIT('TASK');
    DCL TERMAPI CHAR(16) INIT('TERMAPI'); /*                          */
    DCL TIME    BUILTIN;
    DCL 1 TIMEOUT,
          2  TIME_SEC  FIXED BIN(31),    /* value in secs             */
          2  TIME_MSEC FIXED BIN(31);    /* value in millisecs        */
    DCL 1 TIMEVAL,
          2  TV_SEC  BIT(32),            /* value in secs             */
          2  TV_USEC BIT(32);            /* value in microseconds     */
    DCL TYPE_DATAGRAM FIXED BIN(31) INIT(2);/*fixed lengthconnectionless*/
    DCL TYPE_RAW  FIXED BIN(31) INIT(3); /* internal protocol interface */
    DCL TYPE_STREAM FIXED BIN(31) INIT(1); /* two-way byte stream      */
    DCL WRETMSK CHAR(4);                 /* indicate WRITE EVENTS     */
    DCL WRITE   CHAR(16) INIT('WRITE');
    DCL WRITEV   CHAR(16) INIT('WRITEV');
    DCL WSNDMSK CHAR(4);              /*check for pending write events */
    DCL TCP_KEEPALIVE BIT(32) INIT('80000008'BX);
    DCL TCP_NODELAY BIT(32) INIT('80000001'BX);
```

Figure 135. CBLOCK PL/1 common variables (Part 13 of 13)

Common variables used in COBOL sample programs

The EZACOBOL common storage area contains the variables that are used in the COBOL programs in this section.

```
      ****************************************************************
      *                                                              *
      *   MODULE NAME:  EZACOBOL - COBOL COMMON VARIABLES            *
      *                                                              *
      * Copyright:    Licensed Materials - Property of IBM           *
      *                                                              *
      *               "Restricted Materials of IBM"                  *
      *                                                              *
      *               5694-A01                                       *
      *                                                              *
|     *               Copyright IBM Corp. 2007, 2010                 *
      *                                                              *
      *               US Government Users Restricted Rights -        *
      *               Use, duplication or disclosure restricted by   *
      *               GSA ADP Schedule Contract with IBM Corp.       *
      *                                                              *
|     * Status:       CSV1R12                                        *
      *                                                              *
      ****************************************************************
      ****************************************************************
      *                                                              *
      * COBOL COMMON VARIABLES                                       *
      *                                                              *
      ****************************************************************
      *
      * Socket option values.
      *
       01 IP-ADD-MEMBERSHIP            PIC X(4) VALUE X'00100005'.
       01 IP-ADD-SOURCE-MEMBERSHIP     PIC X(4) VALUE X'0010000C'.
       01 IP-BLOCK-SOURCE              PIC X(4) VALUE X'0010000A'.
       01 IP-DROP-MEMBERSHIP           PIC X(4) VALUE X'00100006'.
       01 IP-DROP-SOURCE-MEMBERSHIP    PIC X(4) VALUE X'0010000D'.
       01 IP-MULTICAST-IF              PIC X(4) VALUE X'00100007'.
       01 IP-MULTICAST-LOOP            PIC X(4) VALUE X'00100004'.
       01 IP-MULTICAST-TTL             PIC X(4) VALUE X'00100003'.
       01 IP-UNBLOCK-SOURCE            PIC X(4) VALUE X'0010000B'.
|      01 IPV6-ADDR-PREFERENCES        PIC X(4) VALUE X'00010020'.
       01 IPV6-JOIN-GROUP              PIC X(4) VALUE X'00010005'.
       01 IPV6-LEAVE-GROUP             PIC X(4) VALUE X'00010006'.
       01 IPV6-MULTICAST-HOPS          PIC X(4) VALUE X'00010009'.
       01 IPV6-MULTICAST-IF            PIC X(4) VALUE X'00010007'.
       01 IPV6-MULTICAST-LOOP          PIC X(4) VALUE X'00010004'.
       01 IPV6-UNICAST-HOPS            PIC X(4) VALUE X'00010003'.
       01 IPV6-V6ONLY                  PIC X(4) VALUE X'0001000A'.
       01 MCAST-BLOCK-SOURCE           PIC X(4) VALUE X'0010002C'.
       01 MCAST-JOIN-GROUP             PIC X(4) VALUE X'00100028'.
       01 MCAST-JOIN-SOURCE-GROUP      PIC X(4) VALUE X'0010002A'.
```

Figure 136. EZACOBOL COBOL common variables (Part 1 of 8)

```
 01 MCAST-LEAVE-GROUP            PIC X(4) VALUE X'00100029'.
 01 MCAST-LEAVE-SOURCE-GROUP     PIC X(4) VALUE X'0010002B'.
 01 MCAST-UNBLOCK-SOURCE         PIC X(4) VALUE X'0010002D'.
 01 SO-RCVTIMEO                  PIC X(4) VALUE X'00001006'.
 01 SO-SNDTIMEO                  PIC X(4) VALUE X'00001005'.
*
* IOCTL Commands
*
 01 SIOCGIFMTU                   PIC X(4) VALUE X'C020A726'.
 01 SIOCGIPMSFILTER              PIC X(4) VALUE X'C000A724'.
 01 SIOCSIPMSFILTER              PIC X(4) VALUE X'8000A725'.
 01 SIOCGMSFILTER                PIC X(4) VALUE X'C000F610'.
 01 SIOCSMSFILTER                PIC X(4) VALUE X'8000F611'.
 01 SIOCSAPPLDATA                PIC X(4) VALUE X'8018D90C'.
*
* Structure allows applications to allocate space for
* either form of inet socket address
*
 01 SOCKADDR-STORAGE.
   05 SS-LEN                     PIC X(1).
   05 SS-FAMILY                  PIC X(1).
   05 SS-DATA                    PIC X(126).
*
* IP-MREQ for IP_ADD_MEMBERSHIP and IP_DROP_MEMBERSHIP
*
 01 IP-MREQ.
   05 IMR-MULTIADDR              PIC 9(8) BINARY.
   05 IMR-INTERFACE              PIC 9(8) BINARY.
*
* IP-MREQ-SOURCE for
*   IP_ADD_SOURCE_MEMBERSHIP
*   IP_DROP_SOURCE_MEMBERSHIP
*   IP_BLOCK_SOURCE
*   IP_UNBLOCK_SOURCE
*
 01 IP-MREQ-SOURCE.
   05 IMR-MULTIADDR              PIC 9(8) BINARY.
   05 IMR-SOURCEADDR             PIC 9(8) BINARY.
   05 IMR-INTERFACE              PIC 9(8) BINARY.
*
* IPV6-MREQ for IPV6_JOIN_GROUP and IPV6_LEAVE_GROUP
*
 01 IPV6-MREQ.
   05 IPV6MR-MULTIADDR.
     10 FILLER                   PIC 9(16) BINARY.
     10 FILLER                   PIC 9(16) BINARY.
   05 IPV6MR-INTERFACE           PIC 9(8) BINARY.
*
* GROUP-REQ for
*   MCAST_JOIN_GROUP
*   MCAST_LEAVE_GROUP
*
 01 GROUP-REQ.
   05 GR-INTERFACE               PIC 9(8) BINARY.
   05 FILLER                     PIC X(4).
```

Figure 136. EZACOBOL COBOL common variables (Part 2 of 8)

```
   05 GR-GROUP                   PIC X(128).
   05 GR-GROUP-R                 REDEFINES GR-GROUP.
     10 GR-GROUP-SOCK-LEN        PIC X(1).
     10 GR-GROUP-SOCK-FAMILY     PIC X(1).
     10 GR-GROUP-SOCK-DATA       PIC X(26).
     10 GR-GROUP-SOCK-SIN        REDEFINES GR-GROUP-SOCK-DATA.
       15 GR-GROUP-SOCK-SIN-PORT PIC 9(4) BINARY.
       15 GR-GROUP-SOCK-SIN-ADDR PIC 9(8) BINARY.
       15 FILLER                 PIC X(8).
       15 FILLER                 PIC X(12).
     10 GR-GROUP-SOCK-SIN6       REDEFINES GR-GROUP-SOCK-DATA.
       15 GR-GROUP-SOCK-SIN6-PORT PIC 9(4) BINARY.
       15 GR-GROUP-SOCK-SIN6-FLOWINFO PIC 9(8) BINARY.
       15 GR-GROUP-SOCK-SIN6-ADDR.
         20 FILLER               PIC 9(16) BINARY.
         20 FILLER               PIC 9(16) BINARY.
       15 GR-GROUP-SOCK-SIN6-SCOPEID PIC 9(8) BINARY.
     10 FILLER                   PIC X(100).
*
* GROUP-SOURCE-REQ for
*   MCAST_BLOCK_SOURCE
*   MCAST_UNBLOCK_SOURCE
*   MCAST_JOIN_SOURCE_GROUP
*   MCAST_LEAVE_SOURCE_GROUP
*
 01 GROUP-SOURCE-REQ.
   05 GSR-INTERFACE              PIC 9(8) BINARY.
   05 FILLER                     PIC X(4).
   05 GSR-GROUP                  PIC X(128).
   05 GSR-GROUP-R                REDEFINES GSR-GROUP.
     10 GSR-GROUP-SOCK-LEN       PIC X(1).
     10 GSR-GROUP-SOCK-FAMILY    PIC X(1).
     10 GSR-GROUP-SOCK-DATA      PIC X(26).
     10 GSR-GROUP-SOCK-SIN       REDEFINES GSR-GROUP-SOCK-DATA.
       15 GSR-GROUP-SOCK-SIN-PORT PIC 9(4) BINARY.
       15 GSR-GROUP-SOCK-SIN-ADDR PIC 9(8) BINARY.
       15 FILLER                 PIC X(8).
       15 FILLER                 PIC X(12).
     10 GSR-GROUP-SOCK-SIN6      REDEFINES GSR-GROUP-SOCK-DATA.
       15 GSR-GROUP-SOCK-SIN6-PORT PIC 9(4) BINARY.
       15 GSR-GROUP-SOCK-SIN6-FLOWINFO PIC 9(8) BINARY.
       15 GSR-GROUP-SOCK-SIN6-ADDR.
         20 FILLER               PIC 9(16) BINARY.
         20 FILLER               PIC 9(16) BINARY.
       15 GSR-GROUP-SOCK-SIN6-SCOPEID PIC 9(8) BINARY.
     10 FILLER                   PIC X(100).
   05 GSR-SOURCE                 PIC X(128).
   05 GSR-SOURCE-R               REDEFINES GSR-SOURCE.
     10 GSR-SOURCE-SOCK-LEN      PIC X(1).
     10 GSR-SOURCE-SOCK-FAMILY   PIC X(1).
     10 GSR-SOURCE-SOCK-DATA     PIC X(26).
     10 GSR-SOURCE-SOCK-SIN      REDEFINES GSR-SOURCE-SOCK-DATA.
       15 GSR-SOURCE-SOCK-SIN-PORT PIC 9(4) BINARY.
       15 GSR-SOURCE-SOCK-SIN-ADDR PIC 9(8) BINARY.
       15 FILLER                 PIC X(8).
```

Figure 136. EZACOBOL COBOL common variables (Part 3 of 8)

```
       15 FILLER                PIC X(12).
    10 GSR-SOURCE-SOCK-SIN6     REDEFINES GSR-SOURCE-SOCK-DATA.
      15 GSR-SOURCE-SOCK-SIN6-PORT PIC 9(4) BINARY.
      15 GSR-SOURCE-SOCK-SIN6-FLOWINFO PIC 9(8) BINARY.
      15 GSR-SOURCE-SOCK-SIN6-ADDR.
        20 FILLER               PIC 9(16) BINARY.
        20 FILLER               PIC 9(16) BINARY.
      15 GSR-SOURCE-SOCK-SIN6-SCOPEID  PIC 9(8) BINARY.
    10 FILLER                   PIC X(100).
*
* MULTICAST CONSTANTS
*
 77 MCAST-INCLUDE               PIC 9(8) BINARY VALUE 0.
 77 MCAST-EXCLUDE               PIC 9(8) BINARY VALUE 1.
 77 MCAST-NUMSRC-MAX            PIC 9(8) BINARY VALUE 64.
*
* IP-MSFILTER
*
 01 IP-MSFILTER.
   02 IMSF-HEADER.
     03 IMSF-MULTIADDR          PIC 9(8) BINARY.
     03 IMSF-INTERFACE          PIC 9(8) BINARY.
     03 IMSF-FMODE              PIC 9(8) BINARY.
       88 IMSF-FMODE-INCLUDE    VALUE 0.
       88 IMSF-FMODE-EXCLUDE    VALUE 1.
     03 IMSF-NUMSRC             PIC 9(8) BINARY.
   02 IMSF-SLIST.
     03 IMSF-SRCENTRY           OCCURS 1 TO 64 TIMES
                                DEPENDING ON IMSF-NUMSRC.
       05 IMSF-SRCADDR          PIC 9(8) BINARY.
*
* GROUP-FILTER
*
 01 GROUP-FILTER.
   02 GF-HEADER.
     03 GF-INTERFACE            PIC 9(8) BINARY.
     03 FILLER                  PIC X(4).
     03 GF-GROUP                PIC X(128).
     03 GF-GROUP-R              REDEFINES GF-GROUP.
       05 GF-GROUP-SOCK-LEN     PIC X(1).
       05 GF-GROUP-SOCK-FAMILY  PIC X(1).
       05 GF-GROUP-SOCK-DATA    PIC X(26).
       05 GF-GROUP-SOCK-SIN     REDEFINES GF-GROUP-SOCK-DATA.
         10 GF-GROUP-SOCK-SIN-PORT PIC 9(4) BINARY.
         10 GF-GROUP-SOCK-SIN-ADDR PIC 9(8) BINARY.
         10 FILLER              PIC X(8).
         10 FILLER              PIC X(12).
       05 GF-GROUP-SOCK-SIN6    REDEFINES GF-GROUP-SOCK-DATA.
         10 GF-GROUP-SOCK-SIN6-PORT PIC 9(4) BINARY.
         10 GF-GROUP-SOCK-SIN6-FLOWINFO PIC 9(8) BINARY.
         10 GF-GROUP-SOCK-SIN6-ADDR.
           15 FILLER            PIC 9(16) BINARY.
           15 FILLER            PIC 9(16) BINARY.
         10 GF-GROUP-SOCK-SIN6-SCOPEID  PIC 9(8) BINARY.
       05 FILLER                PIC X(100).
```

Figure 136. EZACOBOL COBOL common variables (Part 4 of 8)

```
     03 GF-FMODE                PIC 9(8) BINARY.
       88 GF-FMODE-INCLUDE      VALUE 0.
       88 GF-FMODE-EXCLUDE      VALUE 1.
     03 GF-NUMSRC               PIC 9(8) BINARY.
   02 GF-SLIST.
     03 GF-SRCENTRY             OCCURS 1 TO 64 TIMES
                               DEPENDING ON GF-NUMSRC.
       05 GF-SRCADDR            PIC X(128).
       05 GF-SRCADDR-R          REDEFINES GF-SRCADDR.
         10 GF-SLIST-SOCK-LEN   PIC X(1).
         10 GF-SLIST-SOCK-FAMILY PIC X(1).
         10 GF-SLIST-SOCK-DATA  PIC X(26).
         10 GF-SLIST-SOCK-SIN   REDEFINES GF-SLIST-SOCK-DATA.
           15 GF-SLIST-SOCK-SIN-PORT PIC 9(4) BINARY.
           15 GF-SLIST-SOCK-SIN-ADDR PIC 9(8) BINARY.
           15 FILLER            PIC X(8).
           15 FILLER            PIC X(12).
         10 GF-SLIST-SOCK-SIN6  REDEFINES GF-SLIST-SOCK-DATA.
           15 GF-SLIST-SOCK-SIN6-PORT PIC 9(4) BINARY.
           15 GF-SLIST-SOCK-SIN6-FLOWINFO PIC 9(8) BINARY.
           15 GF-SLIST-SOCK-SIN6-ADDR.
             20 FILLER          PIC 9(16) BINARY.
             20 FILLER          PIC 9(16) BINARY.
           15 GF-SLIST-SOCK-SIN6-SCOPEID PIC 9(8) BINARY.
         10 FILLER              PIC X(100).
*
* Structure for setting APPLDATA when using the SIOCSAPPLDATA
* ioctl.
*
 77 SETADEYE1                   PIC X(8) VALUE 'SETAPPLD'.
 77 SETADVER                    PIC 9(4) BINARY VALUE 1.
 01 SETAPPLDATA.
   02 SETAD-EYE1                PIC X(8).
   02 SETAD-VER                 PIC 9(4) BINARY.
   02 SETAD-LEN                 PIC 9(4) BINARY.
   02 FILLER                    PIC X(4).
   02 SETAD-PTR64               PIC 9(16) BINARY.
   02 SETAD-PTR31 REDEFINES SETAD-PTR64.
     03 SETAD-PTRHW             PIC 9(8) BINARY.
     03 SETAD-PTR               USAGE IS POINTER.
*
* Structure for containing the actual application data being set
* by the SIOCSAPPLDATA ioctl.
*
 77 SETADEYE2                   PIC X(8) VALUE 'APPLDATA'.
 01 SETADCONTAINER.
   02 SETAD-EYE2                PIC X(8).
   02 SETAD-BUFFER              PIC X(40).
*
* TIMEVAL for SO_RCVTIMEO and SO_SNDTIMEO
*
 01 TIMEVAL.
   02 TV-SEC                    PIC 9(8) BINARY.
   02 TV-USEC                   PIC 9(8) BINARY.
*
```

Figure 136. EZACOBOL COBOL common variables (Part 5 of 8)

```
* IFREQ structure for SIOCGIFxxxx ioctls.
*
 01 IFREQ.
   05 IFR-NAME                  PIC X(16).
   05 IFR-IFR                   PIC X(16).
   05 IFR-ADDR                  REDEFINES IFR-IFR.
     10 IFR-ADDR-LEN            PIC X(1).
     10 IFR-ADDR-FAMILY         PIC X(1).
     10 IFR-ADDR-PORT           PIC 9(4) BINARY.
     10 IFR-ADDR-ADDR           PIC 9(8) BINARY.
     10 FILLER                  PIC X(8).
   05 IFR-DSTADDR               REDEFINES IFR-IFR.
     10 IFR-DSTADDR-LEN         PIC X(1).
     10 IFR-DSTADDR-FAMILY      PIC X(1).
     10 IFR-DSTADDR-PORT        PIC 9(4) BINARY.
     10 IFR-DSTADDR-ADDR        PIC 9(8) BINARY.
     10 FILLER                  PIC X(8).
   05 IFR-BROADADDR             REDEFINES IFR-IFR.
     10 IFR-BROADADDR-LEN       PIC X(1).
     10 IFR-BROADADDR-FAMILY    PIC X(1).
     10 IFR-BROADADDR-PORT      PIC 9(4) BINARY.
     10 IFR-BROADADDR-ADDR      PIC 9(8) BINARY.
     10 FILLER                  PIC X(8).
   05 IFR-FLAGS-R               REDEFINES IFR-IFR.
     10 IFR-FLAGS               PIC X(2).
     10 FILLER                  PIC X(14).
   05 IFR-METRIC-R              REDEFINES IFR-IFR.
     10 IFR-METRIC              PIC 9(8) BINARY.
     10 FILLER                  PIC X(12).
   05 IFR-DATA-R                REDEFINES IFR-IFR.
     10 IFR-DATA                PIC 9(8) BINARY.
     10 FILLER                  PIC X(12).
   05 IFR-MTU-R                 REDEFINES IFR-IFR.
     10 IFR-MTU                 PIC 9(8) BINARY.
     10 FILLER                  PIC X(12).
*
* Constants for use with the IFR_FLAGS field in structure IFREQ.
*
 01 IFF-UP                      PIC X(2) VALUE X'0001'.
 01 IFF-BROADCAST               PIC X(2) VALUE X'0002'.
 01 IFF-DEBUG                   PIC X(2) VALUE X'0004'.
 01 IFF-LOOPBACK                PIC X(2) VALUE X'0008'.
 01 IFF-POINTOPOINT             PIC X(2) VALUE X'0010'.
 01 IFF-NOTRAILERS              PIC X(2) VALUE X'0020'.
 01 IFF-RUNNING                 PIC X(2) VALUE X'0040'.
 01 IFF-NOARP                   PIC X(2) VALUE X'0080'.
 01 IFF-PROMISC                 PIC X(2) VALUE X'0100'.
 01 IFF-ALLMULTI                PIC X(2) VALUE X'0200'.
 01 IFF-MULTICAST               PIC X(2) VALUE X'0400'.
 01 IFF-POINTOMULTIPT           PIC X(2) VALUE X'0800'.
 01 IFF-BRIDGE                  PIC X(2) VALUE X'1000'.
 01 IFF-SNAP                    PIC X(2) VALUE X'2000'.
 01 IFF-VIRTUAL                 PIC X(2) VALUE X'4000'.
 01 IFF-SAMEHOST                PIC X(2) VALUE X'8000'.
*
```

Figure 136. EZACOBOL COBOL common variables (Part 6 of 8)

```
      * HOSTENT structure
      *
       01 HOSTENT.
      * Official name of host
         03 H-NAME                    PIC S9(8) BINARY.
      * Alias list address
         03 H-ALIASES                 PIC S9(8) BINARY.
      * Host address type
         03 H-ADDRTYPE                PIC S9(8) BINARY.
      * Length of address
         03 H-LENGTH                  PIC S9(8) BINARY.
      * List of addresses from name server
         03 H-ADDR-LIST               PIC S9(8) BINARY.
      *
      * Address information structure
      *
       01 ADDRINFO.
      * Flags
         03 AI-FLAGS                  PIC S9(8) BINARY.
      * Socket family
         03 AI-FAMILY                 PIC S9(8) BINARY.
      * Socket type
         03 AI-SOCKTYPE               PIC S9(8) BINARY.
      * Protocol
         03 AI-PROTOCOL               PIC S9(8) BINARY.
      * Length of AI-ADDR value
         03 AI-ADDRLEN                PIC S9(8) BINARY.
      * Pad to double word boundary
         03 FILLER                    PIC X(4).
         03 FILLER                    PIC X(4).
      * Canonical name
         03 AI-CANONNAME              PIC S9(8) BINARY.
         03 FILLER                    PIC X(4).
      * Binary address, sockaddr_in(6)
         03 AI-ADDR                   PIC S9(8) BINARY.
         03 FILLER                    PIC X(4).
      * Next addrinfo structure
         03 AI-NEXT                   PIC S9(8) BINARY.
|     * Extended flags
|        03 AI-EFLAGS                 PIC S9(8) BINARY.
      *
|     * AI-FLAGS mappings
      *
       77 AI-PASSIVE                 PIC X(4) VALUE X'00000001'.
|      77 AI-PASSIVE-BIT             PIC S9(8) BINARY VALUE 1.
       77 AI-CANONNAMEOK             PIC X(4) VALUE X'00000002'.
|      77 AI-CANONNAMEOK-BIT         PIC S9(8) BINARY VALUE 2.
```

Figure 136. EZACOBOL COBOL common variables (Part 7 of 8)

```
          77 AI-NUMERICHOST              PIC X(4) VALUE X'00000004'.
|         77 AI-NUMERICHOST-BIT          PIC S9(8) BINARY VALUE 4.
          77 AI-NUMERICSERV              PIC X(4) VALUE X'00000008'.
|         77 AI-NUMERICSERV-BIT          PIC S9(8) BINARY VALUE 8.
          77 AI-V4MAPPED                 PIC X(4) VALUE X'00000010'.
|         77 AI-V4MAPPED-BIT            PIC S9(8) BINARY VALUE 16.
          77 AI-ALL                      PIC X(4) VALUE X'00000020'.
|         77 AI-ALL-BIT                 PIC S9(8) BINARY VALUE 32.
          77 AI-ADDRCONFIG               PIC X(4) VALUE X'00000040'.
|         77 AI-ADDRCONFIG-BIT           PIC S9(8) BINARY VALUE 64.
|         77 AI-EXTFLAGS                 PIC X(4) VALUE X'00000080'.
|         77 AI-EXTFLAGS-BIT             PIC S9(8) BINARY VALUE 128.
|         77 AI-ALLFLAGMASK              PIC X(4) VALUE X'FFFFFF00'.
|         77 AI-ALLFLAGMASK-BITS         PIC S9(8) VALUE -256.
|        *
|        * AI-EFLAGS mappings
|        * Also maps OPTVAL for getsockopt and setsockopt when
|        * OPTNAME is IPV6-ADDR-PREFERENCES
|        * Also maps FLAGS for inet6_is_srcaddr
|        *
|         77 IPV6-PREFER-SRC-HOME        PIC S9(8) BINARY VALUE 1.
|         77 IPV6-PREFER-SRC-COA         PIC S9(8) BINARY VALUE 2.
|         77 IPV6-PREFER-SRC-TMP         PIC S9(8) BINARY VALUE 4.
|         77 IPV6-PREFER-SRC-PUBLIC      PIC S9(8) BINARY VALUE 8.
|         77 IPV6-PREFER-SRC-CGA         PIC S9(8) BINARY VALUE 16.
|         77 IPV6-PREFER-SRC-NONCGA      PIC S9(8) BINARY VALUE 32.
|         77 IPV6-PREFER-SRC-INVALIDBITS PIC S9(8) BINARY VALUE -64.
        *
        * NI_FLAGS mappings
        *
         77 NI-NOFQDN                   PIC X(4) VALUE X'00000001'.
         77 NI-NUMERICHOST              PIC X(4) VALUE X'00000002'.
         77 NI-NAMEREQD                 PIC X(4) VALUE X'00000004'.
         77 NI-NUMERICSERV              PIC X(4) VALUE X'00000008'.
         77 NI-DGRAM                    PIC X(4) VALUE X'00000010'.
         77 NI-NUMERICSCOPE             PIC X(4) VALUE X'00000020'.
        *
        * End of EZACOBOL - COBOL COMMON VARIABLES
        *
        ****************************************************************
```

Figure 136. EZACOBOL COBOL common variables (Part 8 of 8)

COBOL call interface sample IPv6 server program

The EZASO6CS program is a server program that shows you how to use the following calls provided by the call socket interface:

- ACCEPT
- BIND
- CLOSE
- EZACIC09
- FREEADDRINFO
- GETADDRINFO
- GETCLIENTID
- GETHOSTNAME
- INITAPI
- LISTEN
- NTOP
- PTON
- READ
- SOCKET
- TERMAPI

- WRITE

```
*****************************************************************
*                                                               *
*   MODULE NAME:  EZASO6CS - THIS IS A VERY SIMPLE IPV6 SERVER  *
*                                                               *
* Copyright:    Licensed Materials - Property of IBM            *
*                                                               *
*               "Restricted Materials of IBM"                   *
*                                                               *
*               5694-A01                                        *
*                                                               *
*               Copyright IBM Corp. 2002, 2008                  *
*                                                               *
*               US Government Users Restricted Rights -         *
*               Use, duplication or disclosure restricted by    *
*               GSA ADP Schedule Contract with IBM Corp.        *
*                                                               *
* Status:       CSV1R10                                         *
*                                                               *
*   LANGUAGE:  COBOL                                            *
*                                                               *
*****************************************************************
 Identification Division.
*========================*

 Program-id. EZASO6CS.

*======================*
 Environment Division.
*======================*

*==============*
 Data Division.
*==============*

 Working-storage Section.
*----------------------------------------------------------------*
* Socket interface function codes                                *
*----------------------------------------------------------------*
 01  soket-functions.
     02 soket-accept          pic x(16) value 'ACCEPT          '.
     02 soket-bind            pic x(16) value 'BIND            '.
     02 soket-close           pic x(16) value 'CLOSE           '.
     02 soket-connect         pic x(16) value 'CONNECT         '.
     02 soket-fcntl           pic x(16) value 'FCNTL           '.
     02 soket-freeaddrinfo    pic x(16) value 'FREEADDRINFO    '.
     02 soket-getaddrinfo     pic x(16) value 'GETADDRINFO     '.
     02 soket-getclientid     pic x(16) value 'GETCLIENTID     '.
     02 soket-gethostbyaddr   pic x(16) value 'GETHOSTBYADDR   '.
     02 soket-gethostbyname   pic x(16) value 'GETHOSTBYNAME   '.
     02 soket-gethostid       pic x(16) value 'GETHOSTID       '.
     02 soket-gethostname     pic x(16) value 'GETHOSTNAME     '.
     02 soket-getnameinfo     pic x(16) value 'GETNAMEINFO     '.
     02 soket-getpeername     pic x(16) value 'GETPEERNAME     '.
     02 soket-getsockname     pic x(16) value 'GETSOCKNAME     '.
```

Figure 137. EZASO6CS COBOL call interface sample IPv6 server program (Part 1 of 13)

```
     02 soket-getsockopt      pic x(16) value 'GETSOCKOPT      '.
     02 soket-givesocket      pic x(16) value 'GIVESOCKET      '.
     02 soket-initapi         pic x(16) value 'INITAPI         '.
     02 soket-ioctl           pic x(16) value 'IOCTL           '.
     02 soket-listen          pic x(16) value 'LISTEN          '.
     02 soket-ntop            pic x(16) value 'NTOP            '.
     02 soket-pton            pic x(16) value 'PTON            '.
     02 soket-read            pic x(16) value 'READ            '.
     02 soket-recv            pic x(16) value 'RECV            '.
     02 soket-recvfrom        pic x(16) value 'RECVFROM        '.
     02 soket-select          pic x(16) value 'SELECT          '.
     02 soket-send            pic x(16) value 'SEND            '.
     02 soket-sendto          pic x(16) value 'SENDTO          '.
     02 soket-setsockopt      pic x(16) value 'SETSOCKOPT      '.
     02 soket-shutdown        pic x(16) value 'SHUTDOWN        '.
     02 soket-socket          pic x(16) value 'SOCKET          '.
     02 soket-takesocket      pic x(16) value 'TAKESOCKET      '.
     02 soket-termapi         pic x(16) value 'TERMAPI         '.
     02 soket-write           pic x(16) value 'WRITE           '.
*-------------------------------------------------------------*
* Work variables                                              *
*-------------------------------------------------------------*
 01  errno                          pic 9(8) binary value zero.
 01  retcode                        pic s9(8) binary value zero.
 01  client-ipaddr-dotted           pic x(15) value space.
 01  server-ipaddr-dotted           pic x(15) value space.
 01  ezaconn-function               pic x value space.
     88 CONNECTED                         value 'Y'.
 01  saved-message-id               pic x(8) value space.
     88  close-down-message-received  value '*CLSDWN*'.
 01  Terminate-Options              pic x value space.
     88 Opened-API                        value 'A'.
     88 Opened-Socket                     value 'S'.
 01  saved-message-id-len           pic 9(8) Binary value 8.
 01  Cur-time .
     02  Hour                       pic 9(2).
     02  Minute                     pic 9(2).
     02  Second                     pic 9(2).
     02  Hund-Sec                   pic 9(2).
 01  S                              pic 9(4)  comp.
*-------------------------------------------------------------*
* Variables used for the INITAPI call                         *
*-------------------------------------------------------------*
 01  maxsoc-fwd                     pic 9(8) Binary.
 01  maxsoc-rdf redefines maxsoc-fwd.
     02 filler                      pic x(2).
     02 maxsoc                      pic 9(4) Binary.
 01  initapi-ident.
     05  tcpname                    pic x(8) Value 'TCPCS  '.
     05  asname                     pic x(8) Value space.
 01  subtask                        pic x(8) value 'EZASO6CS'.
 01  maxsno                         pic 9(8) Binary Value 1.
*-------------------------------------------------------------*
* Variables returned by the GETCLIENTID Call                  *
*-------------------------------------------------------------*
```

Figure 137. EZASO6CS COBOL call interface sample IPv6 server program (Part 2 of 13)

```
 01  clientid.
     05  clientid-domain           pic 9(8) Binary value 19.
     05  clientid-name             pic x(8) value space.
     05  clientid-task             pic x(8) value space.
     05  filler                    pic x(20) value low-value.
*-------------------------------------------------------------*
* Variables used for the SOCKET call                         *
*-------------------------------------------------------------*
 01  AF-INET                       pic 9(8) Binary Value 2.
 01  AF-INET6                      pic 9(8) Binary Value 19.
 01  SOCK-STREAM                   pic 9(8) Binary Value 1.
 01  SOCK-DATAGRAM                 pic 9(8) Binary Value 2.
 01  SOCK-RAW                      pic 9(8) Binary Value 3.
 01  IPPROTO-IP                    pic 9(8) Binary Value zero.
 01  IPPROTO-TCP                   pic 9(8) Binary Value 6.
 01  IPPROTO-UDP                   pic 9(8) Binary Value 17.
 01  IPPROTO-IPV6                  pic 9(8) Binary Value 41.
 01  socket-descriptor             pic 9(4) Binary Value zero.
*-------------------------------------------------------------*
* Variables returned by the GETHOSTNAME Call                 *
*-------------------------------------------------------------*
 01  host-name-len                 pic 9(8) binary.
 01  host-name                     pic x(24).
 01  host-name-char-count          pic 9(4) binary.
 01  host-name-unstrung            pic x(24) value spaces.
*-------------------------------------------------------------*
* Variables used/returned by the GETADDRINFO Call            *
*-------------------------------------------------------------*
 01  node-name                     pic x(255).
 01  node-name-len                 pic 9(8) binary.
 01  service-name                  pic x(32).
 01  service-name-len              pic 9(8) binary.
 01  canonical-name-len            pic 9(8) binary.
 01  ai-passive                    pic 9(8) binary value 1.
 01  ai-canonnameok                pic 9(8) binary value 2.
 01  ai-numerichost                pic 9(8) binary value 4.
 01  ai-numericserv                pic 9(8) binary value 8.
 01  ai-v4mapped                   pic 9(8) binary value 16.
 01  ai-all                        pic 9(8) binary value 32.
 01  ai-addrconfig                 pic 9(8) binary value 64.
*-------------------------------------------------------------*
* Variables used for the BIND call                           *
*-------------------------------------------------------------*
 01  server-socket-address.
     05  server-family             pic 9(4) Binary value 19.
     05  server-port               pic 9(4) Binary value 1031.
     05  server-flowinfo           pic 9(8) Binary value 0.
     05  server-ipaddr.
         10 filler                 pic 9(16) Binary value 0.
         10 filler                 pic 9(16) Binary value 0.
     05  server-scopeid            pic 9(8) Binary value 0.
 01  NBYTE                  PIC 9(8)  COMP value 80.
 01  BUF                    PIC X(80).
 01  BACKLOG                PIC S9(8) COMP  VALUE 10.
*-------------------------------------------------------------*
```

Figure 137. EZASO6CS COBOL call interface sample IPv6 server program (Part 3 of 13)

```
* Variables used/returned by the EZACIC09 call                 *
*---------------------------------------------------------------*
 01  input-addrinfo-ptr             usage is pointer.
 01  output-name-len                pic 9(8) binary.
 01  output-canonical-name          pic x(256).
 01  output-name                    usage is pointer.
 01  output-next-addrinfo           usage is pointer.
*---------------------------------------------------------------*
* Variables used for the LISTEN call                            *
*---------------------------------------------------------------*
 01  backlog-level                  pic 9(4) Binary Value zero.
*---------------------------------------------------------------*
* Variables used for the ACCEPT call                            *
*---------------------------------------------------------------*
 01  socket-descriptor-new          pic 9(4) Binary Value zero.
*---------------------------------------------------------------*
* Variables used for the NTOP/PTON call                         *
*---------------------------------------------------------------*
 01  IN6ADDR-ANY                    pic x(45)
                         value '::'.
 01  IN6ADDR-LOOPBACK               pic x(45)
                         value '::1'.
 01  ntop-family                    pic 9(8) Binary.
 01  pton-family                    pic 9(8) Binary.
 01  presentable-addr               pic x(45) value spaces.
 01  presentable-addr-len           pic 9(4) Binary value 45.
 01  numeric-addr.
     05 filler                     pic 9(16) Binary Value 0.
     05 filler                     pic 9(16) Binary Value 0.
*---------------------------------------------------------------*
* Variables used by the RECV Call                               *
*---------------------------------------------------------------*
 01  client-socket-address.
     05  client-family              pic 9(4) Binary Value 19.
     05  client-port                pic 9(4) Binary Value 1032.
     05  client-flowinfo            pic 9(8) Binary Value zero.
     05  client-ipaddr.
         10 filler                  pic 9(16) Binary Value 0.
         10 filler                  pic 9(16) Binary Value 0.
     05  client-scopeid             pic 9(8) Binary Value zero.
*---------------------------------------------------------------*
* Buffer and length field for recv and send operation           *
*---------------------------------------------------------------*
 01  send-request-len               pic 9(8) Binary Value zero.
 01  read-request-len               pic 9(8) Binary Value zero.
 01  read-buffer                    pic x(4000) value space.
 01  filler redefines read-buffer.
     05  message-id                 pic x(8).
     05  filler                     pic x(3992).
*---------------------------------------------------------------*
* recv and send flags                                           *
*---------------------------------------------------------------*
 01  send-flag                      pic 9(8) Binary value zero.
 01  recv-flag                      pic 9(8) Binary value zero.
*---------------------------------------------------------------*
```

Figure 137. EZASO6CS COBOL call interface sample IPv6 server program (Part 4 of 13)

```
* Error message for socket interface errors                    *
*---------------------------------------------------------------*
 77  failure                        pic S9(8) comp.
 01  ezaerror-msg.
     05  filler                     pic x(9) Value 'Function='.
     05  ezaerror-function          pic x(16) Value space.
     05  filler                     pic x value ' '.
     05  filler                     pic x(8) Value 'Retcode='.
     05  ezaerror-retcode           pic ---99.
     05  filler                     pic x value ' '.
     05  filler                     pic x(9) Value 'Errorno='.
     05  ezaerror-errno             pic zzz99.
     05  filler                     pic x value ' '.
     05  ezaerror-text              pic x(50) value ' '.

*================
 Linkage Section.
*================
 01  L1.
     03  hints-addrinfo.
         05  hints-ai-flags         pic 9(8) binary.
         05  hints-ai-family        pic 9(8) binary.
         05  hints-ai-socktype      pic 9(8) binary.
         05  hints-ai-protocol      pic 9(8) binary.
         05  filler                 pic 9(8) binary.
         05  filler                 pic 9(8) binary.
         05  filler                 pic 9(8) binary.
         05  filler                 pic 9(8) binary.
     03  hints-addrinfo-ptr         usage is pointer.
     03  results-addrinfo-ptr       usage is pointer.
*
* Results address info
*
 01  results-addrinfo.
     05  results-ai-flags           pic 9(8) binary.
     05  results-ai-family          pic 9(8) binary.
     05  results-ai-socktype        pic 9(8) binary.
     05  results-ai-protocol        pic 9(8) binary.
     05  results-ai-addr-len        pic 9(8) binary.
     05  results-ai-canonical-name  usage is pointer.
     05  results-ai-addr-ptr        usage is pointer.
     05  results-ai-next-ptr        usage is pointer.
*
* Socket address structure from EZACIC09.
*
 01  output-name-ptr                usage is pointer.
 01  output-ip-name.
     03  output-ip-family           pic 9(4) Binary.
     03  output-ip-port             pic 9(4) Binary.
     03  output-ip-sock-data        pic x(24).
     03  output-ipv4-sock-data redefines
         output-ip-sock-data.
         05  output-ipv4-ipaddr     pic 9(8) Binary.
         05  filler                 pic x(20).
     03  output-ipv6-sock-data redefines
```

Figure 137. EZASO6CS COBOL call interface sample IPv6 server program (Part 5 of 13)

```
         output-ip-sock-data.
         05  output-ipv6-flowinfo   pic 9(8) Binary.
         05  output-ipv6-ipaddr.
             10 filler              pic 9(16) Binary.
             10 filler              pic 9(16) Binary.
         05  output-ipv6-scopeid    pic 9(8) Binary.

*=============================================*
 Procedure Division using L1.
*=============================================*

*~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~*
*           P R O C E D U R E     C O N T R O L S                 *
*~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~*

     Perform Initialize-API      thru    Initialize-API-Exit.
     Perform Get-ClientID        thru    Get-ClientID-Exit.
     Perform Sockets-Descriptor  thru    Sockets-Descriptor-Exit.
     Perform Presentation-To-Numeric thru
                                Presentation-To-Numeric-Exit.
     Perform Get-Host-Name       thru    Get-Host-Name-Exit.
     Perform Get-Address-Info    thru    Get-Address-Info-Exit.
     Perform Bind-Socket         thru    Bind-Socket-Exit.
     Perform Listen-To-Socket    thru    Listen-To-Socket-Exit.
     Perform Accept-Connection   thru    Accept-Connection-Exit.
     Move 45 to presentable-addr-len.
     Move spaces to presentable-addr.
     Move server-ipaddr to numeric-addr.
     Move 19 to ntop-family.
     Perform Numeric-TO-Presentation thru
                                Numeric-To-Presentation-Exit.
     Perform Read-Message        thru    Read-Message-Exit.
     Perform Write-Message       thru    Write-Message-Exit.
     Perform Close-Socket        thru    Exit-Now.

*-------------------------------------------------------------*
* Initialize socket API                                       *
*-------------------------------------------------------------*
 Initialize-API.
     Move soket-initapi to ezaerror-function.
*-------------------------------------------------------------*
* If you want to set maxsoc to the max, uncomment the next line.*
*-------------------------------------------------------------*
*    Move 65535 to maxsoc-fwd.
     Call 'EZASOKET' using soket-initapi maxsoc initapi-ident
        subtask maxsno errno retcode.
     Move 'Initapi failed' to ezaerror-text.
     If retcode < 0  move 12 to failure.
     Perform Return-Code-Check thru Return-Code-Exit.
     Move 'A' to Terminate-Options.
 Initialize-API-Exit.
      Exit.

*-------------------------------------------------------------*
* Let us see the client-id                                    *
```

Figure 137. EZASO6CS COBOL call interface sample IPv6 server program (Part 6 of 13)

```
*-------------------------------------------------------------*
 Get-ClientID.
     move soket-getclientid to ezaerror-function.
     Call 'EZASOKET' using soket-getclientid clientid errno
                       retcode.
     Display 'Client ID = ' clientid-name
             'task=' clientid-task.
     Move 'Getclientid failed' to ezaerror-text.
     If retcode < 0  move 24 to failure.
     Perform Return-Code-Check thru Return-Code-Exit.
 Get-ClientID-Exit.
      Exit.

*-------------------------------------------------------------*
* Get us a stream socket descriptor.                          *
*-------------------------------------------------------------*
 Sockets-Descriptor.
     move soket-socket to ezaerror-function.
     Call 'EZASOKET' using soket-socket AF-INET6 SOCK-STREAM
        IPPROTO-IP errno retcode.
     Move 'Socket call failed' to ezaerror-text.
     If retcode < 0  move 24 to failure.
     Perform Return-Code-Check thru Return-Code-Exit.
     Move retcode to socket-descriptor.
     Move 'S' to Terminate-Options.
 Sockets-Descriptor-Exit.
     Exit.

*-------------------------------------------------------------*
* Use PTON to create an IP address to bind to.                *
*-------------------------------------------------------------*
 Presentation-To-Numeric.
     move soket-pton to ezaerror-function.
     move IN6ADDR-LOOPBACK to presentable-addr.
     Call 'EZASOKET' using soket-pton AF-INET6
        presentable-addr presentable-addr-len
        numeric-addr
        errno retcode.
     Move 'PTON call failed' to ezaerror-text.
     If retcode < 0  move 24 to failure.
     Perform Return-Code-Check thru Return-Code-Exit.
     move numeric-addr to server-ipaddr.
 Presentation-To-Numeric-Exit.
     Exit.

*-------------------------------------------------------------*
* Get the host name.                                          *
*-------------------------------------------------------------*
 Get-Host-Name.
     move soket-gethostname to ezaerror-function.
     move 24 to host-name-len.
     Call 'EZASOKET' using soket-gethostname
        host-name-len host-name
        errno retcode.
     display 'Host name = ' host-name.
```

Figure 137. EZASO6CS COBOL call interface sample IPv6 server program (Part 7 of 13)

```
     Move 'GETHOSTNAME call failed' to ezaerror-text.
     If retcode < 0  move 24 to failure.
     Perform Return-Code-Check thru Return-Code-Exit.
 Get-Host-Name-Exit.
     Exit.

*-------------------------------------------------------------*
* Get address information                                     *
*-------------------------------------------------------------*
 Get-Address-Info.
     move soket-getaddrinfo to ezaerror-function.
     move 0 to host-name-char-count.
     inspect host-name tallying host-name-char-count
        for characters before x'00'.
     unstring host-name delimited by x'00'
        into host-name-unstrung
        count in host-name-char-count.
     string host-name-unstrung delimited by ' '
        into node-name.
     move host-name-char-count to node-name-len
     display 'node-name-len: ' node-name-len.
     move spaces to service-name.
     move 0 to service-name-len.
     move 0 to hints-ai-family.
     move ai-canonnameok to hints-ai-flags
     move 0 to hints-ai-socktype.
     move 0 to hints-ai-protocol.
     display 'GETADDRINFO Input fields: '
     display 'Node name = ' node-name.
     display 'Node name length = ' node-name-len.
     display 'Service name = ' service-name.
     display 'Service name length = ' service-name-len.
     display 'Hints family = ' hints-ai-family.
     display 'Hints flags = ' hints-ai-flags.
     display 'Hints socktype = ' hints-ai-socktype.
     display 'Hints protocol = ' hints-ai-protocol.
     set address of results-addrinfo to results-addrinfo-ptr.
     move soket-getaddrinfo to ezaerror-function.
     set hints-addrinfo-ptr to address of hints-addrinfo.
     Call 'EZASOKET' using soket-getaddrinfo
        node-name node-name-len
        service-name service-name-len
        hints-addrinfo-ptr
        results-addrinfo-ptr
        canonical-name-len
        errno retcode.
     Move 'GETADDRINFO call failed' to ezaerror-text.
     If retcode < 0  move 24 to failure
         Perform Return-Code-Check thru Return-Code-Exit
     else
         Perform Return-Code-Check thru Return-Code-Exit
         display 'Address of results addrinfo is '
             results-addrinfo-ptr.
         set address of results-addrinfo to results-addrinfo-ptr
         set input-addrinfo-ptr to address of results-addrinfo
```

Figure 137. EZASO6CS COBOL call interface sample IPv6 server program (Part 8 of 13)

```
         display 'Address of input-addrinfo-ptr is '
             input-addrinfo-ptr.
         Perform Format-Result-AI thru Format-Result-AI-Exit
         Perform Set-Next-Addrinfo thru
             Set-Next-Addrinfo-Exit until
                 output-next-addrinfo is equal to NULLS
         Perform Free-Address-Info thru Free-Address-Info-Exit.
 Get-Address-Info-Exit.
     Exit.

*-------------------------------------------------------------*
* Set next addrinfo address                                  *
*-------------------------------------------------------------*
 Set-Next-Addrinfo.
     display 'Setting next addrinfo address as '
         results-ai-next-ptr.
     display 'Address of output-next-addrinfo as '
         output-next-addrinfo.
     set address of results-addrinfo to output-next-addrinfo.
     set input-addrinfo-ptr to address of results-addrinfo.
     display 'Address of input-addrinfo-ptr is '
         input-addrinfo-ptr.
     Perform Format-Result-AI thru Format-Result-AI-Exit.
 Set-Next-Addrinfo-Exit.
     Exit.

*-------------------------------------------------------------*
* Format result address information                          *
*-------------------------------------------------------------*
 Format-Result-AI.
     move 'EZACIC09' to ezaerror-function.
     move zeros to output-name-len.
     move spaces to output-canonical-name.
     set output-name to nulls.
     set output-next-addrinfo to nulls.
     Call 'EZACIC09' using input-addrinfo-ptr
            output-name-len
            output-canonical-name
            output-name
            output-next-addrinfo
            retcode.
     Move 'EZACIC09 call failed' to ezaerror-text.
     display 'EZACIC09 output:'
     display 'Canonical name = ' output-canonical-name.
     display 'name length    = ' output-name-len.
     display 'name           = ' output-name.
     display 'next addrinfo  = ' output-next-addrinfo.
     If retcode < 0  move 24 to failure.
     Perform Return-Code-Check thru Return-Code-Exit.
     display 'Formatting result address ip address'.
     set address of output-ip-name to output-name.
     move results-ai-family to ntop-family.
     display 'ntop-family = ' ntop-family.
     if ntop-family = AF-INET then
         display 'Formatting ipv4 addres'
```

Figure 137. EZASO6CS COBOL call interface sample IPv6 server program (Part 9 of 13)

```
         move output-ipv4-ipaddr to numeric-addr
         move 16 to presentable-addr-len
     else
         display 'Formatting ipv6 addres'
         move output-ipv6-ipaddr to numeric-addr
         move 45 to presentable-addr-len.
     move spaces to presentable-addr.
     Perform Numeric-To-Presentation thru
                               Numeric-To-Presentation-Exit.
 Format-Result-AI-Exit.
     Exit.

*-------------------------------------------------------------*
* Release resolver storage                                    *
*-------------------------------------------------------------*
 Free-Address-Info.
     move soket-freeaddrinfo to ezaerror-function.
     Call 'EZASOKET' using soket-freeaddrinfo
        results-addrinfo-ptr
        errno retcode.
     Move 'FREEADDRINFO call failed' to ezaerror-text.
     If retcode < 0  move 24 to failure.
     Perform Return-Code-Check thru Return-Code-Exit.
 Free-Address-Info-Exit.
     Exit.

*-------------------------------------------------------------*
* Bind socket to our server port number                       *
*-------------------------------------------------------------*
 Bind-Socket.
     Move soket-bind to ezaerror-function.
     Call 'EZASOKET' using soket-bind socket-descriptor
                    server-socket-address errno retcode.
     Display 'Port = ' server-port
         ' Address = ' presentable-addr.
     Move 'Bind call failed' to ezaerror-text
     If retcode < 0  move 24 to failure.
     Perform Return-Code-Check thru Return-Code-Exit.
 Bind-Socket-Exit.
      Exit.

*-------------------------------------------------------------*
*   Listen to the socket                                      *
*-------------------------------------------------------------*
 Listen-To-Socket.
     Move soket-listen to ezaerror-function.
     Call 'EZASOKET' using soket-listen socket-descriptor
                    backlog errno retcode.
     Display 'Backlog=' backlog.
     Move 'Listen call failed' to ezaerror-text.
     If retcode < 0  move 24 to failure.
     Perform Return-Code-Check thru Return-Code-Exit.
 Listen-To-Socket-Exit.
      Exit.
```

Figure 137. EZASO6CS COBOL call interface sample IPv6 server program (Part 10 of 13)

```
*-------------------------------------------------------------*
*   Accept a connection request                               *
*-------------------------------------------------------------*
 Accept-Connection.
     Move soket-accept to ezaerror-function.
     Call 'EZASOKET' using soket-accept socket-descriptor
                    server-socket-address errno retcode.
     Move retcode to socket-descriptor-new.
     Display 'New socket=' retcode.
     Move 'Accept call failed' to ezaerror-text .
     If retcode < 0  move 24 to failure.
     Perform Return-Code-Check thru Return-Code-Exit.
 Accept-Connection-Exit.
      Exit.

*-------------------------------------------------------------*
* Use NTOP to display the IP address.                         *
*-------------------------------------------------------------*
 Numeric-To-Presentation.
     move soket-ntop to ezaerror-function.
     Call 'EZASOKET' using soket-ntop ntop-family
        numeric-addr
        presentable-addr presentable-addr-len
        errno retcode.
     Display 'Presentable address = ' presentable-addr.
     Move 'NTOP call failed' to ezaerror-text.
     If retcode < 0  move 24 to failure.
     Perform Return-Code-Check thru Return-Code-Exit.
 Numeric-TO-Presentation-Exit.
     Exit.

*-------------------------------------------------------------*
* Read a message from the client.                             *
*-------------------------------------------------------------*
 Read-Message.
     move soket-read to ezaerror-function.
     move spaces to buf.
     display 'New socket desciptor = ' socket-descriptor-new.
     Call 'EZASOKET' using soket-read socket-descriptor-new
        nbyte buf
        errno retcode.
     display 'Message received = ' buf.
     Move 'Read call failed' to ezaerror-text.
      If retcode < 0 move 24 to failure.
     Perform Return-Code-Check thru Return-Code-Exit.
 Read-Message-Exit.
     Exit.

*-------------------------------------------------------------*
* Write a message to the client.                              *
*-------------------------------------------------------------*
 Write-Message.
     move soket-write to ezaerror-function.
     move 'Message from EZASO6SC' to buf.
     Call 'EZASOKET' using soket-write socket-descriptor-new
```

Figure 137. EZASO6CS COBOL call interface sample IPv6 server program (Part 11 of 13)

```
           nbyte buf
           errno retcode.
        Move 'Write call failed' to ezaerror-text
         If retcode < 0 move 24 to failure.
        Perform Return-Code-Check thru Return-Code-Exit.
 Write-Message-Exit.
        Exit.


*-------------------------------------------------------------*
* Close connected socket                                      *
*-------------------------------------------------------------*
 Close-Socket.
        move soket-close to ezaerror-function
        Call 'EZASOKET' using soket-close socket-descriptor-new
                              errno retcode.
        Accept cur-time from time.
        Display cur-time ' EZASO6CS : CLOSE RETCODE=' RETCODE
            ' ERRNO= ' ERRNO.
        If retcode < 0 move 24 to failure
           move 'Close call Failed' to ezaerror-text
           perform write-ezaerror-msg thru write-ezaerror-msg-exit.
 Close-Socket-Exit.
        Exit.

*-------------------------------------------------------------*
* Terminate socket API                                        *
*-------------------------------------------------------------*

 exit-term-api.
        Call 'EZASOKET' using soket-termapi.

*-------------------------------------------------------------*
* Terminate program                                           *
*-------------------------------------------------------------*

 exit-now.
        move failure to return-code.
        Goback.

*-------------------------------------------------------------*
* Subroutine                                                  *
* ----------                                                  *
*                                                             *
* Write out an error message                                  *
*-------------------------------------------------------------*

 write-ezaerror-msg.
        move errno to ezaerror-errno.
        move retcode to ezaerror-retcode.
        display ezaerror-msg.
 write-ezaerror-msg-exit.
        exit.

*-------------------------------------------------------------*
```

Figure 137. EZASO6CS COBOL call interface sample IPv6 server program (Part 12 of 13)

```
* Check Return Code after each Socket Call                      *
*---------------------------------------------------------------*
 Return-Code-Check.
      Accept Cur-Time from TIME.
      move errno to ezaerror-errno.
      move retcode to ezaerror-retcode.
      Display Cur-Time ' EZASO6CS: ' ezaerror-function
                       ' RETCODE= ' ezaerror-retcode
                       ' ERRNO= ' ezaerror-errno.
      IF RETCODE < 0
         Perform Write-ezaerror-msg thru write-ezaerror-msg-exit
         Move zeros to errno retcode
         IF Opened-Socket Go to Close-Socket
         ELSE IF Opened-API Go to exit-term-api
              ELSE Go to exit-now.
      Move zeros to errno retcode.
 Return-Code-Exit.
     Exit.
```

Figure 137. EZASO6CS COBOL call interface sample IPv6 server program (Part 13 of 13)

COBOL call interface sample IPv6 client program

The EZASO6CC program is a client module that shows you how to use the following calls provided by the call socket interface:

- CLOSE
- CONNECT
- GETCLIENTID
- GETNAMEINFO
- INITAPI
- NTOP
- PTON
- READ
- SHUTDOWN
- SOCKET
- TERMAPI
- WRITE

```
*****************************************************************
*                                                               *
*   MODULE NAME:  EZASO6CC - THIS IS A VERY SIMPLE IPV6 CLIENT  *
*                                                               *
* Copyright:    Licensed Materials - Property of IBM            *
*                                                               *
*               "Restricted Materials of IBM"                   *
*                                                               *
*               5694-A01                                        *
*                                                               *
*               Copyright IBM Corp. 2002, 2008                  *
*                                                               *
*               US Government Users Restricted Rights -         *
*               Use, duplication or disclosure restricted by    *
*               GSA ADP Schedule Contract with IBM Corp.        *
*                                                               *
* Status:       CSV1R10                                         *
*                                                               *
*   LANGUAGE:  COBOL                                            *
*                                                               *
*****************************************************************

 Identification Division.
*========================*

 Program-id. EZASO6CC.

*======================*
 Environment Division.
*======================*

*==============*
 Data Division.
*==============*

 Working-storage Section.
*-----------------------------------------------------------------*
* Socket interface function codes                                 *
*-----------------------------------------------------------------*
 01  soket-functions.
     02 soket-accept          pic x(16) value 'ACCEPT          '.
     02 soket-bind            pic x(16) value 'BIND            '.
     02 soket-close           pic x(16) value 'CLOSE           '.
     02 soket-connect         pic x(16) value 'CONNECT         '.
     02 soket-fcntl           pic x(16) value 'FCNTL           '.
     02 soket-freeaddrinfo    pic x(16) value 'FREEADDRINFO    '.
     02 soket-getaddrinfo     pic x(16) value 'GETADDRINFO     '.
     02 soket-getclientid     pic x(16) value 'GETCLIENTID     '.
     02 soket-gethostbyaddr   pic x(16) value 'GETHOSTBYADDR   '.
     02 soket-gethostbyname   pic x(16) value 'GETHOSTBYNAME   '.
     02 soket-gethostid       pic x(16) value 'GETHOSTID       '.
     02 soket-gethostname     pic x(16) value 'GETHOSTNAME     '.
     02 soket-getnameinfo     pic x(16) value 'GETNAMEINFO     '.
     02 soket-getpeername     pic x(16) value 'GETPEERNAME     '.
```

Figure 138. EZASO6CC COBOL call interface sample IPv6 client program (Part 1 of 9)

```
     02 soket-getsockname     pic x(16) value 'GETSOCKNAME     '.
     02 soket-getsockopt      pic x(16) value 'GETSOCKOPT      '.
     02 soket-givesocket      pic x(16) value 'GIVESOCKET      '.
     02 soket-initapi         pic x(16) value 'INITAPI         '.
     02 soket-ioctl           pic x(16) value 'IOCTL           '.
     02 soket-listen          pic x(16) value 'LISTEN          '.
     02 soket-ntop            pic x(16) value 'NTOP            '.
     02 soket-pton            pic x(16) value 'PTON            '.
     02 soket-read            pic x(16) value 'READ            '.
     02 soket-recv            pic x(16) value 'RECV            '.
     02 soket-recvfrom        pic x(16) value 'RECVFROM        '.
     02 soket-select          pic x(16) value 'SELECT          '.
     02 soket-send            pic x(16) value 'SEND            '.
     02 soket-sendto          pic x(16) value 'SENDTO          '.
     02 soket-setsockopt      pic x(16) value 'SETSOCKOPT      '.
     02 soket-shutdown        pic x(16) value 'SHUTDOWN        '.
     02 soket-socket          pic x(16) value 'SOCKET          '.
     02 soket-takesocket      pic x(16) value 'TAKESOCKET      '.
     02 soket-termapi         pic x(16) value 'TERMAPI         '.
     02 soket-write           pic x(16) value 'WRITE           '.
*-------------------------------------------------------------*
* Work variables                                              *
*-------------------------------------------------------------*
 01  errno                        pic 9(8) binary value zero.
 01  retcode                      pic s9(8) binary value zero.
 01  index-counter                pic 9(8) binary value zero.
 01  buffer-element.
     05  buffer-element-nbr       pic 9(5).
     05  filler                   pic x(3) value space.
 01  server-ipaddr-dotted         pic x(15) value space.
 01  client-ipaddr-dotted         pic x(15) value space.
 01  close-server                 pic 9(8) Binary value zero.
     88  close-server-down        value 1.
 01  Connect-Flag                 pic x value space.
     88 CONNECTED                       value 'Y'.
 01  Client-Server-Flag           pic x value space.
     88 CLIENTS                         value 'C'.
     88 SERVERS                         value 'S'.
 01  Terminate-Options            pic x value space.
     88 Opened-API                      value 'A'.
     88 Opened-Socket                   value 'S'.
 01  timer-accum                  pic 9(8) Binary value zero.
 01  timer-interval               pic 9(8) Binary value 2000.
 01  Cur-time.
     02  Hour                     pic 9(2).
     02  Minute                   pic 9(2).
     02  Second                   pic 9(2).
     02  Hund-Sec                 pic 9(2).
 77  Failure                      Pic S9(8) comp.
*-------------------------------------------------------------*
* Variables used for the INITAPI call                         *
*-------------------------------------------------------------*
 01  maxsoc-fwd                   pic 9(8) Binary.
 01  maxsoc-rdf redefines maxsoc-fwd.
     02 filler                    pic x(2).
```

Figure 138. EZASO6CC COBOL call interface sample IPv6 client program (Part 2 of 9)

```
     02 maxsoc                     pic 9(4) Binary.
 01  initapi-ident.
     05  tcpname                  pic x(8) Value 'TCPCS  '.
     05  asname                   pic x(8) Value space.
 01  subtask                      pic x(8) value 'EZSO6CC'.
 01  maxsno                       pic 9(8) Binary Value 1.
*-------------------------------------------------------------*
* Variables used by the SHUTDOWN Call                         *
*-------------------------------------------------------------*
 01  how                          pic 9(8) Binary.
*-------------------------------------------------------------*
* Variables returned by the GETCLIENTID Call                  *
*-------------------------------------------------------------*
 01  clientid.
     05  clientid-domain          pic 9(8) Binary value 19.
     05  clientid-name            pic x(8) value space.
     05  clientid-task            pic x(8) value space.
     05  filler                   pic x(20) value low-value.
*-------------------------------------------------------------*
* Variables returned by the GETNAMEINFO Call                  *
*-------------------------------------------------------------*
 01  name-len                     pic 9(8) binary.
 01  host-name                    pic x(255).
 01  host-name-len                pic 9(8) binary.
 01  service-name                 pic x(32).
 01  service-name-len             pic 9(8) binary.
 01  name-info-flags              pic 9(8) binary value 0.
 01  ni-nofqdn                    pic 9(8) binary value 1.
 01  ni-numerichost               pic 9(8) binary value 2.
 01  ni-namereqd                  pic 9(8) binary value 4.
 01  ni-numericserver             pic 9(8) binary value 8.
 01  ni-dgram                     pic 9(8) binary value 16.
*-------------------------------------------------------------*
* Variables used for the SOCKET call                          *
*-------------------------------------------------------------*
 01  AF-INET                      pic 9(8) Binary Value 2.
 01  AF-INET6                     pic 9(8) Binary Value 19.
 01  SOCK-STREAM                  pic 9(8) Binary Value 1.
 01  SOCK-DATAGRAM                pic 9(8) Binary Value 2.
 01  SOCK-RAW                     pic 9(8) Binary Value 3.
 01  IPPROTO-IP                   pic 9(8) Binary Value zero.
 01  IPPROTO-TCP                  pic 9(8) Binary Value 6.
 01  IPPROTO-UDP                  pic 9(8) Binary Value 17.
 01  IPPROTO-IPV6                 pic 9(8) Binary Value 41.
 01  socket-descriptor            pic 9(4) Binary Value zero.
*-------------------------------------------------------------*
* Server socket address structure                             *
*-------------------------------------------------------------*
 01  server-socket-address.
     05  server-afinet            pic 9(4) Binary Value 19.
     05  server-port              pic 9(4) Binary Value 1031.
     05  server-flowinfo          pic 9(8) Binary Value zero.
     05  server-ipaddr.
         10 filler                pic 9(16) Binary Value 0.
         10 filler                pic 9(16) Binary Value 0.
```

Figure 138. EZASO6CC COBOL call interface sample IPv6 client program (Part 3 of 9)

```
     05  server-scopeid             pic 9(8) Binary Value zero.
 01  NBYTE                  PIC 9(8)  COMP value 80.
 01  BUF                    PIC X(80).
*-------------------------------------------------------------*
* Variables used by the BIND Call                            *
*-------------------------------------------------------------*
 01  client-socket-address.
     05  client-family              pic 9(4) Binary Value 19.
     05  client-port                pic 9(4) Binary Value 1032.
     05  client-flowinfo            pic 9(8) Binary Value 0.
     05  client-ipaddr.
         10 filler                  pic 9(16) Binary Value 0.
         10 filler                  pic 9(16) Binary Value 0.
     05  client-scopeid             pic 9(8) Binary Value 0.
*-------------------------------------------------------------*
* Buffer and length fields for send operation                 *
*-------------------------------------------------------------*
 01  send-request-length            pic 9(8) Binary value zero.
 01  send-buffer.
     05  send-buffer-total          pic x(4000) value space.
     05  closedown-message redefines send-buffer-total.
         10  closedown-id           pic x(8).
         10  filler                 pic x(3992).
     05  send-buffer-seq redefines send-buffer-total
                                    pic x(8) occurs 500 times.
*-------------------------------------------------------------*
* Variables used for the NTOP/PTON call                       *
*-------------------------------------------------------------*
 01  IN6ADDR-ANY                    pic x(45)
                        value '::'.
 01  IN6ADDR-LOOPBACK               pic x(45)
                        value '::1'.
 01  presentable-addr               pic x(45) value spaces.
 01  presentable-addr-len           pic 9(4) Binary value 45.
 01  numeric-addr.
     05 filler                      pic 9(16) Binary Value 0.
     05 filler                      pic 9(16) Binary Value 0.
*-------------------------------------------------------------*
* Buffer and length fields for recv operation                 *
*-------------------------------------------------------------*
 01  read-request-length            pic 9(8) Binary value zero.
 01  read-buffer                    pic x(4000) value space.
*-------------------------------------------------------------*
* Other fields for send and reccfrom operation                *
*-------------------------------------------------------------*
 01  send-flag                      pic 9(8) Binary value zero.
 01  recv-flag                      pic 9(8) Binary value zero.
*-------------------------------------------------------------*
* Error message for socket interface errors                   *
*-------------------------------------------------------------*
 01  ezaerror-msg.
     05  filler                     pic x(9) Value 'Function='.
     05  ezaerror-function          pic x(16) Value space.
     05  filler                     pic x value ' '.
     05  filler                     pic x(8) Value 'Retcode='.
```

Figure 138. EZASO6CC COBOL call interface sample IPv6 client program (Part 4 of 9)

```
     05  ezaerror-retcode           pic ---99.
     05  filler                     pic x value ' '.
     05  filler                     pic x(9) Value 'Errorno='.
     05  ezaerror-errno             pic zzz99.
     05  filler                     pic x value ' '.
     05  ezaerror-text              pic x(50) value ' '.

 Linkage Section.
*================

*============================================*
 Procedure Division.
*============================================*

*^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^*
*          P R O C E D U R E    C O N T R O L S                    *
*^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^*

      Perform Initialize-API     thru   Initialize-API-Exit.
      Perform Get-Client-ID      thru   Get-Client-ID-Exit.
      Perform Sockets-Descriptor thru   Sockets-Descriptor-Exit.
      Perform Presentation-To-Numeric thru
                                 Presentation-To-Numeric-Exit.
      Perform CONNECT-Socket     thru   CONNECT-Socket-Exit.
      Perform Numeric-TO-Presentation thru
                                 Numeric-To-Presentation-Exit.
      Perform Get-Name-Information thru
                                 Get-Name-Information-Exit.
      Perform Write-Message      thru   Write-Message-Exit.
      Perform Shutdown-Send      thru   Shutdown-Send-Exit.
      Perform Read-Message       thru   Read-Message-Exit.
      Perform Shutdown-Receive   thru   Shutdown-Receive-Exit.
      Perform Close-Socket       thru   Exit-Now.

*-------------------------------------------------------------*
* Initialize socket API                                       *
*-------------------------------------------------------------*
 Initialize-API.
     Move soket-initapi to ezaerror-function.
     Call 'EZASOKET' using soket-initapi maxsoc initapi-ident
                           subtask maxsno errno retcode.
     Move 'Initapi failed' to ezaerror-text.
     If retcode < 0 move 12 to failure.
     Perform Return-Code-Check  thru Return-Code-Exit.
     Move 'A' to Terminate-Options.
 Initialize-API-Exit.
     Exit.

*-------------------------------------------------------------*
* Let us see the client-id                                    *
*-------------------------------------------------------------*
 Get-Client-ID.
      Move soket-getclientid to ezaerror-function.
      Call 'EZASOKET' using soket-getclientid clientid errno
                            retcode.
```

Figure 138. EZASO6CC COBOL call interface sample IPv6 client program (Part 5 of 9)

```
      Display 'Our client ID = ' clientid-name ' ' clientid-task.
      Move 'Getclientid failed' to ezaerror-text.
      If retcode < 0 move 24 to failure.
      Perform Return-Code-Check thru Return-Code-Exit.
      Move 'C' to client-server-flag.
 Get-Client-ID-Exit.
     Exit.

*---------------------------------------------------------------*
* Get us a stream socket descriptor                             *
*---------------------------------------------------------------*
 Sockets-Descriptor.
      Move soket-socket to ezaerror-function.
      Call 'EZASOKET' using soket-socket AF-INET6 SOCK-STREAM
          IPPROTO-IP errno retcode.
      Move 'Socket call failed' to ezaerror-text.
      If retcode < 0 move 60 to failure.
      Perform Return-Code-Check thru Return-Code-Exit.
      Move 'S' to Terminate-Options.
      Move retcode to socket-descriptor.
 Sockets-Descriptor-Exit.
     Exit.

*---------------------------------------------------------------*
* Use PTON to create an IP address to bind to.                  *
*---------------------------------------------------------------*
 Presentation-To-Numeric.
      move soket-pton to ezaerror-function.
      move IN6ADDR-LOOPBACK to presentable-addr.
      Call 'EZASOKET' using soket-pton AF-INET6
         presentable-addr presentable-addr-len
         numeric-addr
         errno retcode.
      Move 'PTON call failed' to ezaerror-text.
      If retcode < 0  move 24 to failure.
      Perform Return-Code-Check thru Return-Code-Exit.
      move numeric-addr to server-ipaddr.
 Presentation-To-Numeric-Exit.
     Exit.

*---------------------------------------------------------------*
* CONNECT                                                       *
*---------------------------------------------------------------*
 Connect-Socket.
      Move space to Connect-Flag.
      Move zeros to errno retcode.
      move soket-connect to ezaerror-function.
      CALL 'EZASOKET' USING SOKET-CONNECT socket-descriptor
                       server-socket-address errno retcode.
      Move 'Connection call failed' to ezaerror-text.
      If retcode < 0  move 24 to failure.
      Perform Return-Code-Check thru Return-Code-Exit.
      If retcode = 0  Move 'Y' to Connect-Flag.
 Connect-Socket-Exit.
     Exit.
```

Figure 138. EZASO6CC COBOL call interface sample IPv6 client program (Part 6 of 9)

```
*-------------------------------------------------------------*
* Use NTOP to display the IP address.                         *
*-------------------------------------------------------------*
 Numeric-To-Presentation.
     move soket-ntop to ezaerror-function.
     move server-ipaddr to numeric-addr.
     move soket-ntop to ezaerror-function.
     Call 'EZASOKET' using soket-ntop AF-INET6
        numeric-addr
        presentable-addr presentable-addr-len
        errno retcode.
     Display 'Presentable address = ' presentable-addr.
     Move 'NTOP call failed' to ezaerror-text.
     If retcode < 0  move 24 to failure.
     Perform Return-Code-Check thru Return-Code-Exit.
 Numeric-TO-Presentation-Exit.
     Exit.

*-------------------------------------------------------------*
* Use GETNAMEINFO to get the host and service names           *
*-------------------------------------------------------------*
 Get-Name-Information.
     move 28 to name-len.
     move 255 to host-name-len.
     move 32 to service-name-len.
     move ni-namereqd to name-info-flags.
     move soket-getnameinfo to ezaerror-function.
     Call 'EZASOKET' using soket-getnameinfo
        server-socket-address name-len
        host-name host-name-len
        service-name service-name-len
        name-info-flags
        errno retcode.
     Display 'Host name = ' host-name.
     Display 'Service = ' service-name.
     Move 'Getaddrinfo call failed' to ezaerror-text.
     If retcode < 0  move 24 to failure.
     Perform Return-Code-Check thru Return-Code-Exit.
 Get-Name-Information-Exit.
     Exit.

*-------------------------------------------------------------*
* Write a message to the server                               *
*-------------------------------------------------------------*
 Write-Message.
      Move soket-write to ezaerror-function.
      Move 'Message from EZASO6CC' to buf.
      Call 'EZASOKET' using soket-write socket-descriptor
          nbyte buf
          errno retcode.
      Move 'Write call failed' to ezaerror-text.
      If retcode < 0 move 84 to failure.
      Perform Return-Code-Check thru Return-Code-Exit.
 Write-Message-Exit.
```

Figure 138. EZASO6CC COBOL call interface sample IPv6 client program (Part 7 of 9)

```
     Exit.

*-------------------------------------------------------------*
* Shutdown to pipe                                            *
*-------------------------------------------------------------*
 Shutdown-Send.
      Move soket-shutdown to ezaerror-function.
      move 1 to how.
      Call 'EZASOKET' using soket-shutdown socket-descriptor
          how
          errno retcode.
      Move 'Shutdown call failed' to ezaerror-text.
      If retcode < 0 move 99 to failure.
      Perform Return-Code-Check thru Return-Code-Exit.
 Shutdown-Send-Exit.
     Exit.

*-------------------------------------------------------------*
* Read a message from the server.                             *
*-------------------------------------------------------------*
 Read-Message.
      Move soket-read to ezaerror-function.
      Move spaces to buf.
      Call 'EZASOKET' using soket-read socket-descriptor
            nbyte buf
            errno retcode.
      If retcode < 0
         Move 'Read call failed' to ezaerror-text
         move 120 to failure
         Perform Return-Code-Check thru Return-Code-Exit.
 Read-Message-Exit.
     Exit.

*-------------------------------------------------------------*
* Shutdown receive pipe                                       *
*-------------------------------------------------------------*
 Shutdown-Receive.
      Move soket-shutdown to ezaerror-function.
      move 0 to how.
      Call 'EZASOKET' using soket-shutdown socket-descriptor
          how
          errno retcode.
      Move 'Shutdown call failed' to ezaerror-text.
      If retcode < 0 move 99 to failure.
      Perform Return-Code-Check thru Return-Code-Exit.
 Shutdown-Receive-Exit.
     Exit.

*-------------------------------------------------------------*
* Close socket                                                *
*-------------------------------------------------------------*
 Close-Socket.
       Move soket-close to ezaerror-function.
       Call 'EZASOKET' using soket-close socket-descriptor
                             errno retcode.
```

Figure 138. EZASO6CC COBOL call interface sample IPv6 client program (Part 8 of 9)

```
       Move 'Close call failed' to ezaerror-text.
       If retcode < 0 move 132 to failure
          perform write-ezaerror-msg thru
                  write-ezaerror-msg-exit.
       Accept Cur-Time from TIME.
       Display Cur-Time ' EZASO6CC: ' ezaerror-function
                    ' RETCODE=' RETCODE ' ERRNO= ' ERRNO.
 Close-Socket-Exit.
     Exit.

*---------------------------------------------------------------*
* Terminate socket API                                          *
*---------------------------------------------------------------*
 exit-term-api.
     ACCEPT cur-time from TIME.
     Display cur-time '  EZASO6CC:  TERMAPI '
             ' RETCODE= ' RETCODE ' ERRNO= ' ERRNO.
     Call 'EZASOKET' using soket-termapi.

*---------------------------------------------------------------*
* Terminate program                                             *
*---------------------------------------------------------------*
 exit-now.
     Move failure to return-code.
     Goback.

*---------------------------------------------------------------*
* Subroutine.                                                   *
* -----------                                                   *
* Write out an error message                                    *
*---------------------------------------------------------------*
 write-ezaerror-msg.
     Move errno to ezaerror-errno.
     Move retcode to ezaerror-retcode.
     Display ezaerror-msg.
 write-ezaerror-msg-exit.
     Exit.

*---------------------------------------------------------------*
* Check Return Code after each Socket Call                      *
*---------------------------------------------------------------*
 Return-Code-Check.
      Accept Cur-Time from TIME.
      Display Cur-Time ' EZASO6CC: ' ezaerror-function
                           ' RETCODE=' RETCODE ' ERRNO= ' ERRNO.
      IF RETCODE < 0
         Perform Write-ezaerror-msg thru write-ezaerror-msg-exit
         Move zeros to errno retcode
         IF Opened-Socket Go to Close-Socket
         ELSE IF Opened-API Go to exit-term-api
              ELSE Go to exit-now.
      Move zeros to errno retcode.
 Return-Code-Exit.
     Exit.
```

Figure 138. EZASO6CC COBOL call interface sample IPv6 client program (Part 9 of 9)

Chapter 14. REXX socket application programming interface

The z/OS Communications Server socket API for REXX supports IPv4 and IPv6 socket call instructions.

The REXX socket API uses the REXX built-in function RXSOCKET to access the z/OS Communications Server socket interface. This API provides similar socket functions to those in other high-level languages. When possible, the REXX socket functions match the C socket functions; an example of the corresponding LE C/C++ socket function is included when applicable.

Overview of the REXX socket API

This section contains introductory material about REXX socket APIs.

Supported REXX APIs

z/OS Communications Server supports the REXX Sockets API and the REXX FTP API.

The REXX FTP API is documented in *z/OS Communications Server: IP Programmer's Guide and Reference*. The REXX Sockets API is documented in this deliverable. Unless noted in *z/OS Communications Server: New Function Summary*, this REXX socket API is upward compatible. Application programs that use new functions will not be downward compatible.

Rule: Unless indicated otherwise, all socket commands that are listed are enabled for IPv4 and IPv6.

Tip: This API is compatible with compiled REXX.

Prerequisites for using REXX sockets

To use REXX sockets, the EZBRXSOC load module must be included.

The EZBRXSOC load module is defined with two load module aliases: RXSOCKET and SOCKET. When a program invokes the REXX socket function, either the load module or an alias is called. The load module and its aliases reside in the SEZALOAD library. The examples in this documentation use the SOCKET alias.

Requirement: The EZBRXSOC load module and its aliases must be included in one of the following items:

- The system LNKLST
- The STEPLIB DD concatenation of the job that is running the program that uses REXX sockets

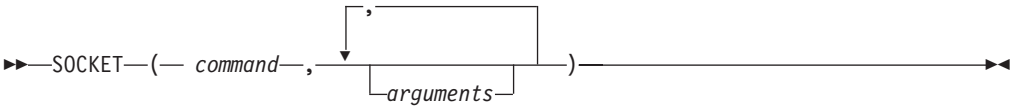
Format of the REXX socket function and return values

You can issue socket commands in REXX by calling the built-in socket function.

Format

This function uses the following format, which is similar to that used to invoke C sockets:

© Copyright IBM Corp. 1989, 2010



Parameters

command
The socket API command to be issued, for example, SEND.

arguments
One or more parameters separated by a comma. All parameters are passed as space-delimited strings.

Returned value

The socket function returns a space-delimited string. If the REXX socket library can issue the socket command, the return value consists of the REXX TCP/IP error number value, the return code, and any additional socket information. If the REXX socket library cannot process the socket command, the return value consists of a REXX socket library error value and information about what caused the error.

Tip: For an error condition, the REXX socket library returns both the numeric and text versions of the error, for example, `2009 ESOCKETNOTDEFINED Socket not defined`.

See Appendix B, "Socket call error return codes," on page 885 for additional information about the numeric error codes that are returned by this command.

Example

Consider the following code sample:

```
src = socket("ACCEPT",l_socketid);
```

where:

- "ACCEPT" is the socket command.
- *l_socketid* is an argument that is required by the ACCEPT command. In this example, it specifies the socket descriptor of the listening socket.

When a new connection is available, the ACCEPT command returns the following string:

```
src = 0 45
```

where 0 is the return code, and 45 is the file descriptor of the new connection.

REXX programming hints and tips

This topic contains information that you might find helpful when you use REXX sockets.

Capitalization

Throughout the documentation, REXX socket API commands and constants are capitalized when they are used in descriptive text. For example, the LISTEN command places a socket descriptor in passive mode.

Quotation marks

Throughout the documentation, REXX socket API commands and constants are enclosed in quotation marks (″) when they are used in code examples, for example, `src = socket("ACCEPT",sockfd);`.

Although the use of quotation marks is optional, consider using quotation marks to prevent programming errors. Using quotation marks forces the socket function to use string literals rather than REXX variables. When REXX encounters an uninitialized variable, it initializes that variable with the name of the variable. The command `socket(ACCEPT,sockid)` is valid because the uninitialized variable ACCEPT is initialized to the character string ACCEPT. However, if the program initializes the ACCEPT variable with a value other than the character string ACCEPT, the socket function fails.

Guideline: Unless otherwise indicated by a specific socket command, all socket commands and constant values must be passed as character strings.

Splitting a function over multiple lines

The socket function, with parameters, might exceed 80 characters. In such cases, you can split the function across multiple lines by using the REXX continuation character, a comma (,). Consider the following examples:

Continuing a string across two lines

```
l_string1 = "This is a string split between",
            "two lines.";
```

Continuing a string when the continuation occurs on a parameter boundry

```
src = socket("GETADDRINFO","CHILE",,
             23,"AI_CANONNAMEOK");
```

In this example, the first comma after the parameter ″CHILE″ indicates the end of the parameter. The second comma indicates that the REXX statement continues on the next line.

Return codes

To avoid problems, an application should check the return code of a socket command after each socket call. The examples in this topic do not always follow this recommendation. The examples are intended to show how to issue the socket command.

Guideline: Use either the REXX PARSE feature or the WORD function to access the return code. For example,

```
parse var l_retcode src remainder;
if src = 0 then do
   /* DO SOME STUFF */
end;
else do
   /* Process the error */
end;
```

Allocating and deallocating socket sets

To use the socket commands provided by the REXX socket function, a socket set must be active. To allocate a socket set, use the INITIALIZE socket command. The INITIALIZE command creates a socket set and can support multiple socket calls.

The *subtaskid* value identifies the socket set and usually corresponds to the application name. The *service* value indicates the TCP/IP stack name to form an affinity with.

Restriction: When the INITIALIZE command is issued, the REXX socket API forms an affinity with the default TCP/IP stack. In an INET environment, the affinity is created with the active stack. In a CINET environment, the affinity is created with the default stack. The default stack is determined either by the first BPXPRMxx SUBFILESYSTYPE statement or by the SUBFILESYSTYPE statement with the keyword DEFAULT. For additional information, see *z/OS Communication Server: MVS Initialization and Tuning Reference*.

Guideline: Before you exit the program or when you do not need the socket environment, use the TERMINATE socket command to deallocate the socket set.

Blocking and nonblocking mode

A socket can be in blocking or nonblocking mode. In blocking mode, commands such as SEND and RECV block the caller until either the operation is completed successfully or an error occurs. In nonblocking mode, the caller is not blocked, but the operation ends immediately with either the `35 EWOULDBLOCK` or `36 EINPROGRESS` return code. Use the FCNTL or IOCTL commands to switch the socket between blocking and nonblocking modes.

When a socket is in nonblocking mode, you can use the SELECT command to monitor the socket for one or more socket events. The socket can be monitored for events that indicate that the socket is ready for writing or reading, or whether an exception has occurred.

Transferring a socket to a subtask

If the application uses the GIVESOCKET and TAKESOCKET commands to transfer a socket from a parent program to a subtask, both the parent and subtask must agree on a mechanism for exchanging the client ID and the socket descriptor. The parent program can use the SELECT command to monitor when the subtask takes the socket. After the subtask takes the socket, the parent then can close the socket that was given.

SO_ASCII and SO_EBCDIC socket options

The socket options SO_ASCII and SO_EBCDIC identify the socket data type for use by the REXX RXSOCKET program. Setting the SO_EBCDIC option to ON has no effect, and setting the SO_ASCII option to ON causes all incoming data on the socket to be translated from ASCII to EBCDIC and all outgoing data on the socket to be translated from EBCDIC to ASCII.

How structures are represented

Instead of using binary-based data structures, the REXX socket library represents all data structures as strings of space-delimited values, where each value represents a field in the data structure.

The REXX language is a type-independent language. All data is manipulated and represented using a character format. When an application passes data into the

REXX socket library, the data must be a space-delimited string. When the REXX socket library returns socket information, it returns the information as a space-delimited string on the return value.

Rules:

- All IPv4 addresses are represented as strings in dotted decimal format.
- All IPv6 addresses are represented as strings in IPv6 colon hexadecimal format.
- When a NAME string is returned as a result, the IP address is in IPv4 dotted decimal or IPv6 colon hexadecimal format.

Tip: When you specify a NAME string as an input parameter to a command, you can specify the *ipaddress* field either as an IP address or as a host name to be resolved by a name server. For example, you can code `NAME="AF_INET 1049 MYHOST"`, where AF_INET is the address family, 1049 is the port number, and MYHOST is the host name to be resolved to an IP address.

struct sockaddr_in

This structure represents an IPv4 socket address. In the REXX socket library, this structure is represented by the NAME string. The NAME string has the following format:

```
NAME = "domain portid ipaddress"
```

where:

domain
The number 2 or AF_INET

portid
The local or remote port to which the socket is to be bound or connected

ipaddress
The IPv4 address of the local or remote host to which the socket is to be bound or connected

The following string is an example of an IPv4 NAME string:

```
NAME = "AF_INET 24 10.11.103.1";
```

struct sockaddr_in6

This structure represents an IPv6 socket address. In the REXX socket library, this structure is represented by the NAME string. The NAME string has the following format:

```
NAME = "domain portid flowinfo ipaddress scopeid"
```

where:

domain
The number 19 or AF_INET6.

portid
The local or remote port to which the socket is to be bound or connected.

flowinfo
This value must be set to 0.

ipaddress
The IPv6 address of the local or remote host to which the socket is to be bound or connected.

scopeid
Identifies the interfaces that are applicable for the scope of the address that is specified in the *ipaddress* field. For a link-local IP address, the *scopeid* field can specify a link index, which identifies a set of interfaces. For all other scopes, the *scopeid* field must be set to 0. Setting the *scopeid* field to 0 indicates that any address type and scope can be specified.

The following string is an example of an IPv6 NAME string:

```
NAME = "AF_INET6 24 0 2001:10:11:103::1 0"
```

struct ip_mreq

This structure represents the mapping between an IPv4 multicast address and an IPv4 interface. In the REXX socket library, this structure is represented by the *ipmreq* string. The *ipmreq* string has the following format:

```
ipmreq = "maddress iaddress"
```

where:

maddress
An IPv4 multicast address

iaddress
The IPv4 interface address

The following string is an example of an IPv4 *ipmreq* string:

```
ipmreq = "224.224.224.1 10.123.21.3"
```

struct ipv6_mreq

This structure represents the mapping between an IPv6 multicast address and an interface index. In the REXX socket library, this structure is represented by the *ipmreq* string. The *ipmreq* string has the following format:

```
ipmreq = "maddress index"
```

where:

maddress
An IPv6 multicast address

index
An interface index number

The following string is an example of an IPv6 *ipmreq* string:

```
ipmreq = "FF05::101 34"
```

struct ip_mreq_source

This structure represents a multicast source filter. It is used with the IOCTL command to filter the multicast packets that an application wants to receive; it also defines the remote host from which the packets are sent. In the REXX socket library, this structure is represented by the *ip_mreq_source* string. The *ip_mreq_source* string has the following format:

```
ipmreqsource = "maddress saddress iaddress"
```

where:

maddress
An IPv4 multicast address

saddress
An IPv4 source address of a remote host

iaddress
An IPv4 interface address

The following string is an example of an *ip_mreq_source* string:

```
ipmreqsource ="224.224.224.2 10.1.2.3 10.123.21.3"
```

Restriction: This structure supports IPv4 addresses only.

struct group_req

This structure represents a protocol-independent mapping between a multicast IP address and an interface index. It is used with the IOCTL command to join and leave multicast groups. In the REXX socket library, this structure is represented by the *groupreq* string. The *groupreq* string has the following format:

```
groupreq = "index NAME"
```

where:

index
An interface index

NAME
The NAME string of a multicast socket address

The following strings are examples of *groupreq* strings:

```
groupreq = "15664 AF_INET 5000 224.224.224.2"
groupreq = "15667 AF_INET6 5000 0 FF05::101 0"
```

struct group_req_source

This structure represents a protocol-independent mapping between a multicast IP address, an interface index, and a source address for a remote host. It is used with the IOCTL command to filter the multicast packets that an application wants to receive; it also defines the remote host from which the packets are sent. In the REXX socket library, this structure is represented by the *groupreqsource* string. The *groupreqsource* string has the following format:

```
groupreqsource = "index M_NAME S_NAME"
```

where:

index
An interface index

M_NAME
The NAME string of a multicast socket address

S_NAME
The NAME string of a source socket address

The following strings are examples of *groupreqsource* strings:

```
groupreqsource = "15664 AF_INET 5000 224.224.224.2 AF_INET 5000 10.1.2.3"
groupreqsource = "15667 AF_INET6 5000 0 FF05::101 0 AF_INET6 5000 0
                  2001:10:1:2::3 0"
```

REXX runtime functions

This section describes the subcommands that are supported by the REXX socket function. When applicable, the LE C/C++ Equivalent call is also shown.

Commands to process socket sets	
"INITIALIZE" on page 758	Use the INITIALIZE command to preallocate a socket set.
"SOCKETSET" on page 803	Use the SOCKETSET command to retrieve the name of the active socket set. If you specify the name of a socket set as a parameter, then that socket set becomes the active socket set.
"SOCKETSETLIST" on page 803	Use the SOCKETSETLIST command to list the names of all available socket sets that are currently defined by the application.
"SOCKETSETSTATUS" on page 804	Use the SOCKETSETSTATUS command to list information about a socket set.
"TERMINATE" on page 808	Use the TERMINATE command to close all sockets in the specified socket set and to release the socket set.
Commands to open, close, and manipulate sockets	
"ACCEPT" on page 704	Use the ACCEPT command to accept new connections from a client.
"BIND" on page 707	Use the BIND command to bind a local NAME string to a socket descriptor.
"BIND2ADDRSEL" on page 709	Use the BIND2ADDRSEL command to bind a socket to the local IP address that would be selected by the stack to communicate with the input destination IP address.
"CLOSE" on page 711	Use the CLOSE command to close a socket and release the resources that are associated with the socket descriptor.
"CONNECT" on page 712	A client application uses the CONNECT command to establish a connection between a local socket and a remote socket.
"GIVESOCKET" on page 753	Use the GIVESOCKET command to transfer a socket descriptor to another application that is running on the same host.
"LISTEN" on page 769	Use the LISTEN command to determine whether a socket is ready to accept client connection requests.
"SHUTDOWN" on page 800	Use the SHUTDOWN command to shut down all or part of a duplex connection.
"SOCKET" on page 801	Use the SOCKET command to open a socket descriptor in the active socket set.

"TAKESOCKET" on page 806	Use the TAKESOCKET command to take a socket descriptor that is passed from another program using the GIVESOCKET command. A socket descriptor can be taken by an application only when the socket is in the same address family.
Commands to exchange data on sockets	
"READ" on page 770	Use the READ command to read data on the specified socket. The maximum amount of data to be read is specified by the *maxlength* parameter. If the socket is in blocking mode and data is not available on the socket, the command blocks until data arrives.
"RECV" on page 773	Use the RECV command to receive data on a specified socket. The RECV command can be issued only against connected sockets.
"RECVFROM" on page 775	Use the RECVFROM command to receive data on the specified socket.
"SEND" on page 783	Use the SEND command to send an outgoing message on the connected socket.
"SENDTO" on page 785	Use the SENDTO command to send an outgoing message on a socket descriptor. This command differs from the SEND command in that it includes the destination address as a parameter.
"WRITE" on page 810	Use the WRITE command to send an outgoing message on the connected socket. The WRITE command is similar to the SEND command, except that the WRITE command does not support the control flags that are available with the SEND command.
Commands to resolve host names and IP addresses	
"GETADDRINFO" on page 717	Use the GETADDRINFO command to resolve host or service name information.
"GETCLIENTID" on page 727	Use the GETCLIENTID command to retrieve the client ID for the calling application. The client ID is the identifier by which the calling application is known to the TCP/IP address space.
"GETDOMAINNAME" on page 728	Use the GETDOMAINNAME command to retrieve the name of the domain to which the current TCP/IP stack belongs.
"GETHOSTBYADDR" on page 729	Use the GETHOSTBYADDR command to resolve an IPv4 address to a host name.
"GETHOSTBYNAME" on page 730	Use the GETHOSTBYNAME command to resolve a host name to an IPv4 address.
"GETHOSTID" on page 732	Use the GETHOSTID command to return the primary IPv4 address for the current host. The primary address is the IP address of the default home address that is specified in the TCP/IP configuration file for the stack with which the current socket set is associated.

"GETHOSTNAME" on page 733	Use the GETHOSTNAME command to return the name of the host on which the application is running
"GETNAMEINFO" on page 734	Use the GETNAMEINFO command to translate a socket address to a node name and service location.
"GETPEERNAME" on page 736	Use the GETPEERNAME command to return the name of the remote peer that is connected to the socket.
"GETPROTOBYNAME" on page 738	Use the GETPROTOBYNAME command to translate a network protocol name to a protocol number.
"GETPROTOBYNUMBER" on page 739	Use the GETPROTOBYNUMBER command to translate a network protocol number to a protocol name.
"GETSERVBYNAME" on page 740	Use the GETSERVBYNAME command to retrieve a service and port number.
"GETSERVBYPORT" on page 741	Use the GETSERVBYPORT command to translate a port number to the name of the service that is using the port.
"GETSOCKNAME" on page 742	Use the GETSOCKNAME command to retrieve the name of a bound socket.
"INET6ISSRCADDR" on page 755	Use the INET6ISSRCADDR command to indicate whether an input IPV6 socket address matches an address that is defined to the stack, which conforms to one or more input IPV6_ADDR_PREFERENCES flags.
"RESOLVE" on page 778	Use the RESOLVE command to resolve a host name or an IP address.
Commands to manage socket configuration, options, and modes	
"FCNTL" on page 715	Use the FCNTL command to control the operating characteristics of a socket.
"GETSOCKOPT" on page 743	Use the GETSOCKOPT command to retrieve the active socket options that were set by the SETSOCKOPT command.
"IOCTL" on page 759	Use the IOCTL command to perform control functions on sockets.
"SELECT" on page 779	Use the SELECT command to monitor groups of sockets to determine when one or more of the sockets is ready for a read operation, is ready for a write operation, or has an exception pending.
"SETSOCKOPT" on page 786	Use the SETSOCKOPT command to set socket options.
"VERSION" on page 809	Use the VERSION command to retrieve the name, version number, and version date of the REXX socket library.

ACCEPT

Use the ACCEPT command to accept new connections from a client.

This command is valid only for stream sockets. Connection requests are processed in the order in which they are received. When a new connection is accepted, a new socket ID is created with the same properties as the listening socket ID. The new socket ID cannot be used to accept new connections. The original socket remains available to accept new connection requests.

This command supports both blocking and nonblocking sockets.

Rule: When the listening socket is in blocking mode, the ACCEPT command blocks the caller until a new connection request is received. When the listening socket is in nonblocking mode, the ACCEPT command immediately returns the `35 EWOULDBLOCK` return code.

Tip: When you use blocking or nonblocking socket calls, use the SELECT command to check for new connection requests before you call the ACCEPT command. The availability of a new connection is reported as a READ event on the listening socket. The new socket should not be accepted until after the READ event is received.

Format

Parameters

socketid
The socket descriptor of the listening socket where new connection requests are queued

Returned value

The command returns a string that contains the return code, the new *scopeid* value for the accepted connection, and the NAME string of the connecting client. The return code can be 0, a REXX socket API error number, or the REXX TCP/IP error number that is set by the socket command. The return code 0 indicates that the requested socket command was completed successfully.

For information about the format of the NAME string, see "How structures are represented" on page 698.

Consider the following IPv4 and IPv6 examples:

IPv4 The string, 0 6 AF_INET 50000 10.1.2.3, is an example of what this command returns. 0 is the function return code, 6 is the new socket ID of the accepted connection, AF_INET is the address family to which the socket belongs, 50000 is the remote port from which the client is connecting, and 10.1.2.3 is the remote address from which the client is connecting.

IPv6 The string, 0 6 AF_INET6 5462 0 2001:10:11:103::1 0, is an example of what this command returns. 0 is the function return code, 6 is the new socket ID of the accepted connection, AF_INET6 is the address family to which the socket belongs, 5462 is the remote port from which the client is connecting, 0 is the *flowinfo* value, 2001:10:11:103::1 is the remote address from which the client is connecting, and 0 is the *scopeid* value. For IPv6 connections, the *flowinfo* and *scopeid* fields are set to 0.

See Appendix B, "Socket call error return codes," on page 885 for additional information about the numeric error codes that are returned by this command.

The following REXX TCP/IP error numbers can be returned:

- 1 EPERM
- 9 EBADF
- 22 EINVAL
- 35 EWOULDBLOCK

The following REXX socket API error numbers can be returned:

- 2001 EINVALIDRXSOCKETCALL
- 2006 ESOCKETNOTDEFINED
- 2007 EMAXSOCKETSREACHED
- 2009 ESOCKETNOTDEFINED
- 2012 EINVALIDNAME

LE C/C++ equivalent

```
int accept(int socket, struct sockaddr *address, int *address_len);
```

Code example

```
/* REXX EZARXR01 */
/*
 * This sample demonstrates the use of the INITIALIZE, SOCKET, BIND
 * LISTEN, ACCEPT, RECV, CLOSE, and TERMINATE socket commands.
 *
 * The program creates a listening socket and then goes into a
 * loop and blocks on the accept command. When a new connection is
 * ACCEPTED the program will issue one receive command and then close
 * the connection. If the data received is the string "DONE", then the
 * program will close the listening socket and terminate. Otherwise the
 * program will wait for the next connection.
 *
 * RESTRICTION: This program is designed to read 1 packet with a max
 *              size of 512 bytes.
 *
 * GUIDELINE: It is generally recommended that a program loop around
 *            the RECV command to ensure that all data is read off
 *            the socket. This sample does not follow the guideline.
 */
src = socket("INITIALIZE","MYSET01",10);
if perror(src,"INITIALIZE") = 0 then do
   src = socket("SOCKET","AF_INET6","STREAM");
   if perror(src,"SOCKET") = 0 then do
      parse var src . l_sockid
      l_name6 = "AF_INET6 54004 0 ::0 0";
      src = socket("BIND", l_sockid, l_name6);
      if perror(src,"BIND") = 0 then do
         src = socket("LISTEN", l_sockid);
         if perror(src,"LISTEN") = 0 then do
            l_Done = "FALSE";
            do until l_Done = "TRUE";
               say "Listening on socket "l_sockid;
               src = socket("ACCEPT", l_sockid );
               if perror(src,"ACCEPT") = 0 then do
                  parse var src . l_newsockid . ;
                  src = socket("RECV",l_newsockid,512);
                  parse var src l_retcode l_datalen l_data
                  if l_data = "DONE" | perror(src,"RECV") \= 0 then
                     l_Done = "TRUE";
                  src = socket("CLOSE",l_newsockid);
                  src = perror(src,"Accepted socket close");
               end;
               else do
                  src = socket("CLOSE",l_sockid);
                  src = perror(src,"Listen close");
                  l_done = "TRUE";
               end; /* ACCEPT */
            end; /* DO */
         end; /* LISTEN */
      end; /* BIND */
   end; /* SOCKET */
end; /* INITIALIZE */
src = socket("TERMINATE","MYSET01");
src = perror(src,"TERMINATE");
exit 0;
/* This routine returns -1 if the first word if arg 1 is not zero */
perror: if word(arg(1),1) = 0 then return 0; else
    Say arg(2) "Error : "arg(1);
    return -1;
```

Figure 139. ACCEPT command example

BIND

Use the BIND command to bind a local NAME string to a socket descriptor.

The format of the NAME string depends on the addressing family of the socket. An application can use the BIND command to specify the network interface from which the socket can receive TCP connection requests or UDP packets. A socket bound to a specific local-IP address receives only packets that are targeted to that address. Outgoing packets have as their source address the address that is used to bind the socket. The BIND command supports both stream or datagram sockets, and it can be issued by both clients or servers.

Guidelines:

- Do not bind a socket to a specific interface address. Binding a socket to a specific interface address limits network access to the application and might result in unexpected outages. To enable TCP connections to be accepted and UDP datagrams to be received over any interface, specify INADDR_ANY or IN6ADDR_ANY in the *ipaddress* field of the NAME parameter.
- A server (an application that calls the LISTEN command) should always bind to the same well-known port. When the socket is bound and the LISTEN command is issued, the bound socket is marked as being passive. Passive sockets cannot be used to send or receive data. They are used to receive new connection requests from remote clients using the ACCEPT command.
- The `48 EADDRINUSE` error message indicates that a previous application is using the port. This error also can be received when a listening server is restarted. The TCP/IP stack maintains state information from the previous instance of the server for a fixed time before it releases a port and address for reuse. To avoid this situation, use the SETSOCKOPT command to set the SO_REUSEADDR socket option on the listening socket.

Format

Parameters

socketid
The socket descriptor.

name
The socket address to which the socket is to be bound.

The format for the *name* parameter depends on the socket type:

AF_INET sockets (IPv4)
name = "domain portid ipaddress"

AF_INET6 sockets (IPv6)
name = "domain portid flowinfo ipaddress scopeid"

where:

- The *domain* value is the decimal number 2 for AF_INET and the decimal number 19 for AF_INET6.
- The *portid* value is 0 or the local port to which the socket will bind. When the *portid* field is set to 0, the stack selects the local port.
- The *ipaddress* value is the IP address to which the socket binds and the source address of outgoing packets. Other valid values are INADDR_ANY,

IN6ADDR_ANY, INADDR_BROADCAST, BROADCAST, and LOOPBACK. When the *ipaddress* field is set to INADDR_ANY or IN6ADDR_ANY, the stack passes to the application any TCP connection requests or UDP datagrams that are received for the socket on any local interface. For outgoing packets, the stack selects the source address.

Tip: System administrators can override the INADDR_ANY or IN6ADDR_ANY value by specifying the BIND option on the PORT reservation statement in the `TCPIP.PROFILE` file. This is equivalent to coding the IP address on the *name* parameter. For more information, see *z/OS Communication Server: IP Configuration Reference*.

- The *flowinfo* value must be 0.
- The *scopeid* value identifies the interfaces that are applicable for the scope of the address that is specified in the *ipaddress* field. For a link-local IP address, the *scopeid* field can specify a link index, which identifies a set of interfaces. For all other scopes, the *scopeid* field must be set to 0. Setting the *scopeid* field to 0 indicates that any address type and scope can be specified.

Returned value

The return code can be 0, a REXX socket API error number, or the REXX TCP/IP error number that is set by the socket command. The return code 0 indicates that the requested socket command was completed successfully.

See Appendix B, "Socket call error return codes," on page 885 for additional information about the numeric error codes that are returned by this command.

The following REXX TCP/IP error numbers can be returned:

- 1 EPERM
- 9 EBADF
- 22 EINVAL
- 47 EAFNOSUPPORT
- 48 EADDRINUSE
- 49 EADDRNOTAVAIL

The following REXX socket API error numbers can be returned:

- 2001 EINVALIDRXSOCKETCALL
- 2009 ESOCKETNOTDEFINED

LE C/C++ equivalent

```
int bind(int socket, struct sockaddr *address, int *address_len);
```

Returned value

See the "ACCEPT" on page 704 command for an example of using the BIND command.

BIND2ADDRSEL

Use the BIND2ADDRSEL command to bind a socket to the local IP address that would be selected by the stack to communicate with the input destination IP address.

Use the BIND2ADDRSEL command when the application must verify that the local IP address assigned by the stack meets its address selection criteria as specified by the IPV6_ADDR_PREFERENCES socket option before the stack sends any packets to the remote host. In a TCP or UDP application, the BIND2ADDRSEL command usually follows the SETSOCKOPT command with option IPV6_ADDR_PREFERENCES and precedes any communication with a remote host.

Result: The stack attempts to select a local IP address according to your application preferences. However, a successful BIND2ADDRSEL command does not guarantee that all the selection preferences of your source IP address were met.

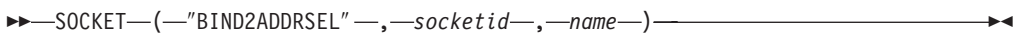
Guidelines:

- Use the SETSOCKOPT command to set the IPV6_ADDR_PREFERENCES option to indicate your selection preferences of source IP address before binding the socket and before allowing an implicit bind of the socket to occur.

  Result: If a socket has not been explicitly bound to a local IP address with a BIND or BIND2ADDRSEL command when a CONNECT, SENDTO, or SENDMSG macro is issued, an implicit bind of the socket occurs. The stack chooses the local IP address used for outbound packets.

  Requirement: When your application is using stream sockets, and must prevent the stack from sending any packets whatsoever (such as SYN) to the remote host before it can verify that the local IP address meets the values specified for the IPV6_ADDR_PREFERENCES option, do not allow the CONNECT command to implicitly bind the socket to a local IP address. Instead, bind the socket with the BIND2ADDRSEL command and test the local IP address assigned with the INET6_IS_SRCADDR command. If the assigned local IP address is satisfactory, you can then use the CONNECT command to establish communication with the remote host.
- After you successfully issue the BIND2ADDRSEL command, use the GETSOCKNAME command to obtain the local IP address that is bound to the socket. When the local IP address is obtained, use the INET6_IS_SRCADDR command to verify that the local IP address meets your address selection criteria.

Format



Parameters

socketid
The socket descriptor.

name
The socket address of the remote host machine that the application communicates with.

name = "domain portid flowinfo ipaddress scopeid

where:

- The *domain* value must be the decimal number 19 or AF_INET6.

- The *portid* value is not used by the BIND2ADDRSEL command.

  Requirement: You must specify a decimal numeral between 0 and 65535 for the *portid* value.
- The *flowinfo* value is not used by the BIND2ADDRSEL command.

  Requirement: You must specify a decimal numeral between 0 and 2147483647 for the *flowinfo* value.
- The *ipaddress* value is the IPv6 address of the remote host machine the application will communicate with.

  Rule: Specify an IPv4 address by using its IPV4 mapped IPV6 format.
- The *scopeid* value identifies the interfaces that are applicable for the scope of the address that is specified in the *ipaddress* field. For a link-local IP address, the *scopeid* field can specify a link index, which identifies a set of interfaces. For all other scopes, the *scopeid* field must be set to 0. Setting the *scopeid* field to 0 indicates that any address type and scope can be specified.

Returned value

The return code can be 0, a REXX socket API error number, or the REXX TCP/IP error number that is set by the socket command. The return code 0 indicates that the requested socket command was completed successfully.

See Appendix B, "Socket call error return codes," on page 885 for additional information about the numeric error codes that are returned by this command.

The following REXX TCP/IP error numbers can be returned:

- 1 EPERM
- 9 EBADF
- 22 EINVAL
- 41 EPROTOTYPE
- 45 EOPNOTSUPP
- 47 EAFNOSUPPORT
- 49 EADDRNOTAVAIL
- 65 EHOSTUNREACH

The following REXX socket API error numbers can be returned:

- 2001 EINVALIDRXSOCKETCALL
- 2009 ESOCKETNOTDEFINED

LE C/C++ equivalent

```
int bind2addrsel(int socket, struct sockaddr *address, int *address_len);
```

CLOSE

Use the CLOSE command to close a socket and release the resources that are associated with the socket descriptor.

If the socket descriptor is a connected stream socket, the connection to the remote host is also closed. If a connected stream socket is closed but has input data still pending on the socket, the CLOSE command causes the connection to be reset.

Format

Parameters

socketid
The socket descriptor

Returned value

The return code can be 0, a REXX socket API error number, or the REXX TCP/IP error number that is set by the socket command. The return code 0 indicates that the requested socket command was completed successfully.

See Appendix B, "Socket call error return codes," on page 885 for additional information about the numeric error codes that are returned by this command.

The following REXX TCP/IP error numbers can be returned:

- 9 EBADF

The following REXX socket API error numbers can be returned:

- 2001 EINVALIDRXSOCKETCALL
- 2009 ESOCKETNOTDEFINED

LE C/C++ equivalent

```
int close(int socket);
```

Code example

```
/* REXX EZARXR02 */
/*
 * This sample demonstrates the use of the CLOSE socket commands.
 * The program will open a STREAM socket, and if successful,
 * the socket will be closed.
 */
src = socket("INITIALIZE","MYSET01",10);
if perror(src,"INITIALIZE") = 0 then do
   src = socket("SOCKET","AF_INET6","STREAM");
   if perror(src,"SOCKET") = 0 then do
      parse var src l_retcode l_sockid
      src = perror(socket("CLOSE",l_sockid),"CLOSE");
   end; /* SOCKET */
end; /* INITIALIZE */
src = perror(socket("TERMINATE","MYSET01"),"TERMINATE");
exit 0;

/* This routine returns -1 if the first word if arg 1 is not zero */
perror: if word(arg(1),1) = 0 then return 0; else
    Say arg(2) "Error : "arg(1);
    return -1;
```

Figure 140. CLOSE command example

CONNECT

A client application uses the CONNECT command to establish a connection between a local socket and a remote socket.

The command supports both blocking and nonblocking sockets. When the socket is in blocking mode, the function does not return until a connection with the remote peer is established or until an error is received. When the socket is in nonblocking mode, the function returns immediately with either the 36 EINPROGRESS return code or an error.

The CONNECT command performs differently depending on the socket type:

Stream (TCP) sockets
If the application has not already issued an explicit bind, the CONNECT command completes the bind of the socket. The API then attempts to establish a connection to the remote socket that is specified by the *name* parameter. You can call the CONNECT command only once. Issuing additional CONNECT commands results in a `56 EISCONN` error.

Datagram (UDP) sockets
The CONNECT command enables an application to associate a socket with the socket name of a peer. The socket then is considered to be a connected UDP socket. You can call the CONNECT command multiple times with different peer names to change the socket association.

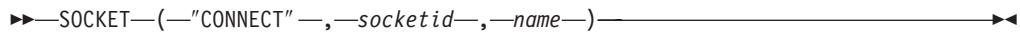
Rules:

- Using the CONNECT command on a UDP socket does not change the UDP protocol from a connectionless to a connection-based protocol. The UDP socket remains connectionless. The primary benefit of using connected UDP sockets is to limit communication with a single remote application.
- When a UDP socket becomes a connected UDP socket, it can no longer use the SENDTO and RECVFROM commands. Connected UDP sockets use the socket commands READ, WRITE, SEND, or RECV to communicate with the remote peer, instead of using the SENTO and RECVFROM commands.

Tips:

- For nonblocking sockets, use the SELECT command to determine when a connection has been established. Test for the ability to write to the socket.
- A connected UDP socket can revert back to an unconnected UDP socket by calling CONNECT with 0 or AF_UNSPEC specified in the *domain* field of the *name* parameter.

Format



Parameters

socketid
The descriptor of the local socket.

name
Identifies the remote socket.

The format for the *name* parameter depends on the socket type:

AF_INET sockets (IPv4)
name = "domain portid ipaddress"

AF_INET6 sockets (IPv6)
name = "domain portid flowinfo ipaddress scopeid"

where

- The *domain* value is the decimal number 2 for AF_INET and the decimal number 19 for AF_INET6.
- The *portid* value is the port number.
- The *ipaddress* value is the IP address of the remote host. It must be an IPv4 address for AF_INET and an IPv6 address for AF_INET6.
- The *flowinfo* value must be 0.
- The *scopeid* value identifies the interfaces that are applicable for the scope of the address that is specified in the *ipaddress* field. For a link-local IP address, the *scopeid* field can specify a link index, which identifies a set of interfaces. For all other scopes, the *scopeid* field must be set to 0. Setting the *scopeid* field to 0 indicates that any address type and scope can be specified.

Returned value

The return code can be 0, a REXX socket API error number, or the REXX TCP/IP error number that is set by the socket command. The return code 0 indicates that the requested socket command was completed successfully.

Tip: When a connection attempt is made with a nonblocking socket, the string `36 EINPROGRESS` is returned to the application. The program should check for this condition when using nonblocking sockets.

See Appendix B, "Socket call error return codes," on page 885 for additional information about the numeric error codes that are returned by this command.

The following REXX TCP/IP error numbers can be returned:

- 1 EPERM
- 9 EBADF
- 35 EWOULDBLOCK
- 36 EINPROGRESS
- 37 EALREADY
- 47 EAFNOSUPPORT
- 49 EADDRNOTAVAIL
- 51 ENETUNREACH
- 56 EISCONN
- 60 ETIMEDOUT
- 61 ECONNREFUSED

The following REXX socket API error numbers can be returned:

- 2001 EINVALIDRXSOCKETCALL
- 2009 ESOCKETNOTDEFINED

LE C/C++ equivalent

```
int connect(int socket, struct sockaddr *address, int address_len);
```

Code example

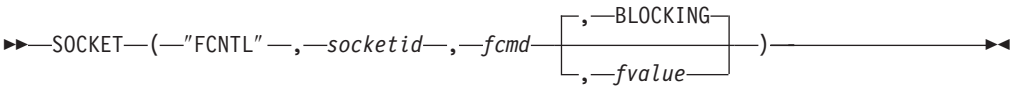
```
/* REXX EZARXR03 */
/*
 * This sample demonstrates the use of the INITIALIZE, SOCKET,
 * CONNECT, GETSOCKNAME, SEND, RECV, CLOSE and TERMINATE
 * socket commands.
 *
 * The program will INITIALIZE a socket set and create a STREAM
 * socket.  If successful an attempt will be made to connect to
 * port 7 using the loopback address and 7 bytes of data will be
 * sent.  The program will then wait for the data to be echoed
 * back.
 *
 * Port 7 is the well known port for the ECHO server. The ECHO
 * Server for the z/OS Communication Server is the MISCSERV. For
 * Information on setting up the MISCSERV see the IP Configuration
 * Reference.
 *
 * The example EZARXR01 can be modified to echo data back by adding
 * a SEND command after the RECV command. This is left as an exercise.
 *
 * GUIDELINE: It is generally recommended that a program loop around
 *            the RECV command to ensure that all data is read off
 *            the socket.
 */
src = socket("INITIALIZE","MYSET01");
if perror(src,"INITIALIZE") = 0 then do
   src = socket("SOCKET","AF_INET","STREAM");
   if perror(src,"SOCKET") = 0 then do
      l_socketid = WORD(src,2);
      l_RMTname = "AF_INET 7 127.0.0.1";
      src = socket("CONNECT",l_socketid,l_RMTname);
      if perror(src,"CONNECT") = 0  then do
         src = socket("GETSOCKNAME",l_socketid);
         if perror(src,"GETSOCKNAME") = 0 then do
            l_LOCname = SUBWORD(src,2);
            Say "The local socket name is: "l_LOCName;
            src = socket("SEND",l_socketid,"*******");
            if perror(src,"SEND") = 0 then do
               src = socket("RECV",l_socketid);
               if perror(src,"RECV") = 0 then
                  Say "Echoed data: " word(src,3);
            end; /* SEND*/
         end; /* GETSOCKNAME*/
      end; /* CONNECT */
   end; /* SOCKET */
   src = socket("CLOSE",l_socketid);
   src = perror(src,"CLOSE");
end; /* INITIALIZE */
src = socket("TERMINATE","MYSET01");
src = perror(src,"TERMINATE");
exit 0;

/* This routine returns -1 if the first word if arg 1 is not zero */
perror: if word(arg(1),1) = 0 then return 0; else
    Say arg(2) "Error : "arg(1);
    return -1;
```

Figure 141. CONNECT command example

FCNTL

Use the FCNTL command to control the operating characteristics of a socket.

Format



Parameters

socketid
The socket descriptor.

fcmd
The command to be run. The following commands are available:

F_SETFL
Sets the status flags for the socket

F_GETFL
Retrieves the status flags of the socket

fvalue
One of the following flags:

BLOCKING
Puts a socket into blocking mode. If the targeted socket is in nonblocking mode and there is no data on the socket, issuing this command causes socket commands that support nonblocking socket descriptors to return the `35 EWOULDBLOCK` error message. By default, the *fvalue* parameter is set to BLOCKING.

NON-BLOCKING
Puts a socket into nonblocking mode. The value FNDELAY is also accepted.

Returned value

The command returns a string that contains the return code. If the F_GETFL flag is issued, the string also contains the flag. The return code can be 0, a REXX socket API error number, or the REXX TCP/IP error number that is set by the socket command. The return code 0 indicates that the requested socket command was completed successfully.

The string 0 BLOCKING is an example of what this command might return.

See Appendix B, "Socket call error return codes," on page 885 for additional information about the numeric error codes that are returned by this command.

The following REXX TCP/IP error numbers can be returned:
- 1 EPERM
- 9 EBADF
- 35 EWOULDBLOCK

The following REXX socket API error numbers can be returned:
- 2001 EINVALIDRXSOCKETCALL
- 2009 ESOCKETNOTDEFINED

LE C/C++ equivalent

```
int fcntl(int socket, int cmd, ...);
```

Code example

```
/* REXX EXARXR04 */
/*
 * This sample demonstrates the use of the FCNTL
 * socket command.
 *
 * The program will open a STREAM socket and use the
 * FCNTL command to set the socket to NON-BLOCKING
 * mode.
 */
src = socket("INITIALIZE","MYSET01");
if perror(src,"INITIALIZE") = 0 then do
   src = socket("SOCKET","AF_INET","STREAM");
   if perror(src,"SOCKET") = 0 then do
      l_socketid = WORD(src,2);
      src = socket("FCNTL",l_socketid,F_SETFL,"NON-BLOCKING");
      src = socket("FCNTL",l_socketid,F_GETFL);
      Say src;
   end; /* SOCKET */
   src = socket("CLOSE",l_socketid);
   src = perror(src,"CLOSE");
end;
src = socket("TERMINATE","MYSET01");
src = perror(src,"TERMINATE");
exit 0;

/* This routine returns -1 if the first word if arg 1 is not zero */
perror: if word(arg(1),1) = 0 then return 0; else
    Say arg(2) "Error : "arg(1);
    return -1;
```

Figure 142. FCNTL command example

GETADDRINFO

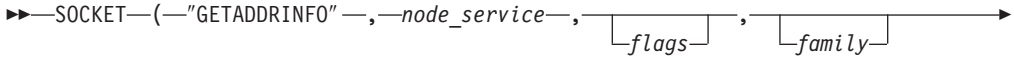
Use the GETADDRINFO command to resolve host or service name information.

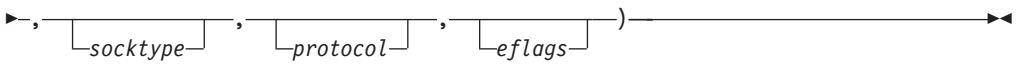
This command translates the name of a service location (host name) or a service name. The command returns a set of NAME strings and associated information; this information can be used to create a socket with which to address the specified service or to send a datagram to the specified service. For information about the format of the NAME string, see "How structures are represented" on page 698.

Guideline: Use the application to cycle through each NAME string until a successful connection is established. An example is provided in "Code example" on page 724.

Tip: You can use a resolver trace to determine why a resolver command failed. See *z/OS Communications Server: IP Diagnosis Guide*.

Format





Parameters

node_service
This variable takes one of the following formats:

where:

node
The host name or IP address. If the value of the *node* parameter is an IP address, you also must issue the AI_NUMERICHOST flag. The value of the *node* parameter can be up to 255 bytes in length.

Scope information can be appended to the host name, using the following format:

```
"node%scope information"
```

For example, you could set the *node* parameter to `"MYNODE%23"`. For more information, see *z/OS Communication Server: IPv6 Network and Application Design Guide*.

service
The TCP/IP service that is queried. If the value of the *service* parameter is a port number, you must specify the AI_NUMERICSERV flag. The value of the *service* parameter can be up to 32 bytes in length

flags
To specify multiple flags, code the *flags* parameter as a space-delimited string. The following flags are supported:

AI_PASSIVE
Specifies how to fill the returned socket NAME string. If this flag is set, the returned NAME string can be used with the BIND command to bind a socket for accepting new connection requests.

Rules:

- If the AI_PASSIVE flag is specified and the *node* parameter is not specified, the IP address portion of the NAME string is set to either the IPv4 address (INADDR_ANY) or to the IPv6 unspecified address (in6addr_any).
- If the AI_PASSIVE flag is not specified, then the returned NAME string can be used with the CONNECT or the SENDTO commands.
- If the AI_PASSIVE flag is not specified and the *node* parameter is not specified, the IP address portion of the NAME string is set to the default loopback address: 127.0.0.1 (IPv4) or ::1 (IPv6).

If you issue the following command:

```
src = socket("GETADDRINFO",,54123,"AI_PASSIVE","AF_UNSPEC")
```

Then the following string is returned:

```
0 '' AF_INET6 54123 0 ::0 0 AF_INET 54123 0.0.0.0
```

See example 2 in "Code example" on page 724 for one method of how to use this flag.

AI_CANONNAMEOK

Specifies that the canonical name that corresponds to the *node* parameter is returned. The *node* parameter must also be issued.

If you issue the following command:

```
src = socket("GETADDRINFO","chile",21,"AI_CANONNAMEOK")
```

Then the following string is returned:

```
0 host.department.com AF_INET 21 10.11.103.1
```

Tip: See "Code example" on page 724 for examples of how to use this flag.

AI_NUMERICHOST

If you specify this flag, the *node* parameter must be specified as an IP address, for example, 10.11.103.1. Otherwise, the command fails with a 1 EAI_NONAME return code.

If you issue the following command:

```
src = socket("GETADDRINFO","10.11.103.1",,"AI_NUMERICHOST")
```

Then the following string is returned:

```
0 '' AF_INET 0 10.11.103.1
```

AI_NUMERICSERV

If you specify this flag, you must specify the *service* parameter as a port number, for example, 1821. Otherwise, the command fails with a 1 EAI_NONAME return code.

If you issue the following command

```
src = socket("GETADDRINFO",,23,"AI_NUMERICSERV")
```

Then the following string is returned.

```
0 '' AF_INET6 23 0 ::1 0 AF_INET 23 127.0.0.1
```

AI_V4MAPPED

If you specify this flag and the family is AF_INET6 or AF_UNSPEC, the caller accepts IPv4-mapped IPv6 addresses.

Rules:

- When the AI_ALL flag is not specified and no IPv6 addresses are found, then a query is made for IPv4 addresses. Any IPv4 addresses that are found are returned as IPv4-mapped IPv6 addresses.
- If the value of the *family* parameter is not AF_INET6 or AF_UNSPEC, and if IPv6 is not supported on the system, then this flag is ignored.

If you issue the following command:

```
src = socket("GETADDRINFO","CHILE",,"AI_V4MAPPED AI_CANONNAMEOK");
```

Then the following string is returned:

```
0 host.department.com AF_INET6 0 0 ::FFFF:10.11.103.1 0
```

AI_ALL
If you specify this flag, the NAME strings that are returned depend on the value of the *family* parameter.

Rules:

- If this flag is specified and the value of the *family* parameter is AF_INET6, then the AI_V4MAPPED flag must also be set to indicate that both IPv4-mapped IPv6 addresses and IPv6-mapped IP addresses are acceptable.
- If value of the *family* parameter is AF_UNSPEC and the system supports IPv6, then two queries are made. The first query is for IPv6 addresses; if any are found, they are returned. The second query is for IPv4 addresses. If the AI_V4MAPPED flag is not specified, the IPv4 addresses are returned as IPv4 addresses. If the AI_V4MAPPED flag is specified, theIPv4 addresses are returned as IPv4-mapped IPv6 addresses.
- If the value of the *family* parameter is not AF_INET6 or AF_UNSPEC, and if the system supports IPv6, then this flag is ignored.

If you issue the following command:

```
src = socket("GETADDRINFO","CHILE",,,
"AI_ALL AI_V4MAPPED AI_CANONNAMEOK",,
"AF_UNSPEC");
```

The following string is returned (all on one line):

```
0 CHILE.department.com AF_INET6 0 0 ::FFFF:10.11.103.1 0
    AF_INET6 0 0 2001:10:11:103::1 0
```

AI_ADDRCONFIG
If you specify this flag, the node is queried if the resolver determines that one of the following conditions is true:

- The system is IPv6 enabled and has at least one IPv6 interface. In this case, the resolver makes a query for AAAA DNS records (IPv6).
- The system is IPv4 enabled and has at least one IPv4 interface. In this case, the resolver makes a query for A DNS records (IPv4).

The loopback address is not a valid interface for this flag.

AI_EXTFLAGS
If you specify this flag, the extended form of the getaddrinfo function is requested. The extended form allows additional hints to be passed to the resolver to determine the order of destination addresses that are returned. This flag only affects the order of IPv6 addresses that are returned, if any. If AI_EXTFLAGS flag is specified, the *eflags* parameter must be specified.

family
Limits the returned information to a specific address family. The following families are supported:

AF_UNSPEC
Any protocol family. The value 0 is accepted also.

AF_INET
IPv4 families. The value 2 is accepted also.

AF_INET6
IPv6 families. The value 19 is accepted also.

socktype
Limits the returned information to a specific socket type. If no socket type is specified, the command returns address information for all types. The following socket types are supported:

Type name	Decimal value	Description
SOCK_STREAM	1	Stream socket
SOCK_DGRAM	2	Datagram socket
SOCK_RAW	3	Raw-protocol interface

Consider the following points:

- If the value of the *socktype* parameter is set to any value other than SOCK_STREAM, SOCK_DGRAM, or SOCK_RAW, the GETADDRINFO command fails with a `9 EAI_SOCKTYPE` return code.
- If the value of the *socktype* parameter is SOCK_RAW, the value of the *service* parameter must be numeric.
- If the value of the *socktype* parameter is set to SOCK_STREAM or SOCK_DGRAM, then the resolver searches the services file for a service name.

If the *socktype* and *protocol* parameters are both specified as 0, then the GETADDRINFO command is processed in the following way:

- If the value of the *service* parameter is null or numeric, then any returned address information has the default *socktype* value of SOCK_STREAM.
- If the value of the *service* parameter is a service name, for example, FTP, then the GETADDRINFO command searches the appropriate services file twice. The first search uses SOCK_STREAM as the protocol, and the second search uses SOCK_DGRAM as the protocol. There is no default socket-type provision in this case.

If both the *socktype* and *protocol* parameters are specified as nonzero values, then the values must be compatible, regardless of the value specified by the *service* parameter. In this case, compatible means one of the following combinations of parameters:

- The *socktype* parameter is SOCK_STREAM and the *protocol* parameter is IPPROTO_TCP.
- The *socktype* parameter is SOCK_DGRAM and the *protocol* parameter is IPPROTO_UDP.
- The *socktype* parameter is SOCK_RAW, in which case the *protocol* parameter can have any value.

protocol
Limits the returned information to a specific protocol. The value 0 indicates that the caller accepts any protocol. The following protocols are supported:

Protocol name	Decimal value	Description
IPPROTO_TCP	6	TCP
IPPROTO_UDP	16	UDP

Consider the following points:

- If the *socktype* parameter is 0 and the *protocol* parameter is not 0, the only acceptable input values for the *protocol* parameter are IPPROTO_TCP and IPPROTO_UDP. If any other values are issued for the *protocol* parameter, the GETADDRINFO command fails with a `7 EAI_BADFLAGS` return code.
- If the *protocol* and *socktype* parameters are both specified as 0, then the GETADDRINFO command is processed in the following way:
  - If the *service* parameter value is null or numeric, then any returned address information assumes that the socket type is SOCK_STREAM.
  - If the *service* parameter is specified as a service name, for example, FTP, then the GETADDRINFO command searches the applicable services file twice. The first search uses the protocol SOCK_STREAM, and the second search uses the protocol SOCK_DGRAM. There is no default socket type provision in this case.
- If both the *protocol* and *socktype* parameters are specified as nonzero values, the values must be compatible, regardless of the value that is specified by the *service* parameter. In this context, compatible means one of the following combinations of parameters:
  - The *socktype* parameter is SOCK_STREAM and the *protocol* parameter is IPPROTO_TCP.
  - The *socktype* parameter is SOCK_DGRAM and the *protocol* parameter is IPPROTO_UDP.
  - The *socktype* parameter is SOCK_RAW, in which case the *protocol* parameter can have any value.
- If the lookup for the value specified by the *service* parameter fails (for example, the *service* name does not appear in the applicable services file), then the GETADDRINFO command fails with the `8 EAI_SERVICE` return code.

eflags

A fullword binary field that specifies the source IPv6 address selection preferences. If AI_EXTFLAGS flag is specified in FLAGS, this field is required. To specify multiple eflags, code the *eflags* parameter as a space-delimited string.

This field must have the value of 0 or of one or more of the following values:

IPV6_PREFER_SRC_HOME
Requests that resolver returns destination IPv6 addresses that can be reached by a home IPv6 source address before it returns destinations that can be reached by a care-of IPv6 source address. This is the default behavior if AI_EXTFLAGS flag is not specified.

IPV6_PREFER_SRC_COA
Requests that resolver returns destination IPv6 addresses that can be reached by a care-of IPv6 source address before it returns destinations that can be reached by a home IPv6 source address.

IPV6_PREFER_SRC_PUBLIC
Requests that resolver returns destination IPv6 addresses that can be reached by a public IPv6 source address before it returns destinations that can be reached by a temporary IPv6 source address.

IPV6_PREFER_SRC_TMP
Requests that the resolver returns destination IPv6 addresses that can be reached by a temporary IPv6 source address before it returns destinations that can be reached by a public IPv6 source address.

IPV6_PREFER_SRC_CGA
Requests that resolver returns destination IPv6 addresses that can be reached by a cryptographically generated IPv6 source address before it returns destinations that can be reached by a non-cryptographically generated IPv6 source address.

IPV6_PREFER_SRC_NONCGA
Requests that resolver returns destination IPv6 addresses that can be reached by a non-cryptographically generated IPv6 source address before it returns destinations that can be reached by a cryptographically generared IPv6 source address.

ZERO No preferences are specified.

Any EFLAGS specification other than the value of 0 or one of the options listed above causes an EINVALIDRXSOCKETCALL error to be returned.

If contradictory EFLAGS, for example, IPV6_PREFER_SRC_TMP and IPV6_PREFER_SRC_PUBLIC, are specified, the GETADDRINFO call returns EINVALIDCOMBINATION.

Returned value

The command returns a string that contains the return code, canonical name, and a NAME string or list of NAME strings. The return code can be 0, a REXX socket API error number, or the REXX TCP/IP error number that is set by the socket command. The return code 0 indicates that the requested socket command was completed successfully.

The following string is an example of what is returned by the GETADDRINFO command:

```
0 RALEIGH.IBM.COM name1 name2 name3
```

In the example, 0 is the return code, RALEIGH.IBM.COM is the canonical name, and `name1 name2 name3` is a list of NAME strings. Depending on the flags that were issued, these names can be IPv4 or IPv6 values.

Tip: For a description of the format of a socket name, see "CONNECT" on page 712 or "BIND" on page 707.

See Appendix B, "Socket call error return codes," on page 885 for additional information about the numeric error codes that are returned by this command.

The following REXX TCP/IP error numbers can be returned:

- 1 EAI_NONAME
- 2 EAI_AGAIN
- 5 EAI_FAIMLY
- 6 EAI_MEMORY
- 7 EAI_BADFLAGS
- 8 EAI_SERVICE
- 9 EAI_SOCKTYPE
- 9 EBADF
- 35 EWOULDBLOCK

The following REXX socket API error numbers can be returned:

- 2001 EINVALIDRXSOCKETCALL
- 2005 ESUBTASKNOTACTIVE
- 2006 ESOCKETNOTALLOCATED

LE C/C++ equivalent

```
int getaddrinfo(const char *nodename, const char *servname,
    const struct addrinfo *hints, struct addrinfo **res);
```

Code example

```
/* REXX EZARXR05 */
/*
 * This sample demonstrates a use of the GETADDRINFO command.
 * It is possible that the GETADDRINFO command will return
 * more then one name address. The program shows one
 * technique that can be used to parse the information
 * returned. After a successful connection has been established
 * the program will sends data to a server listeneing on port
 * 54777.  The program then waits for a reply.
 *
 * HINT: The program code provided under the IOCTL command can
 * be used as a server for this sample.
 *
 * GUIDELINE: It is generally recommended that a program loop around
 *            the RECV command to ensure that all data is read off
 *            the socket. This sample does not follow the guideline.
 */
src = socket("INITIALIZE","MYSET01",10);
if perror(src,"INITIALIZE") = 0 then do
   src = socket("SOCKET","AF_INET6","SOCK_STREAM");
   if perror(src,"SOCKET") \= 0 then signal ENDPROGRAM
   parse var src l_retcode l_sockid
   /* ************************************************
    * Issue GETADDRINFO command.  Request that all IPv6 address
    * information be returned, and if possible provide the
    * canon name. IPV4 addresses are to be mapped to
    * IPv6 mapped addresses. Names will be returned as AF_INET6
    * NAMES.
    * ************************************************/
   src = socket("GETADDRINFO","MVS150",54777,,
             "AI_ALL AI_CANONNAMEOK AI_NUMERICSERV",
             "AI_V4MAPPED","AF_INET6","SOCK_STREAM",,
             "IPPROTO_TCP");
   if perror(src,"GETADDRINFO") = 0 then do
      parse var src l_retcode l_canonname l_names
      l_LOCName = "AF_INET6 0 0 IN6ADDR_ANY 0";
      src = socket("BIND", l_sockid, l_LOCname);
      if perror(src,"BIND") \= 0 then signal ENDPROGRAM
      /* ************************************************
       * It is possible that GETADDRINFO returned multiple
       * name structures.  Cycle through them until a
       * successful connection is achived or none are left.
       * ************************************************/
      l_done = "FALSE";
      l_connectOK = "FALSE";
      do while l_names \= '' | l_done = "FALSE"
         if word(l_names,1) = "AF_INET6" then do
            parse var l_names .  l_port l_flow l_addr,
                                 l_scope l_names
            l_RMTname = "AF_INET6 "l_port" "l_flow" "l_addr,
                        ||" "l_scope;
         end; /* AF_INET6 */
         else do
            parse var l_names .  l_port l_addr l_names
            l_RMTname = "AF_INET "l_port" "l_addr;
```

```
         end; /* AF_INET */
         Say "Attempting connection using RMT NAME: ",
             l_RMTname;
         src = socket("CONNECT",l_sockid,l_RMTname);
         if perror(src,"CONNECT") = 0 then do
            Say "...Connected";
            l_connectOK = "TRUE";
            l_done = "TRUE";
         end; /* CONNECT */
         else do
            l_done = "TRUE";
         end;
      end; /* DO LOOP */
      if l_connectOK = "TRUE" then do
         l_data = time() "**** **** **** **** ";
         src = socket("GETSOCKNAME",l_sockid);
         Say "GETSOCKNAME: "src;
         src = socket("SEND",l_sockid,l_data);
         if perror(src,"SEND") = 0 then do
            src = socket("RECV",l_sockid);
            if perror(src,"RECV") = 0 then do
               parse var src .  l_amtdata l_data
               Say "Received " l_amtdata " bytes from ",
                   l_addr " on" port " l_port";
               Say "The received data is: "l_data;
            end; /* RECV */
         end; /* SEND */
      end;  /* CONNECT OK */
      else do /* CONNECT not OK */
         say "No Connection to remote host could be",
             "establisthed";
      end;
   end; /* GETADDRINFO */
end; /* INITIALIZE */

ENDPROGRAM:
src=socket("CLOSE",l_sockid);
src=perror(src,"CLOSE");
src=socket("TERMINATE","MYSET01");
src=perror(src,"TERMINATE");
exit 0;

/* This routine returns -1 if the first word if arg 1 is not zero */
perror: if word(arg(1),1) = 0 then return 0; else
    Say arg(2) "Error : "arg(1);
    return -1;
```

```
/* REXX EZARXR32 */
/*
 * This example shows how to use the GETADDRINFO command
 * to obtain a list of NAME constructs suitable for
 * use with the BIND command using the well-known port 54123.
 * The addr fields of the NAME constructs returned will be
 * set to
 *
 * This example also shows how to use the SELECT command to
 * monitor listening sockets for for new connections.
 *
 * In the case of 2 name constructs being returned the
 * first successful bind will be used.
 *
 * HINT: To limit the NAME structures to a specific
 *       Address family change AF_UNSPEC to either
 *       AF_INET or AF_INET6
 *
 * HINT: Coding a hostname for the node paramter will result
 *       in the ipaddress fields of the NAME constructs to
```

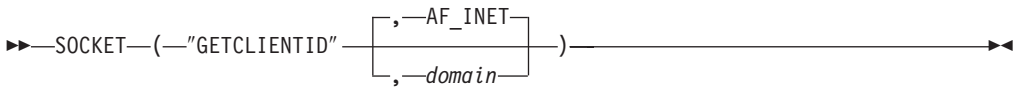
```
 *       have a specific interface address assigned.
 *
 */

l_selectlist = '';
src = socket("INITIALIZE","MYSET01");
src = socket("GETADDRINFO",,54123,"AI_PASSIVE",
             "AI_CANONNAMEOK","AF_UNSPEC");
parse var src l_retcode l_canname l_names
l_bindok = "FALSE";
Say "Canonname returned is: "l_canname;
do while l_names \= ''
   select
      when word(l_names,1) = "AF_INET" then do
         l_SockName = word(l_names,1) word(l_names,2),
                      word(l_names,3)
         l_names = subword(l_names,4);
      end;
      when word(l_names,1) = "AF_INET6" then do
         l_SockName = word(l_names,1) word(l_names,2),
                      word(l_names,3) word(l_names,4),
                      word(l_names,5);
         l_names = subword(l_names,6);
      end;
      otherwise
         l_sockname = "unknown";
   end;
   src=socket("SOCKET",word(l_sockname,1),"STREAM");
   if word(src,1) = 0 then do
      l_socket = word(src,2);
      src = socket("BIND",l_socket1,l_sockname);
      if word(src,1) = 0 then do
         src = socket("LISTEN",l_socket);
         if word(src,1) = 0 then do
            Say "Listening on socket: "l_sockname;
            l_selectlist = l_selectlist" "l_socket;
            l_bindOK = "TRUE";
         end;
      end;
   end;
end;
if l_selectlist \= 0 then do
   Say "The following sockets will be monitored" l_selectlist;
   l_fdset = "READ "l_selectlist" WRITE EXCEPTION";
   src = socket("SELECT",l_fdset,0);
   if word(src,1) = 0 & word(src,2) \= 0 then do
      l_socklist = subword(src,3);
      do while l_socklist \= ''
         parse var l_socklist l_sockid l_socklist
         src = socket("ACCEPT",l_sockid);
         if word(src,1) = 0 then do
            l_newsock = word(src,2);
            /*
             * DO SOME STUFF WITH l_newsock
             *
             */
            src = socket("CLOSE",l_newsock);
         end;
      end;
   end;
   src = socket("CLOSE",word(l_selectlist,1));
   src = socket("CLOSE",word(l_selectlist,2));
end;
src = socket("TERMINATE","MYSET01");
exit word(src,1);
```

GETCLIENTID

Use the GETCLIENTID command to retrieve the client ID for the calling application. The client ID is the identifier by which the calling application is known to the TCP/IP address space.

Tip: The client ID that is returned by the GETCLIENTID command can be used with the GIVESOCKET and TAKESOCKET commands.

Format



Parameters

domain

The domain. This parameter is optional for IPv4, but it is required for IPv6. If this parameter is not specified, by default, the *domain* parameter is set to AF_INET. The following domain values are supported:

- AF_UNSPEC or 0
- AF_INET or 2
- AF_INET6 or 19

Returned value

The command returns a string that contains the return code and the application identifier. The return code can be 0 or the REXX API error number. The return code 0 indicates that the requested socket command was completed successfully.

The application identifier has the following format:

```
clientid = domain userid socketset
```

The following examples show what is returned for the specific address families:

IPv4 `0 AF_INET IBMUSER SOCSET01`

IPv6 `0 AF_INET6 IBMUSER SOCSET01`

See Appendix B, "Socket call error return codes," on page 885 for additional information about the numeric error codes that are returned by this command.

The following REXX socket API error numbers can be returned:

- 2001 EINVALIDRXSOCKETCALL
- 2005 ESUBTASKNOTACTIVE
- 2013 EINVALIDCLIENTID

LE C/C++ equivalent

```
int getclientid(int domain, struct clientid *clientid);
```

Code example

```
/* REXX EZARXR06 */
/*
 * This sample demonstrates the use of the GETCLIENTID
 * socket command.
 */
src = socket("INITIALIZE","MYSET01");
if perror(src,"INITIALIZE") \= 0 then signal ENDPROGRAM;
src = socket("GETCLIENTID");
Say src;

ENDPROGRAM:
src = socket("TERMINATE","MYSET01");
src = perror(src,"TERMINATE");

exit 0;

/* This routine returns -1 if the first word if arg 1 is not zero */
perror: if word(arg(1),1) = 0 then return 0; else
    Say arg(2) "Error : "arg(1);
    return -1;
```

Figure 143. GETCLIENTID command example

GETDOMAINNAME

Use the GETDOMAINNAME command to retrieve the name of the domain to which the current TCP/IP stack belongs.

Tip: You can use a resolver trace to determine why a resolver command failed. See *z/OS Communications Server: IP Diagnosis Guide*.

Format

Parameters

This command has no parameters.

Returned value

The command returns a string that contains the return code and the domain, for example, `0 RALEIGH.IBM.COM`.

See Appendix B, "Socket call error return codes," on page 885 for additional information about the numeric error codes that are returned by this command.

The following REXX socket API error number can be returned:

- 2005 ESUBTASKNOTACTIVE

LE C/C++ equivalent

This command has no LE C/C++ equivalent.

Code example

```
/* REXX EZARXR07 */
/*
 * This sample demonstrates the use of the GETDOMAINNAME
 * socket command.
 */
src = socket("INITIALIZE","MYSET01");
if perror(src,"INITIALIZE") = 0 then do
   Say socket("GETDOMAINNAME");
end;

src = socket("TERMINATE","MYSET01");
src = perror(src,"TERMINATE");
exit 0;

/* This routine returns -1 if the first word if arg 1 is not zero */
perror: if word(arg(1),1) = 0 then return 0; else
    Say arg(2) "Error : "arg(1);
    return -1;
```

Figure 144. GETDOMAINNAME command example

GETHOSTBYADDR

Use the GETHOSTBYADDR command to resolve an IPv4 address to a host name.

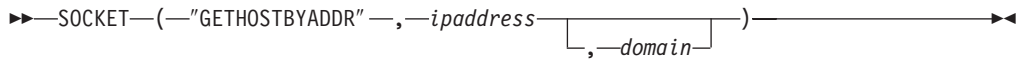
This command uses a domain name system (DNS) server. If the IP address is not resolved by the DNS server, then the resolver searches the local hosts tables. For information about the local host tables, see *z/OS Communications Server: IP Configuration Guide*.

Restriction: This command does not support IPv6 addresses.

Tips:

- Use either the GETADDRINFO or GETNAMEINFO command to resolve a IPv6 address to a host name.
- You can use a resolver trace to determine why a resolver command failed. See *z/OS Communications Server: IP Diagnosis Guide*.

Format



Parameters

ipaddress
The IP address of the remote host.

domain
The network domain to which the IP address belongs. The only supported domain is AF_INET or 2.

Returned value

This command returns a string that contains the return code and the host name, for example, `0 ABCD.RALEIGH.IBM.COM`. The return code can be 0 or the REXX API error number. The return code 0 indicates that the requested socket command was completed successfully.

See Appendix B, "Socket call error return codes," on page 885 for additional information about the numeric error codes that are returned by this command.

The following REXX socket API error numbers can be returned:

- 2001 EINVALIDRXSOCKETCALL
- 2005 ESUBTASKNOTACTIVE
- 2017 EIPADDRNOTFOUND

LE C/C++ equivalent

```
struct hostent *gethostbyaddr(char *address,
       int address_len, int domain);
```

Code example

```
/* REXX EZARXR08 */
/*
 * This sample demonstrates the use of the GETHOSTBYADDR
 * socket command.
 */
src = socket("INITIALIZE","MYSET01");
if perror(src,"INITIALIZE") = 0 then do
   Say socket("GETHOSTBYADDR","128.123.222.1");
end;

src = socket("TERMINATE","MYSET01");
src = perror(src,"TERMINATE");
exit 0;

/* This routine returns -1 if the first word if arg 1 is not zero */
perror: if word(arg(1),1) = 0 then return 0; else
    Say arg(2) "Error : "arg(1);
    return -1;
```

Figure 145. GETHOSTBYADDR command example

GETHOSTBYNAME

Use the GETHOSTBYNAME command to resolve a host name to an IPv4 address.

This command uses a DNS server. Any trailing blanks are removed from the host name. If the host is multi-homed, then this command returns a list of the space-delimited IP addresses that are associated with the host name. If the host name is not resolved by the DNS server, then the resolver searches the local hosts tables. For information about the local host tables, see *z/OS Communications Server: IP Configuration Guide*.

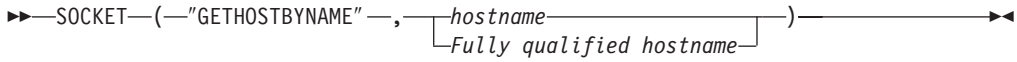
Restriction: This command does not support IPv6 addresses.

Tips:

- Use either the GETADDRINFO or GETNAMEINFO command to resolve a IPv6 address to a host name.

- You can use a resolver trace to determine why a resolver command failed. See *z/OS Communications Server: IP Diagnosis Guide*.

Format



Parameters

hostname
The name of the remote host. The parameter cannot be longer than 255 characters.

Fully qualified hostname
The fully qualified name of the host in the format *hostname.domainname*. The parameter cannot be longer than 255 characters.

Returned value

This command returns string that contains the return code and one or more space-delimited IPv4 addresses, for example, `0 1.2.3.4 5.4.3.2 1.2.3.5`. The return code can be 0 or the REXX API error number. The return code 0 indicates that the requested socket command was completed successfully.

See Appendix B, "Socket call error return codes," on page 885 for additional information about the numeric error codes that are returned by this command.

The following REXX socket API error numbers can be returned:

- 2001 EINVALIDRXSOCKETCALL
- 2005 ESUBTASKNOTACTIVE
- 2016 EHOSTNOTFOUND
- 2019 ENORECOVERY

LE C/C++ equivalent

```
struct hostent *gethostbyname(char *name);
```

Code example

```
/* REXX EZARXR09 */
/*
 * This sample demonstrates the use of the GETHOSTBYNAME
 * socket command.
 */
src = socket("INITIALIZE","MYSET01");
if perror(src,"INITIALIZE") = 0 then do
   Say socket("GETHOSTBYNAME", "MYCOMPANY");
   Say socket("GETHOSTBYNAME", "MYCOMPANY.somewhere.com");
end;

src = socket("TERMINATE","MYSET01");
src = perror(src,"TERMINATE");
exit 0;

/* This routine returns -1 if the first word if arg 1 is not zero */
perror: if word(arg(1),1) = 0 then return 0; else
    Say arg(2) "Error : "arg(1);
    return -1;
```

Figure 146. GETHOSTBYNAME command example

GETHOSTID

Use the GETHOSTID command to return the primary IPv4 address for the current host. The primary address is the IP address of the default home address that is specified in the TCP/IP configuration file for the stack with which the current socket set is associated.

Restriction: This command does not support IPv6 addresses.

Format

Parameters

This command has no parameters.

Returned value

This command returns a string that contains the return code and the primary IPv4 address of the host, for example, "0 10.11.103.1". The return code can be 0 or the REXX API error number. The return code 0 indicates that the requested socket command was completed successfully.

See Appendix B, "Socket call error return codes," on page 885 for additional information about the numeric error codes that are returned by this command.

The following REXX socket API error numbers can be returned:

- 2001 EINVALIDRXSOCKETCALL
- 2005 ESUBTASKNOTACTIVE
- 2016 EHOSTNOTFOUND
- 2019 ENORECOVERY

LE C/C++ equivalent

```
int gethostid();
```

Code example

```
/* REXX EZARXR10 */
/*
 * This sample demonstrates the use of the GETHOSTID
 * socket command.
 */
src = socket("INITIALIZE","MYSET01");
if perror(src,"INITIALIZE") = 0 then do
   say socket("GETHOSTID");
end;
src = socket("TERMINATE","MYSET01");
src = perror(src,"TERMINATE");
exit 0;

/* This routine returns -1 if the first word if arg 1 is not zero */
perror: if word(arg(1),1) = 0 then return 0; else
    Say arg(2) "Error : "arg(1);
    return -1;
```

Figure 147. GETHOSTID command example

GETHOSTNAME

Use the GETHOSTNAME command to return the name of the host on which the application is running.

Format

Parameters

This command has no parameters.

Returned value

This command returns a string that contains the return code and the name of the host system, for example, `0 MYHOST01`. If the host name is longer than 256 bytes, it is truncated. The return code can be 0, a REXX socket API error number, or the REXX TCP/IP error number that is set by the socket command. The return code 0 indicates that the requested socket command was completed successfully.

See Appendix B, "Socket call error return codes," on page 885 for additional information about the numeric error codes that are returned by this command.

The following REXX TCP/IP error number can be returned:

- 2018 ETRYAGAIN

The following REXX socket API error number can be returned:

- 2005 ESUBTASKNOTACTIVE

LE C/C++ equivalent

```
rc = int gethostname(char *name, size_t namelen);
```

Code example

```
/* REXX EZARXR11 */
/*
 * This sample demonstrates the use of the GETHOSTNAME
 * socket command.
 */
src = socket("INITIALIZE","MYSET01");
if perror(src,"INITIALIZE") = 0 then do
   src = socket("GETHOSTNAME");
   Say "Host name is: "WORD(src,2);
end;
src = socket("TERMINATE","MYSET01");
src = perror(src,"TERMINATE");
exit 0;

/* This routine returns -1 if the first word if arg 1 is not zero */
perror: if word(arg(1),1) = 0 then return 0; else
    Say arg(2) "Error : "arg(1);
    return -1;
```

Figure 148. GETHOSTNAME command example

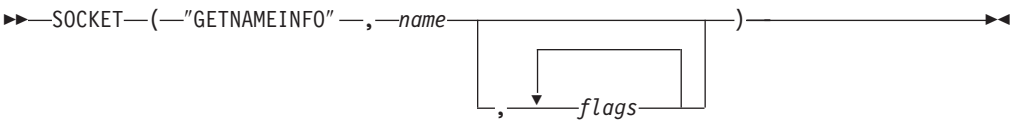
GETNAMEINFO

Use the GETNAMEINFO command to translate a socket address to a node name and service location.

This command can be used for both IPv4 or IPv6 socket addresses.

Tip: You can use a resolver trace to determine why a resolver command failed. See *z/OS Communications Server: IP Diagnosis Guide*.

Format



Parameters

name

An IPv4 or IPv6 NAME string. If the NAME string is an IPv4-mapped IPv6 address, then the embedded IPv4 address is extracted; then, the lookup is performed on the IPv4 address. If the NAME string is an IPv6 unspecified address, the lookup is not performed and the 1 `EAI_NONAME` error code is returned.

The format for the *name* parameter depends on the socket type:

AF_INET sockets (IPv4)
name = "domain portid ipaddress"

AF_INET6 sockets (IPv6)
name = "domain portid flowinfo ipaddress scopeid"

where

- The *domain* value is the decimal number 2 for AF_INET and the decimal number 19 for AF_INET6.
- The *portid* value is the port number.

- The *ipaddress* value is the IP address of the remote host. It must be an IPv4 address for AF_INET and an IPv6 address for AF_INET6.
- The *flowinfo* value must be 0.
- The *scopeid* value identifies the interfaces that are applicable for the scope of the address that is specified in the *ipaddress* field. For a link-local IP address, the *scopeid* field can specify a link index, which identifies a set of interfaces. For all other scopes, the *scopeid* field must be set to 0. Setting the *scopeid* field to 0 indicates that any address type and scope can be specified.

If the *scopeid* field is specified and the destination is not a link-local address, the resolver ignores the *scopeid* field.

flags
An optional parameter that specifies the type of information that is returned. Separate multiple flags with spaces. If no flag is issued, the fully qualified host name is returned. The following flags are supported:

NI_NOFQDN
Returns the host name of the fully qualified domain name.

NI_NUMERICHOST
Returns only the numeric form of the host address.

NI_NAMEREQD
Returns an error if the host name cannot be found.

NI_NUMERICSERV
Returns the numeric form of the service.

NI_DGRAM
Indicates that the service query is for a datagram socket. If this flag is not issued, the GETNAMEINFO command assumes that the query is for a stream socket.

NI_NUMERICSCOPE
Returns only the numeric form of the *scopeid* interface index.

Returned value

This command returns a string that contains the return code, the host name, and the service. The return code can be 0, a REXX socket API error number, or the REXX TCP/IP error number that is set by the socket command. The return code 0 indicates that the requested socket command was completed successfully.

If a link-local IPv6 address is passed as input and the value of the *scopeid* parameter is not 0, then scope information is appended to the host name, using the format *host name%scope information*. For more information about scope information and the GETNAMEINFO command, see *z/OS Communication Server: IPv6 Network and Application Design Guide*.

The following string is an example of what is returned by the GETNAMEINFO command:

```
0 BOB01.THEWORLD.COM%23 echo
```

In the example, 0 is the return code, BOB01.THEWORLD.COM is the host name, 23 is the scope ID, and echo denotes the service. The numeric scope information is returned only if the NI_NUMERICSCOPE flag is issued.

For information about the format of the NAME string, see "How structures are represented" on page 698. See Appendix B, "Socket call error return codes," on page 885 for additional information about the numeric error codes that are returned by this command.

The following REXX TCP/IP error numbers can be returned:

- 1 EAI_NONAME
- 5 EAI_FAMILY
- 7 EAI_BADFLAGS

The following REXX socket API error numbers can be returned:

- 2001 EINVALIDRXSOCKETCALL
- 2005 ESUBTASKNOTACTIVE

LE C/C++ equivalent

```
int getnameinfo(cons struct sockaddr *sa, socklen_t salen,
         char *host, socklen_t hostlen, char *serv, socklen_t servlen,
         int flags);
```

Code example

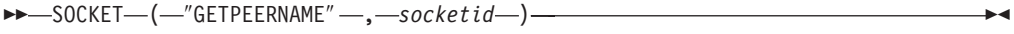
```
/* REXX EZARXR13 */
/*
 * This sample demonstrates the use of the GETNAMEINFO
 * socket command.
 */
src = socket("INITIALIZE","MYSET01");
if perror(src,"INITIALIZE") = 0 then
   Say socket("GETNAMEINFO", "AF_INET6 21 0 2000:197:11:103::1 0");
src = socket("TERMINATE","MYSET01");
src = perror(src,"TERMINATE");
exit 0;

/* This routine returns -1 if the first word if arg 1 is not zero */
perror: if word(arg(1),1) = 0 then return 0; else
    Say arg(2) "Error : "arg(1);
    return -1;
```

Figure 149. GETNAMEINFO command example

GETPEERNAME

Use the GETPEERNAME command to return the name of the remote peer that is connected to the socket.

Format



Parameters

socketid
The socket descriptor

Returned value

This command returns a string that contains the return code and the name of the remote peer, for example, `0 NAME`. The return code can be 0, a REXX socket API

error number, or the REXX TCP/IP error number that is set by the socket command. The return code 0 indicates that the requested socket command was completed successfully.

For information about the format of the NAME string, see "How structures are represented" on page 698. See Appendix B, "Socket call error return codes," on page 885 for additional information about the numeric error codes that are returned by this command.

Returned value

The following REXX TCP/IP error numbers can be returned:

- 9 EBADF
- 38 ENOTSOCK
- 45 EOPNOTSUPP
- 57 ENOTCONN

The following REXX socket API error numbers can be returned:

- 2001 EINVALIDRXSOCKETCALL
- 2005 ESUBTASKNOTACTIVE
- 2009 ESOCKETNOTDEFINED
- 2012 EINVALIDNAME

LE C/C++ equivalent

```
int getpeername(int socket, struct sockaddr *name, int *namelen);
```

Code example

```
/* REXX EZARXR14 */
/*
 * This sample demonstrates the use of the GETPEERNAME
 * socket command.
 */
src = socket("INITIALIZE","MYSET01");
if perror(src,"INITIALIZE") = 0 then do
   src = socket("SOCKET","AF_INET","STREAM");
   if perror(src,"SOCKET") = 0 then do
      l_socketid = word(src,2);
      l_RMTName = "AF_INET 7 127.0.0.1";
      src = socket("CONNECT",l_socketid,l_RMTName);
      if perror(src,"CONNECT") = 0 then do
         src = socket("GETPEERNAME",l_socketid);
         if perror(src,"GETPEERNAME") = 0 then do
            l_PeerName = Subword(src,2);
            say "The remote peer is: "l_PeerName;
         end;
      end;
   end;
   src = perror(socket("CLOSE",l_socketid),"CLOSE");
end;
src = perror(socket("TERMINATE","MYSET01"),"TERMINATE");
exit 0;

/* This routine returns -1 if the first word if arg 1 is not zero */
perror: if word(arg(1),1) = 0 then return 0; else
    Say arg(2) "Error : "arg(1);
    return -1;
```

Figure 150. GETPEERNAME command example

GETPROTOBYNAME

Use the GETPROTOBYNAME command to translate a network protocol name to a protocol number.

Format

Parameters

protocolname
The name of the network protocol

Returned value

This command returns a string that contains the return code and the protocol number, for example, `0 6`. The return code can be 0 or the REXX API error number. The return code 0 indicates that the requested socket command was completed successfully.

See Appendix B, "Socket call error return codes," on page 885 for additional information about the numeric error codes that are returned by this command.

The following REXX socket API error numbers can be returned:

- 2001 EINVALIDRXSOCKETCALL
- 2005 ESUBTASKNOTACTIVE

LE C/C++ equivalent

```
struct protoent *getprotobyname(char name);
```

Code example

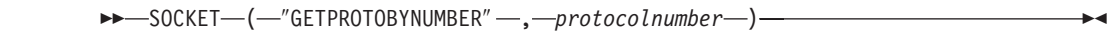
```
/* REXX EZARXR15 */
/*
 * This sample demonstrates the use of the GETPROTOBYNAME
 * socket command.
 */
if perror(socket("INITIALIZE","MYSET01"),"INITIALIZE") = 0,
   then do
     src = socket("GETPROTOBYNAME","TCP");
     Say "The TCP protocol is assigned the number of",
         WORD(src,2);
   end;
src = perror(socket("TERMINATE","MYSET01"),"TERMINATE");
exit 0;

/* This routine returns -1 if the first word if arg 1 is not zero */
perror: if word(arg(1),1) = 0 then return 0; else
    Say arg(2) "Error : "arg(1);
    return -1;
```

Figure 151. GETPROTOBYNAME command example

GETPROTOBYNUMBER

Use the GETPROTOBYNUMBER command to translate a network protocol number to a protocol name.

Format



Parameters

protocolnumber
The number of the network protocol

Returned value

This command returns a string that contains the return code and the protocol name, for example, `0 TCP`. The return code can be 0 or the REXX API error number. The return code 0 indicates that the requested socket command was completed successfully.

See Appendix B, "Socket call error return codes," on page 885 for additional information about the numeric error codes that are returned by this command.

The following REXX socket API error numbers can be returned:

- 2001 EINVALIDRXSOCKETCALL
- 2005 ESUBTASKNOTACTIVE

LE C/C++ equivalent

```
struct protoent *getprotobynumber(int proto);
```

Code example

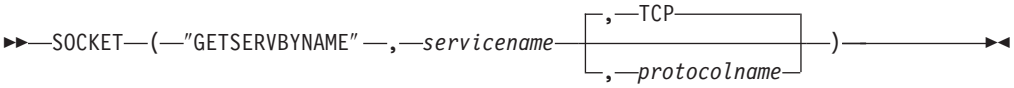
```
/* REXX EZARXR16 */
/*
 * This sample demonstrates the use of the GETPROTOBYNUMBER
 * socket command.
 */
if perror(socket("INITIALIZE","MYSET01"),"INITIALIZE") = 0,
   then do
   src = socket("GETPROTOBYNUMBER","6");
   Say "The name assigned to protocol 6 is "WORD(src,2);
end;
src = perror(socket("TERMINATE","MYSET01"),"TERMINATE");
exit 0;

/* This routine returns -1 if the first word if arg 1 is not zero */
perror: if word(arg(1),1) = 0 then return 0; else
    Say arg(2) "Error : "arg(1);
    return -1;
```

Figure 152. GETPROTOBYNUMBER command example

GETSERVBYNAME

Use the GETSERVBYNAME command to retrieve a service and port number.

Format



Parameters

servicename
The service name.

protocolname
The name of a network protocol, for example, TCP or UDP. By default, the *protocolname* parameter is set to TCP.

Returned value

This command returns a string containing the return code, service name, the port number that the service is using, and the network protocol, for example, `0 FTP 21 TCP`. The return code can be 0 or the REXX API error number. The return code 0 indicates that the requested socket command was completed successfully.

See Appendix B, "Socket call error return codes," on page 885 for additional information about the numeric error codes that are returned by this command.

The following REXX socket API error numbers can be returned:

- 2001 EINVALIDRXSOCKETCALL
- 2005 ESUBTASKNOTACTIVE

LE C/C++ equivalent

```
struct servent *getservbyname(char *name, char *proto);
```

Code example

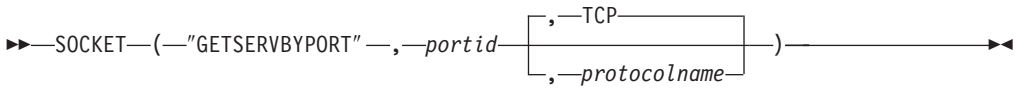
```
/* REXX EZARXR17 */
/*
 * This sample demonstrates the use of the GETSERVBYNAME
 * socket command.
 */
if perror(socket("INITIALIZE","MYSET01"),"INITIALIZE") = 0,
   then do
   src = socket("GETSERVBYNAME","FTP");
   Say "The FTP service is assigned "SUBWORD(src,2);
end;
src = perror(socket("TERMINATE","MYSET01"),"TERMINATE");
exit 0;

/* This routine returns -1 if the first word if arg 1 is not zero */
perror: if word(arg(1),1) = 0 then return 0; else
    Say arg(2) "Error : "arg(1);
    return -1;
```

Figure 153. GETSERVBYNAME command example

GETSERVBYPORT

Use the GETSERVBYPORT command to translate a port number to the name of the service that is using the port.

Format



Parameters

portid
The port number of the service

protocolname
The name of a network protocol, for example, TCP or UDP. By default, the *protocolname* parameter is set to TCP.

Returned value

This command returns a string that contains the return code, service name, the port number that the service is using, and the network protocol, for example, `0 FTP 21 TCP`. The return code can be 0 or the REXX API error number. The return code 0 indicates that the requested socket command was completed successfully.

See Appendix B, "Socket call error return codes," on page 885 for additional information about the numeric error codes that are returned by this command.

The following REXX socket API error numbers can be returned:

- 2001 EINVALIDRXSOCKETCALL
- 2005 ESUBTASKNOTACTIVE

LE C/C++ equivalent

```
struct servent *getservbyport(int port, char *proto);
```

Code example

```
/* REXX EZARXR18 */
/*
 * This sample demonstrates the use of the GETSERVBYPORT
 * socket command.
 */
if perror(socket("INITIALIZE","MYSET01"),"INITIALIZE") = 0,
   then do
   src = socket("GETSERVBYPORT","21");
   Say "Port 21 is using service "SUBWORD(src,2);
end;
src = perror(socket("TERMINATE","MYSET01"),"TERMINATE");
exit 0;

/* This routine returns -1 if the first word if arg 1 is not zero */
perror: if word(arg(1),1) = 0 then return 0; else
    Say arg(2) "Error : "arg(1);
    return -1;
```

Figure 154. GETSERVBYPORT command example

GETSOCKNAME

Use the GETSOCKNAME command to retrieve the name of a bound socket.

Stream sockets are not assigned a name until after a successful BIND, CONNECT, or ACCEPT command is completed.

Tip: Use this command to discover the port number that is assigned to a socket after the socket has been implicitly bound, for example, after a CONNECT command has been completed.

Format

Parameters

socketid
The socket descriptor

Returned value

This command returns a string that contains the return code and the NAME string of the bound socket, for example, `0 AF_INET6 7 0 2001:197:11:103::1 0`. The return code can be 0, a REXX socket API error number, or the REXX TCP/IP error number that is set by the socket command. The return code 0 indicates that the requested socket command was completed successfully.

For information about the format of the NAME string, see "How structures are represented" on page 698. See Appendix B, "Socket call error return codes," on page 885 for additional information about the numeric error codes that are returned by this command.

The following REXX TCP/IP error numbers can be returned:

- 9 EBADF
- 38 ENOTSOCK

- 45 EOPNOTSUPP
- 57 ENOTCONN

The following REXX socket API error numbers can be returned:

- 2001 EINVALIDRXSOCKETCALL
- 2005 ESUBTASKNOTACTIVE
- 2009 ESOCKETNOTDEFINED
- 2012 EINVALIDNAME

LE C/C++ equivalent

```
int getsockname(int socket, struct sockaddr *name, int *namelen);
```

Code example

```
/* REXX EZARXR19 */
/*
 * This sample demonstrates the use of the GETSOCKNAME
 * socket command. After the remote peer is obtained
 * send is echoed to the remote server.
 *
 * GUIDELINE: It is generally recommended that a program loop around
 *            the RECV command to ensure that all data is read off
 *            the socket. This sample does not follow the guideline.
 */
src = socket("INITIALIZE","MYSET01");
if perror(src,"INITIALIZE") = 0 then do
   src = socket("SOCKET","AF_INET","STREAM");
   if perror(src,"SOCKET") = 0 then do
      l_socketid = WORD(src,2);
      l_RMTname = "AF_INET 7 127.0.0.1";
      src = socket("CONNECT",l_socketid,l_RMTname);
      if perror(src,"CONNECT") = 0 then do
         src = socket("GETSOCKNAME",l_socketid);
         if perror(src,"GETSOCKNAME") = 0 then do
            l_LOCname = SUBWORD(src,2);
            Say "The local socket name is: "l_LOCName;
         end;
         src = socket("SEND",l_socketid,"*******");
         if perror(src,"SEND") = 0 then do
            src = socket("RECV",l_socketid);
            if perror(src,"RECV") = 0 then
               Say "Echoed data: " word(src,3);
         end;
      end;
   end;
end;
src = perror(socket("TERMINATE","MYSET01"),"TERMINATE");
exit 0;

/* This routine returns -1 if the first word if arg 1 is not zero */
perror: if word(arg(1),1) = 0 then return 0; else
    Say arg(2) "Error : "arg(1);
    return -1;
```

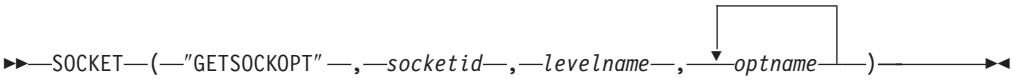
Figure 155. GETSOCKNAME command example

GETSOCKOPT

Use the GETSOCKOPT command to retrieve the active socket options that were set by the SETSOCKOPT command.

You can specify multiple options with this command; however, at least one option is required.

Format



Parameters

socketid
The local socket descriptor.

levelname
The protocol level. The following protocol levels are supported:

IPPROTO_TCP
Retrieve the socket options that are set at the TCP layer

IPPROTO_IP
Retrieve the IPv4 socket options that are set at the IP layer

IPPROTO_IPV6
Retrieve the IPv6 socket options that are set at the IP layer

SOL_SOCKET
Retrieve the socket options that are set at the socket layer

optname
The option to be retrieved. The options that can be retrieved depend on the value of the *levelname* parameter.

The following rules apply:

- Options that begin with SO_ require the SOL_SOCKET protocol level.
- Options that begin with TCP_ require the IPPROTO_TCP protocol level.
- Options that begin with IP_ require the IPPROTO_IP protocol level.
- Options that begin with IPV6_ require the IPPROTO_IPV6 protocol level.

The following values are supported for the *optname* parameter:

IP_MULTICAST_IF
(IPv4-only) Retrieves the IPv4 interface address that is used to send outbound multicast datagrams from the socket application. When you specify this option, the GETSOCKOPT command returns a string that contains the return code and interface address, for example, `0 10.11.103.1`.

IP_MULTICAST_LOOP
(IPv4-only) Determines what occurs when datagrams are sent to a group to which the sending host belongs. If this option is enabled, the IP layer loops back a copy of multicast datagrams for local delivery. By default, this option is enabled. When you specify this option, the GETSOCKOPT command returns either 1 (enabled) or 0 (disabled).

IP_MULTICAST_TTL
(IPv4-only) Retrieves the IP time-to-live of outgoing multicast datagrams. By default, this option is set to the binary value '01'x, which means that multicast is available to the local subnet only. When

you specify this option, the GETSOCKOPT command returns a string that contains the return code and a value in the range 0-255, for example, `0 227`.

IPV6_ADDR_PREFERENCES
(AF_INET6 only) Retrieves the IPv6 address preferences to be used when selecting the source address.The IPV6_ADDR_PREFERENCES flags that are returned can be one or more of the following values:

IPV6_PREFER_SRC_HOME
A home IPv6 address is preferred over a care-of IPv6 address.

IPV6_PREFER_SRC_COA
A care-of IPv6 address is preferred over a home IPv6 address.

IPV6_PREFER_SRC_TMP
A temporary IPv6 address is preferred over a public IPv6 address.

IPV6_PREFER_SRC_PUBLIC
A public IPv6 address is preferred over a temporary IPv6 address.

IPV6_PREFER_SRC_CGA
A cryptographically generated IPv6 address is preferred over a non-cryptographically generated IPv6 address.

IPV6_PREFER_SRC_NONCGA
A non-cryptographically generated IPv6 address is preferred over a cryptographically generated IPv6 address.

IPV6_MULTICAST_HOPS
(IPv6-only) Retrieves the hop limit used for outgoing multicast packets. When you specify this option, the GETSOCKOPT command returns a string that contains the return code and the hop limit, which is a number in the range 0-255.

IPV6_MULTICAST_IF
(IPv6-only) Retrieves the index of the IPv6 interface that is used to send outbound multicast datagrams from the socket application. When you specify this option, the GETSOCKOPT command returns a string that contains the return code and the IPv6 interface index, for example, `0 1523`.

IPV6_MULTICAST_LOOP
(IPv6-only) Determines what occurs when datagrams are sent to a group to which the sending host belongs. If this option is enabled, the IP layer loops back a copy of multicast datagrams for local delivery. By default, this option is enabled. When you specify this option, the GETSOCKOPT command returns either 1 (enabled) or 0 (disabled).

IPV6_UNICAST_HOPS
(IPv6-only) Retrieves the hop limit used for outgoing unicast IPv6 packets. When you specify this option, the GETSOCKOPT command returns a string that contains the return code and the hop limit, which is a number in the range 0-255.

IPV6_V6ONLY
(IPv6-only) Determines whether the socket is restricted to sending or receiving IPv6 packets only. By default, a socket is not restricted. When you specify this option, the GETSOCKOPT command returns a string that contains the return code and a number: 1 (enabled) or 0 (disabled).

SO_ASCII

(REXX only) Determines whether all incoming data is translated from ASCII to EBCDIC, and whether all outgoing data is translated from EBCDIC to ASCII. This option returns a string that contains the error code and either ON (enabled) or OFF (disabled). If the option is enabled, the name of the translation table is returned also. The following string is an example of what might be returned: `0 ON MYTRANTB`.

The translation tables are searched in the following order:

1. *user_prefix*.*subtaskid*.TCPXLBIN
2. *user_prefix*.*userid*.TCPXLBIN
3. *system_prefix*.STANDARD.TCPXLBIN
4. *system_prefix*.RXSOCKET.TCPXLBIN
5. Internal tables

The following descriptions apply:

- The *user_prefix* value is either the user ID or the job name of the REXX program.
- The *system_prefix* value is either TCPIP or the DATASETPREFIX value from the *hlq*.TCPIP.DATA. You can change the *system_prefix* value to match your site convention.
- The *subtaskid* value is the name of the socket set.
- The *userid* value is the user ID under which the REXX EXEC is running.

When the internal tables are used, the data is converted in the following way:

ASCII to EBCDIC	second hex digit of byte of ASCII data														
	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
first hex digit of byte of ASCII data	0	00	01	02	03	37	2D	2E	2F	16	05	25	0B	0C	0D	0E	0F
	1	10	11	12	13	3C	3D	32	26	18	19	3F	27	1C	1D	1E	1F
	2	40	4F	7F	7B	5B	6C	50	7D	4D	5D	5C	4E	6B	60	4B	61
	3	F0	F1	F2	F3	F4	F5	F6	F7	F8	F9	7A	5E	4C	7E	6E	6F
	4	7C	C1	C2	C3	C4	C5	C6	C7	C8	C9	D1	D2	D3	D4	D5	D6
	5	D7	D8	D9	E2	E3	E4	E5	E6	E7	E8	E9	4A	E0	5A	5F	6D
	6	79	81	82	83	84	85	86	87	88	89	91	92	93	94	95	96
	7	97	98	99	A2	A3	A4	A5	A6	A7	A8	A9	C0	6A	D0	A1	07
	8	20	21	22	23	24	15	06	17	28	29	2A	2B	2C	09	0A	1B
	9	30	31	1A	33	34	35	36	08	38	39	3A	3B	04	14	3E	E1
	A	41	42	43	44	45	46	47	48	49	51	52	53	54	55	56	57
	B	58	59	62	63	64	65	66	67	68	69	70	71	72	73	74	75
	C	76	77	78	80	8A	8B	8C	8D	8E	8F	90	9A	9B	9C	9D	9E
	D	9F	A0	AA	AB	AC	AD	AE	AF	B0	B1	B2	B3	B4	B5	B6	B7
	E	B8	B9	BA	BB	BC	BD	BE	BF	CA	CB	CC	CD	CE	CF	DA	DB
	F	DC	DD	DE	DF	EA	EB	EC	ED	EE	EF	FA	FB	FC	FD	FE	FF

Figure 156. ASCII to EBCDIC

EBCDIC to ASCII	second hex digit of byte of EBCDIC data														
	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
first hex digit of byte of EBCDIC data	0	00	01	02	03	9C	09	86	7F	97	8D	8E	0B	0C	0D	0E	0F
	1	10	11	12	13	9D	85	08	87	18	19	92	8F	1C	1D	1E	1F
	2	80	81	82	83	84	0A	17	1B	88	89	8A	8B	8C	05	06	07
	3	90	91	16	93	94	95	96	04	98	99	9A	9B	14	15	9E	1A
	4	20	A0	A1	A2	A3	A4	A5	A6	A7	A8	5B	2E	3C	28	2B	21
	5	26	A9	AA	AB	AC	AD	AE	AF	B0	B1	5D	24	2A	29	3B	5E
	6	2D	2F	B2	B3	B4	B5	B6	B7	B8	B9	7C	2C	25	5F	3E	3F
	7	BA	BB	BC	BD	BE	BF	C0	C1	C2	60	3A	23	40	27	3D	22
	8	C3	61	62	63	64	65	66	67	68	69	C4	C5	C6	C7	C8	C9
	9	CA	6A	6B	6C	6D	6E	6F	70	71	72	CB	CC	CD	CE	CF	D0
	A	D1	7E	73	74	75	76	77	78	79	7A	D2	D3	D4	D5	D6	D7
	B	D8	D9	DA	DB	DC	DD	DE	DF	E0	E1	E2	E3	E4	E5	E6	E7
	C	7B	41	42	43	44	45	46	47	48	49	E8	E9	EA	EB	EC	ED
	D	7D	4A	4B	4C	4D	4E	4F	50	51	52	EE	EF	F0	F1	F2	F3
	E	5C	9F	53	54	55	56	57	58	59	5A	F4	F5	F6	F7	F8	F9
	F	30	31	32	33	34	35	36	37	38	39	FA	FB	FC	FD	FE	FF

Figure 157. EBCDIC to ASCII

SO_BROADCAST
(REXX only) Determines whether a program can send broadcast messages over the socket to destinations that can receive datagram messages. By default, this option is disabled. When you specify this option, the GETSOCKOPT command returns a string that contains the return code and a number: 1 (enabled) or 0 (disabled).

Restriction: This option has no meaning for stream sockets. It is valid only for datagram sockets.

SO_DEBUG
(REXX only) Determines whether debug information is recorded. By default, this option is disabled. When you specify this option, the GETSOCKOPT command returns a string that contains the return code and a number: 1 (enabled) or 0 (disabled).

Restriction: This option is valid only for stream sockets.

SO_DONTROUTE
Determines whether normal routing determination is bypassed for outgoing packets on the socket. When you specify this option, the GETSOCKOPT command returns a string that contains the return code and a number: 1 (enabled) or 0 (disabled).

Restriction: When a packet is sent, if the local interface cannot be determined from the destination address, the `51 ENETUNREACH` error message is returned.

SO_EBCDIC
(REXX only) Determines whether data is translated to and from EBCDIC. This option is ignored by EBCDIC hosts. When you specify this option, the GETSOCKOPT command returns a string that contains the return code and either ON (enabled) or OFF (disabled). If the option is enabled, the name of the translation table is returned also.

Restriction: This option has no effect on the data that is processed by the socket library.

SO_ERROR
Retrieves information about pending errors on the socket or other errors that are not explicitly returned by any socket commands. The error status is cleared after each call. When you specify this option, the GETSOCKOPT command returns a string that contains the return code and the most recent error, for example, `0 36`.

SO_KEEPALIVE
Determines if the keep alive mechanism periodically sends a packet on an otherwise idle connection for a stream socket. When enabled, if the remote TCP/IP does not respond to the packet or to retransmissions of the packet, the connection is terminated with the `ETIMEDOUT` error . By default, this option is disabled. When you specify this option, the GETSOCKOPT command returns a string that contains the return code and a number: 1 (enabled) or 0 (disabled).

Tip: The site administrator can enable the global keep-alive mechanism by modifying the `TCPIP.PROFILE` file. To modify the `TCPIP.PROFILE` file, use the TCPCONFIG INTERVAL statement.

SO_LINGER
Determines how TCP/IP processes data that has not been transmitted when the CLOSE command is issued for the socket. When this option is enabled and the CLOSE command is issued, the calling program is blocked until either the data is successfully transmitted or the connection times out. When this option is disabled and the CLOSE command is issued, the CLOSE command returns without blocking the caller; then TCP/IP continues to attempt to send data for a specified time, which usually provides sufficient time to complete the data transfer. By default, this option is disabled. When you specify this option, the GETSOCKOPT command returns a string that contains the return code and either 1 (enabled) or 0 (disabled), for example, `0 1`.

Restrictions:

- Using the SO_LINGER option does not guarantee that a data transfer will be completed, because TCP/IP waits only for the amount of time that is specified by SETSOCKOPT command.
- This option is valid only for stream sockets.

SO_OOBINLINE
Determines whether out-of-band data is available to the RECV or RECVFROM commands. When this option is enabled, out-of-band data is placed in the normal data input queue as it is received; this data is

then available to RECV or RECVFROM commands, even if the OOB flag is not set. When this option is disabled, out-of-band data is placed in the priority data input queue as it is received; this data is then available to RECV or RECVFROM commands only if the OOB flag is set. When you specify this option, the GETSOCKOPT command returns a string that contains the return code and a number: 1 (enabled) or 0 (disabled).

Restriction: This option is valid only for stream sockets.

SO_RCVBUF
Retrieves the size of the data portion of the TCP/IP receive buffer. The size of the receive buffer is protocol specific and is based on the following values:

- (TCP socket) The TCPRCVBufrsize keyword on the TCPCONFIG statement in the PROFILE.TCPIP data set.
- (UDP socket) The UDPRCVBufrsize keyword on the UDPCONFIG statement in the PROFILE.TCPIP data set.
- (Raw socket) The default size of 65 535.

When you specify this option, the GETSOCKOPT command returns a string that contains the return code and either the size of the receive buffer or 0 (disabled).

SO_RCVTIMEO
Reports the timeout value for receive-type functions. This option returns a string that contains the number of seconds followed by the number of microseconds. These values specify the length of time to wait for a receive-type function to complete. Returns a value in the range 0 – 2 678 400 (equal to 31 days) for the number of seconds. Returns a value in the range 0 – 1 000 000 (equal to 1 second) for the number of microseconds. If a receive-type function has blocked for this length of time without receiving data, it returns with an errno set to EWOULDBLOCK. The value 0 (the default) indicates that a receive-type function does not time out.

The following receive-type commands are supported:

- READ
- RECV
- RECVFROM

SO_REUSEADDR
Determines whether local addresses are reused. Enabling this option alters the normal algorithm that is used with the BIND command. The normal BIND algorithm permits each Internet address and port combination to be bound only once. If the address and port already have been bound, a subsequent BIND command fails with the 48 EADDRINUSE error message . When this option is enabled, the following situations are supported:

- A server can bind the same port multiple times. Each invocation either must use a different local IP address, or it must use a wildcard address (INADDR_ANY or in6addr_any) only one time for each port.
- A server with active client connections can be restarted and can bind to its port without having to close all of the client connections.

- For datagram sockets, multicasting is supported so that multiple BIND commands can be made to the same class D address and port number.

By default, this option is disabled. When you specify this option, the GETSOCKOPT command returns a string that contains the return code and a number: 1 (enabled) or 0 (disabled).

Tip: If you want multiple servers that bind to INADDR_ANY or IN6ADDR_ANY to listen on the same port number, use the SHAREPORT option on the PORT statement in TCPIP.PROFILE.

SO_SNDBUF

Determines the size of the data portion of the TCP/IP send buffer. The size of the send buffer is protocol specific and is based on the following values:

- (TCP socket) The TCPRCVBufrsize keyword on the TCPCONFIG statement in the PROFILE.TCPIP data set.
- (UDP socket) The UDPRCVBufrsize keyword on the UDPCONFIG statement in the PROFILE.TCPIP data set.
- (Raw socket) The default size of 65 535.

When you specify this option, the GETSOCKOPT command returns a string that contains the return code and either the size of the send buffer or 0 (disabled).

SO_SNDTIMEO

Reports the timeout value for send-type functions. This option returns a string that contains the number of seconds followed by the number of microseconds. These values specify the length of time to wait for a send-type function to complete. Returns a value in the range 0 – 2 678 400 (equal to 31 days) for the number of seconds. Returns a value in the range 0 – 1 000 000 (equal to 1 second) for the number of microseconds. If a send-type function has blocked for this length of time without receiving data, it returns with an errno set to EWOULDBLOCK. The value 0 (the default) indicates that a send-type function does not time out.

The following send-type commands are supported:

- SEND
- SENDTO
- WRITE

SO_TYPE

Retrieves the socket type. When you specify this option, the GETSOCKOPT command returns a string that contains the return code and a number: 1 (SOCK_STREAM), 2 (SOCK_DATAGRAM), or 3 (SOCK_RAW).

TCP_KEEPALIVE

Determines whether a socket-specific timeout value (in seconds) is used instead of a configuration-specific value, when keep alive timing is active for the socket. When enabled, the socket-specific timeout value remains in effect until either the socket is closed or it is reset by a SETSOCKOPT command. When you specify this option, the GETSOCKOPT command returns a string that contains the return code and either the timeout value or 0 (disabled).

Tip: The site administrator can enable the global keep-alive mechanism by modifying the `TCPIP.PROFILE` file. To modify the `TCPIP.PROFILE` file, use the TCPCONFIG INTERVAL statement.

TCP_NODELAY
Determines whether the data that is sent over the socket is subject to the Nagle algorithm (RFC 896). When this option is enabled, TCP waits to send small amounts of data until the acknowledgment for the previous data sent is received. When this option is disabled, TCP sends data when it is presented. When you specify this option, the GETSOCKOPT command returns a string that contains the return code and a number: 1 (enabled) or 0 (disabled).

TCP_MAXSEG
(IPPROTO_TCP protocol only) Retrieves the maximum segment size for a TCP send. When you specify this option, the GETSOCKOPT command returns a string that contains the return code and either the maximum segment size or 0 (disabled).

Returned value

The command returns a string that contains the return code and the option value. The return code can be 0, a REXX socket API error number, or the REXX TCP/IP error number that is set by the socket command. The return code 0 indicates that the requested socket command was completed successfully.

See Appendix B, "Socket call error return codes," on page 885 for additional information about the numeric error codes that are returned by this command.

The following REXX TCP/IP error numbers can be returned:

- 9 EBADF
- 22 ENOTSOCK
- 38 ENOTSOCK
- 42 ENOPROTOOPT
- 45 EOPNOTSUPP

The following REXX socket API error numbers can be returned:

- 2001 EINVALIDRXSOCKETCALL
- 2005 ESUBTASKNOTACTIVE
- 2009 ESOCKETNOTDEFINED
- 2012 EINVALIDNAME

LE C/C++ equivalent

```
int getsockopt(int socket, int level, int option_name, char
 *option_value, int *option_len);
```

Code example

```
/* REXX EZARXR20 */
/*
 * This sample demonstrates the use of the GETSOCKOPT
 * and SETSOCKOPT commands.
 *
 * The program opens a STREAM socket and connects to port 7
 * (echo server) using the loop back address.  Before sending
 * data the program issues the SETSOCKOPT command to set the
 * sockets send buffer to 32000 bytes. Data is then sent to
 * and recevied. After the data is received the GETSOCKOPT
 *
 * GUIDELINE: It is generally recommended that a program loop around
 *            the RECV command to ensure that all data is read off
 *            the socket. This sample does not follow the guideline.
 *
 */
src = socket("INITIALIZE","MYSET01");
if perror(src,"INITIALIZE") \= 0 then signal ENDPROGRAM;
src = socket("SOCKET","AF_INET","STREAM");
if perror(src,"SOCKET") = 0 then do
   l_socketid = WORD(src,2);
   src = socket("GETSOCKOPT",l_socketid,"SOL_SOCKET",,
                "SO_SNDBUF");
   if perror(src,"GETSOCKOPT") = 0 then do
      Say "Current socket send buffer size is",
          word(src,2);
      if word(src,2) < 32000 then do
         Say "Increasing the socket send buffer size",
             "to 320000";
         src = socket("SETSOCKOPT",l_socketid,,
                      "SOL_SOCKET","SO_SNDBUF",32000);
         /* ****************************************
         * Data can be sent even if command fails
         * so just post an message if an error occurs.
         * ****************************************/
         src = perror(src,"SETSOCKOPT");
      end;
      l_RMTname = "AF_INET 7 127.0.0.1";
      src = socket("CONNECT",l_socketid,l_RMTname);
      if perror(src,"CONNECT") = 0 then do
         src = socket("SEND",l_socketid,"*******");
         if perror(src,"RECV","SEND") = 0 then do
            src = socket("RECV",l_socketid);
            if perror(src,"RECV") = 0 then
            Say "Echoed data: " word(src,3);
      end;
   end;
   src = perror(socket("CLOSE",l_socketid),"CLOSE");
end;
end;
ENDPROGRAM:
src = perror(socket("TERMINATE","MYSET01"),"CLOSE");
exit 0;

/* This routine returns -1 if the first word if arg 1 is not zero */
perror: if word(arg(1),1) = 0 then return 0; else
    Say arg(2) "Error : "arg(1);
    return -1;
```

Figure 158. GETSOCKOPT command example

GIVESOCKET

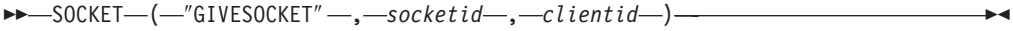
Use the GIVESOCKET command to transfer a socket descriptor to another application that is running on the same host.

The other application can use the TAKESOCKET command to take the socket. If the socket is closed before an application can take it, then the socket is reset. Any stream socket can be given.

Restriction: A socket given by the GIVESOCKET command can be taken only by a process that issues the TAKESOCKET command with the same address family.

Guideline: The application that issues the GIVESOCKET command can use the SELECT command to test for a socket exception condition. The exception condition indicates that the socket has been successfully taken by another application. After the socket has been successfully taken, the application that issued the GIVESOCKET command can safely close the socket. For example, when a server accepts a new connection, the server issues the GIVESOCKET command and then monitors the socket for an exception condition using the SELECT command. The server subtask issues the TAKESOCKET command. After the subtask takes the socket, the server issues the CLOSE command and waits for a new connection request.

Format



Parameters

socketid
The socket descriptor.

clientid
The client ID of the application. The *clientid* parameter uses the following format:

```
"domain jobname subtaskid"
```

where:

domain
The address family of the socket. The following domains are supported:

- AF_INET or 2
- AF_INET6 or 19

jobname
This optional field specifies the name of the address space that will issue the TAKESOCKET command. If this field is not specified, any address space can take the socket.

Guideline: To prevent possible security exposures, always specify the *jobname* field.

subtaskid
This optional field specifies the name of the active socket set. It can be specified only if the *jobname* field is specified also. If the *subtaskid* field is specified but the value is not the name of the active socket set, then the name of the active socket set is used. If the *subtaskid* field is not specified, by default the name of the active socket set is used.

Consider the following situation: The GETCLIENTID command returns the following string: `AF_INET RUNC1 TTLSCXXX`. If the application issues the

GIVESOCKET command using the *clientid* parameter value of "AF_INET RUNC1 BBBB", BBBB is replaced with TTLSCXXXX, because TTLSCXXXX is the name of the active socket set .

Returned value

The command returns a string that contains the return code. The return code can be 0, a REXX socket API error number, or the REXX TCP/IP error number that is set by the socket command. The return code 0 indicates that the requested socket command was completed successfully.

See Appendix B, "Socket call error return codes," on page 885 for additional information about the numeric error codes that are returned by this command.

The following REXX socket API error number can be returned:

- 9 EBADF

The following REXX socket API error numbers can be returned:

- 2001 EINVALIDRXSOCKETCALL
- 2005 ESUBTASKNOTACTIVE
- 2009 ESOCKETNOTDEFINED
- 2012 EINVALIDNAME

LE C/C++ equivalent

```
int givesocket(int d, struct clientid *clientid);
```

Code example

See the EZARXS04 REXX sample in the SEZAINST file for an example of using the GIVESOCKET command.

INET6ISSRCADDR

Use the INET6ISSRCADDR command to indicate whether an input IPV6 socket address matches an address that is defined to the stack, which conforms to one or more input IPV6_ADDR_PREFERENCES flags.

A client or server program can use the INET6ISSRCADDR command when it strictly requires the IP addresses that it uses to have one or more specific attributes before allowing network activity. Such a program can perform the following actions:

1. (Optional) Issue the SETSOCKOPT macro with option IPV6_ADDR_PREFERENCES to set source IP address selection preferences for the socket.
2. Issue the BIND2ADDRSEL command to bind a socket to a local IP address. The BIND2ADDRSEL command attempts to assign a local IP address that matches the IPv6_ADDR_PREFERENCES flags that are specified with the SETSOCKOPT command, but does not guarantee that the local IP address that it selects satisfies all preferences.
3. Issue the GETSOCKNAME command to obtain the local IP address that is bound to the socket.
4. Issue the INET6ISSRCADDR command to verify whether the local IP address has the correct attributes.

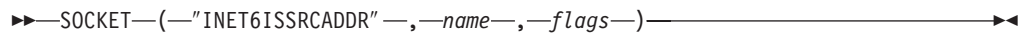
The command returns a string that contains the return code and the result. The return code can be 0, a REXX socket API error number, or the REXX TCP/IP error number that is set by the socket command. The return code 0 indicates that the requested socket command was completed successfully and indicates one of the following results:

TRUE The IP address is an address that is known to the TCP/IP stack and satisfies the preference flags.

FALSE
The IP address is an address known to the TCP/IP stack but does not satisfy the preference flags.

You can specify more than one IPV6_ADDR_PREFERENCES flags on this command. All flags must be satisfied for the result to be TRUE. Some IPV6_ADDR_PREFERENCES flags are contradictory. If you specify contradictory flags on a single command invocation, the result is FALSE.

Format



Parameters

name
The socket address that is to be tested.

name = "domain portid flowinfo ipaddress scopeid"

where:

- The *domain* value must be the decimal number 19 or AF_INET6.
- The *portid* value is not used by the INET6ISSRCADDR command.

  Requirement: You must specify a decimal numeral between 0 and 65535 for the *portid* value.
- The *flowinfo* value is not used by the INET6ISSRCADDR command.

  Requirement: You must specify a decimal numeral between 0 and 2147483647 for the *flowinfo* value.
- The *ipaddress* value is the IP address to be tested.

  Rule: You can specify an IPv6 address or an IPv4-mapped IPv6 address.
- The *scopeid* value identifies the interfaces that are applicable for the scope of the address that is specified in the *ipaddress* field. For a link-local IP address, the *scopeid* field can specify a link index, which identifies a set of interfaces. For all other scopes, the *scopeid* field must be set to 0.

flags
A space-delimited string that contains one or more of the following values:

IPV6_PREFER_SRC_HOME
Tests whether the IP address is a home address. Any valid address that is known to the TCP/IP stack satisfies this flag.

IPV6_PREFER_SRC_COA
Tests whether the IP address is a care-of address. This type of address is not supported and the command always returns FALSE if this flag is specified.

IPV6_PREFER_SRC_PUBLIC
Tests whether the IP address is a public address.

IPV6_PREFER_SRC_TMP
Tests whether the IP address is a temporary address.

IPV6_PREFER_SRC_CGA
Tests whether the IP address is a cryptographically generated address. This type of address is not supported and the command always returns FALSE if this flag is specified.

IPV6_PREFER_SRC_NONCGA
Tests whether the IP address is not cryptographically generated. Any valid address that is known to the TCP/IP stack satisfies this flag.

Any *flags* specification that contains values other than 0 or the options listed above causes an EINVALIDRXSOCKETCALL error to be returned.

Tip: Some of these flags are contradictory. For example:

- The flag IPV6_PREFER_SRC_HOME contradicts the flag IPV6_PREFER_SRC_COA.
- The flag IPV6_PREFER_SRC_CGA contradicts the flag IPV6_PREFER_SRC_NONCGA.
- The flag IPV6_PREFER_SRC_TMP contradicts the flags IPV6_PREFER_SRC_PUBLIC.

Result: If you specify contradictory flags on the macro, the result is FALSE.

Returned value

The command returns a string that contains the return code and the result. The return code can be 0, a REXX socket API error number, or the REXX TCP/IP error number that is set by the socket command. The return code 0 indicates that the requested socket command was completed successfully. The result is TRUE if the IP address is an address that is known to the TCP/IP stack and satisfies the preference flags, or FALSE if the IP address is an address that is known to the TCP/IP stack but does not satisfy the preference flags.

See Appendix B, “Socket call error return codes,” on page 885 for additional information about the numeric error codes that are returned by this command.

The following REXX TCP/IP error numbers can be returned:

- 1 EPERM
- 22 EINVAL
- 47 EAFNOSUPPORT
- 49 EADDRNOTAVAIL

The following REXX socket API error numbers can be returned:

- 2001 EINVALIDRXSOCKETCALL
- 2005 ESUBTASKNOTACTIVE
- 006 ESOCKETNOTALLOCATED

LE C/C++ equivalent

```
short inet6_is_srcaddr(struct sockaddr_in6 *srcaddr, uint32_t flags);
```

INITIALIZE

Use the INITIALIZE command to preallocate a socket set.

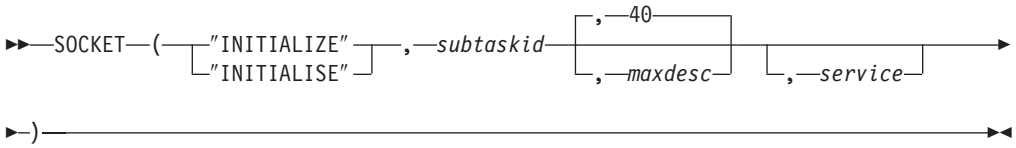
A socket set is a number of preallocated sockets available to a single REXX application. You can define multiple socket sets for one session, but only one socket set can be active at a time. The INITIALIZE command must be issued before any socket services are requested.

Restrictions:

- In a CINET environment, the INITIALIZE command establishes a stack affinity either to the default TCP/IP stack or the stack specified with the *service* parameter. The default stack is determined by the BPXPARMxx SUBFILESYSTYPE statement that contains the keyword DEFAULT or by the order of the SUBFILESYSTYPE statements and currently active stacks. To specify a stack other than the default, add the *service* parameter to the INITIALIZE command. As different stacks are specified, the results of the GETSOCKNAME command return the IP address of the associated stack. If a valid service name is not supplied, the INITIALIZE command fails with the `1004 EIBMIUCVERR` return code.
- In an INET environment, any service name is accepted. However, if the service name does not match an active SUBFILESYSTYPE statement defined in BPXPARMxx, the service name is changed to *INET.

Guideline: When multiple socket sets are initialized, the last socket set that is initialized becomes the active socket set. Before closing a socket belonging to a specific socket set, you must ensure that the socket set that owns the socket is the active set. Otherwise, the CLOSE command fails.

Format



Parameters

subtaskid
The name of the socket set. This parameter can be 1-8 characters in length; it cannot contain blanks.

maxdesc
The number of sockets descriptors that can be opened in this socket set. By default, this parameter is set to 40.

service
The name of the TCP/IP service. This is the job name of an active TCP/IP stack. The name of the TCP/IP service must match one of the following values:

- The TYPE operand that was specified on the FILESYSTYPE statement

- The NAME operand of the SUBFILESYSTYPE statement that defined this physical file system in the BPXPRMxx PARMLIB member

Returned value

The command returns a string that contains the return code, the name of the socket set, the number of socket descriptors that can be opened, and the name of the TCP/IP services, for example, `0 MYTASK 40 TCPSVT`. The return code can be 0, a REXX socket API error number, or the REXX TCP/IP error number that is set by the socket command. The return code 0 indicates that the requested socket command was completed successfully.

For information about the format of the NAME string, see "How structures are represented" on page 698. See Appendix B, "Socket call error return codes," on page 885 for additional information about the numeric error codes that are returned by this command.

The following REXX TCP/IP error numbers can be returned:

- 9 EBADF
- 22 EINVAL
- 38 ENOTSOCK
- 45 EOPNOTSUPP
- 1004 EIBMIUCVERR

The following REXX socket API error numbers can be returned:

- 2001 EINVALIDRXSOCKETCALL
- 2003 ESUBTASKINVALID
- 2004 ESUBTASKALREADYACTIVE2012 EINVALIDNAME

Tip: If the `2003 ESUBTASKINVALID` error code is returned, issue the TERMINATE command and then reissue the INITIALIZE command. If the command continues to fail, verify that the value of *service* parameter is applicable for the system.

LE C/C++ equivalent

This command has no LE C/C++ equivalent.

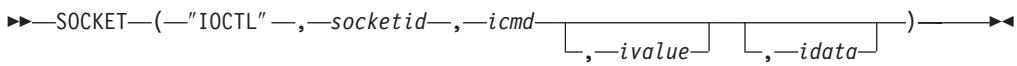
Code example

The example code described in "GETADDRINFO" on page 717 can be used to experiment with the INITIALIZE command in a CINET environment.

IOCTL

Use the IOCTL command to perform control functions on sockets.

Format



Parameters

socketid
The socket descriptor.

icmd
The control function. The following commands are supported:

FIONBIO
Enables or disables blocking mode. When the *ivalue* parameter is set to ON, the socket is set to nonblocking mode. When the *ivalue* parameter is set to OFF, the socket is in blocking mode. The command returns a string that contains the return code.

FIONREAD
Requests the number of bytes on the receive queue that are ready for reading. The command returns a string that contains the return code and the number of bytes that are ready for reading.

SIOCATMARK
Determines whether the current location in the input data points to out-of-band data. The command returns a string that contains the return code and YES or NO. YES indicates that there is out-of-band data.

SIOCGIFADDR
Obtains a network interface address. The *ivalue* parameter must specify the name of the network interface, for example, LOGETH13. The network interface name can be 1-16 characters in length. The command returns a string that contains the return code and the network interface address, which has the following format: `interface domain port ipaddress`.

Restriction: This function is valid only for IPv4 interfaces.

SIOCGIFBRDADDR
Obtains the network broadcast address of an interface. The *ivalue* parameter must specify the name of the network interface, for example, LOGETH13. The network interface name can be 1-16 characters in length. The command returns a string that contains the return code and the network broadcast address, which has the following format: H`interface domain port ipaddress`.

Restriction: This function is valid only for IPv4 interfaces.

SIOCGIFCONF
Obtains the list of the interfaces that are defined to the system. The *ivalue* parameter must specify the maximum number of interfaces to be returned. The command returns a string that contains the return code and a list of interfaces, which has the following format: `interface domain port ipaddress`

Restriction: Only IPv4 interface information is returned.

Tip: You can parse the information in the following way:

```
Drop st.
l_retcode = socket("IOCTL",l_sockid,"SIOCGIFCONF",10);
parse var l_retcode l_rc l_iflist
i=0;
do until l_iflist = ""
i=i+1;
```

```
parse var l_iflist st.i.interface st.i.domain st.i.port,
st.i.address l_iflist
st.i.name = st.i.domain st.i.port st.i.address;
end;
st.0 = i;
```

SIOCGIFDSTADDR
Obtains the network destination address of an interface. The *ivalue* parameter must specify the name of the network interface, for example, LOGETH13. The network interface name can be 1-16 characters in length. The command returns a string that contains the return code and the network destination address, which has the following format: *interface domain port ipaddress*

Restriction: This function is valid only for IPv4 interfaces.

SIOCGIFMTU
Obtains the network MTU (maximum transmission unit) of an interface. The *ivalue* parameter must specify the name of the network interface, for example, LOGETH13. The network interface name can be 1-16 characters in length. The command returns a string that contains the return code, the interface name, and the numeric MTU value.

Restriction: This function is valid only for IPv4 interfaces.

SIOCGIFNAMEINDEX
Obtains a list of all interface names and device indexes that are defined to the system. This list includes loopback addresses, but excludes VIPA addresses. The command returns a string that contains the return code and a list of interfaces, which have the following format: `interface_index interface_name`.

Tip: You can parse the information in the following way:

```
DROP st.
l_retcode = socket("IOCTL",1,"SIOCGIFNAMEINDEX");
i = 0;
do until l_retcode = ''
    i=i+1;
    parse var l_retcode st.i.interfindex st.i.name l_retcode;
end;
```

SIOCGIFFLAGS
Obtains the network interface flags of an interface. The *ivalue* parameter must specify the link name of the interface, for example, LOGETH13. The command returns a string that contains the return code, the interface name, the flags in four hexadecimal digits, and the symbolic names of the flags.

The following string is an example of what is returned by the SIOCGIFFLAGS function:

```
0 LOOPBACK 0049 IFF_UP IFF_LOOPBACK IFF_RUNNING
```

Restriction: This function is valid only for IPv4 interfaces.

SIOCGIFMETRIC
Obtains the network routing metric of an interface. The *ivalue* parameter must specify the link name of the interface, for example, LOGETH13. The command returns a string that contains the return code, interface name, and routing metric.

Restriction: This function is valid only for IPv4 interfaces.

SIOCGIFNETMASK
Obtains the network mask of an interface. The `ivalue` parameter must specify the interface name, for example, LOGETH13. The command returns a string that contains the return code, interface name, and a socket NAME with the network mask, for example, `0 LOFETH13 AF_INET 0 255.255.240.0`.

For more information about the format of the NAME string, see "How structures are represented" on page 698.

Restriction: This function is valid only for IPv4 interfaces.

SIOCGIPMSFILTER
Obtains a list of the IPv4 source addresses from the stack for a specified interface and multicast group. The *ivalue* parameter must be a space-delimited string that contains an IPv4 multicast address, an IPv4 interface address, and the number of addresses to be returned, for example, "224.224.224.1 176.11.16.103 5". If the number of addresses to be returned is set to 0, all source filters are returned. The command returns a string that contains the return code, filter mode (either MCAST_INCLUDE or MCAST_EXCLUDE), number of IPV4 source addresses that are returned, and the IPv4 source addresses. Depending on the filter mode, source addresses are included or excluded.

The following string is an example of what is returned by the SIOCGIPMSFILTER function:

```
0 MCAST_INCLUDE 2 10.11.103.1 176.11.16.103
```

SIOCGMSFILTER
Obtains a list of the IPv4 or IPv6 source addresses for the specified interface index and multicast group. The *ivalue* parameter must be a space-delimited string that contains an interface index, a socket name for the multicast address, and the number of addresses to be returned, for example, "34 AF_INET 21 224.224.224.1 5". If the number of addresses to be returned is set to 0, all source addresses are returned. The command returns a string that contains the return code, filter mode (either MCAST_INCLUDE or MCAST_EXCLUDE), the number of source addresses that are returned, and a list of the source-socket name groups.

The following string is an example of what is returned by the SIOCGMSFILTER function:

```
0 MCAST_INCLUDE 1 AF_INET 21 176.11.16.103
```

In the example, `AF_INET 12 176.11.16.103` is the source-socket name.

For more information about the format of the NAME string, see "How structures are represented" on page 698 or the BIND or CONNECT commands.

SIOCGPARTNERINFO
Provides an interface for an application to retrieve security information about its partner. The *ivalue* parameter must be a space-delimited string that contains a request type and a timeout value in the range 0 – 60.

The request type is one of the following values:

- PI_REQTYPE_CONNTYPE, CONNTYPE, C, or 0

- PI_REQTYPE_PARTNER_USERID, USERID, U, or 1

The command returns a string that contains the return code and the output data.

The return code is either 0 or -1, with 0 indicating successful completion and -1 indicating that an error occurred.

The output data includes the following:

- Status

  The status indicates the type of information that is returned, which includes connection routing information that can be followed by partner user ID information. If the partner user ID information is not returned, or only the address-space user ID is returned, the appropriate user ID fields are set to 0.
- Connection type (8 hexadecimal digits)
- Length of the returned address-space user ID
- Returned address space user ID
- Length of the returned task-level user ID
- Returned task-level user ID
- Additional error code and the text version of the error (if the return code is -1)

The following string is an example of the output data for a successful command:

```
0 3 0000000E 5 USER1 0 0
```

In this example, `0` is the return code, `3` is the PI_STATUS (indicating that the connection routing information and the partner user ID are returned), `0000000E` is the connection routing value (indicating PI_CONNTYPE_SAME_CLUSTER, PI_CONNTYPE_SAME_IMAGE, and PI_CONNTYPE_INTERNAL), `5` is the length of the returned address space user ID, `USER1` is the returned address space user ID, and `0 0` indicates that there is no task-level user ID.

If an error occurs, the output data is similar to the following:

```
-1 1 0000000E 0 0 0 0 ( 73 ETIME Timer expired
```

In this example, `-1` is the return code, `1` is the PI_STATUS (indicates that the connection routing information is returned), `0000000E` is the connection routing value (indicates PI_CONNTYPE_SAME_CLUSTER, PI_CONNTYPE_SAME_IMAGE, and PI_CONNTYPE_INTERNAL), `0 0 0 0` indicates that no user ID information is returned, `73` is the error code, and `ETIME Timer expired` is the error description.

For more information about using the SIOCGPARTNERINFO IOCTL, see *z/OS Communications Server: IP Programmer's Guide and Reference*.

SIOCSAPPLDATA

Associates user-defined data with a socket descriptor. This data can be used to identify socket endpoints for network-management applications or tools such as Netstat or SMF. The *ivalue* parameter is a string that contains the user-defined data; it can be up to 40 bytes in length. The command returns an error code.

Guideline: The content of this field is determined by the application that owns the connection. See application-specific

documentation for explanations of the layout, format, and meaning of this field. Typically, the field contains printable EBCDIC characters, although some applications might include binary data.

The application data is displayed by the following items only when the TCP connection has application data associated with it:

- Netstat reports. The information is displayed on the ALL/-A report. If the APPLDATA modifier is used, the information also is displayed on the ALLConn/-a and COnn/-c reports.
- The SMF 119 TCP connection termination record. For more information, see *z/OS Communications Server: IP Programmer's Guide and Reference*.
- Network management applications. For more information, see *z/OS Communications Server: IP Programmer's Guide and Reference*.

SIOCSIPMSFILTER

Sets the list of the IPv4 source addresses and the filter mode for an interface and multicast group. The *ivalue* parameter must be a space-delimited string that contains an IPv4 multicast address, an IPv4 interface address, filter mode, the number of IPv4 source addresses to be added, and the list of IPv4 source addresses, for example:

```
224.224.224.1 176.11.16.103 MCAST_INCLUDE 2 48.11.16.103
  176.11.16.103
```

The filter mode is one of the following values:

Include
MCAST_INCLUDE, INCLUDE, I, or 0

Exclude
MCAST_EXCLUDE, EXCLUDE, E, or 1

The maximum number of source addresses is 64. If the interface address is 0.0.0.0, then the stack selects the default IPv4-multicast interface address. The command returns a string that contains the return code.

SIOCSMSFILTER

Sets a list of the IPv4 or IPv6 source addresses and the filter mode for an interface and multicast group. The *ivalue* parameter must be a space-delimited string that contains an interface index, the socket address name for the multicast address, the filter mode, the number of source address names, and a list of the source address names, for example:

```
34 AF_INET6 56504 0 FF02::67:69 0 MCAST_INCLUDE 1 2001:10:11:103::1
```

The filter mode is one of the following values:

Include
MCAST_INCLUDE, INCLUDE, I, or 0

Exclude
MCAST_EXCLUDE, EXCLUDE, E, or 1

The maximum number of source addresses is 64. If the interface index is 0, then the stack selects an interface. The command returns a string that contains the return code.

For more information about the format of the NAME string, see "How structures are represented" on page 698.

SIOCSPARTNERINFO
The SIOCSPARTNERINFO IOCTL sets an indicator to retrieve the partner security credentials during connection setup and saves the information. In this way, an application can issue a SIOCGPARTNERINFO IOCTL without suspending the application or at least minimizing the time to retrieve the information. The *ivalue* parameter must be set to PI_REQTYPE_SET_PARTNERDATA, PARTNERDATA, P, or 1. The command returns a string that contains the return code.

For more information about using the SIOCSPARTNERINFO IOCTL, see *z/OS Communications Server: IP Programmer's Guide and Reference*.

SIOCTTLSCTL
Queries or controls Application Transparent Transport Layer Security (AT-TLS) for a TCP stream socket connection. If the socket is in blocking mode, this function blocks during the initial handshake. If the socket is in nonblocking mode, it returns the 36 EWOULDBLOCK error. See the Application Transparent TLS information in *z/OS Communications Server: IP Programmer's Guide and Reference* for more information.

Unless the *ivalue* parameter is set to QUERYONLY, the application must be mapped to an AT-TLS policy and the parameter ApplicationControlled must be set to ON. The *ivalue* parameter can have the following values:

QUERYONLY
Requests security information about the current socket. This request can be issued by any application, regardless of the value of the ApplicationControlled parameter. If the socket is not mapped to an AT-TLS policy and the socket is in a writable state, issuing this command causes AT-TLS to try to locate and assign a policy. The command returns a string that contains status information about the security level of the connection.

QUERYHOST
Queries the partner certificate to validate that the certificate matches the host name. The*ivalue* parameter must specify the host name. This request returns one of the following values:

0 Validation status unknown. This value is returned if no partner certificate is present. This can occur for servers if client authentication is not enabled in the policy.

1 Host name validation succeeded. The host name in the partner certificate matches the value of the *ivalue* parameter.

2 Host name validation failed. The host name in the partner certificate did not match the value of the *idata* parameter.

QUERYRULENAME
Queries the TTLSRule name that is mapped to the connection. This request returns the TTLSRule name or `*N/A*`, if no mapping exists.

QUERYGROUPACTIONNAME
Queries the TTLSGroupAction name that is mapped to the connection. This request returns the TTLSGroupAction name or *N/A*, if no mapping exists.

QUERYENVIRONMENTACTIONNAME
Queries the TTLSEnvironmentAction name that is mapped to the connection. This request returns the TTLSEnvironmentAction name or *N/A*, if no mapping exists.

QUERYCONNECTIONACTIONNAME
Queries the TTLSConnectionAction name that is mapped to the connection. This request returns the TTLSConnectionAction name or *N/A*, if no mapping exists.

INITCONNECTION
Initializes a secure SSL connection using the role that is defined by the Handshake parameter in the mapped policy. When this command is successful, it returns a string that contains status information about the security level of the connection.

INITCONNHSTIMEOUT
Initializes a secure SSL connection using the role that is defined by the Handshake parameter in the mapped policy. The Handshake parameter must be set to Server or ServerWithClientAuth. If the SSL handshake times out before receiving data from the client, SSL is stopped on the connection and the TCP connection remains established. Using this command is equivalent to requesting TTLS_INIT_CONNECTION and TTLS_ALLOW_HSTIMEOUT.

RESETSESSION
Resets the session ID so that it is not reused by another connection. When this command is successful, it returns a string that contains status information about the security level of the connection.

RESETCIPHER
Resets and renegotiates the cipher that is used for the secure session. If the session ID times out or has been reset, a full handshake is performed. Otherwise, a short handshake is performed. When this command is successful, it returns a string that contains status information about the security level of the connection.

STOPCONNECTION
Stops SSL security on the connection. The TCP connection remains established. Future sends and receives are not encrypted.

If an error occurs, the SIOCTTLSCTL function returns an error code. Unless otherwise specified in the *ivalue* parameter, if the command is completed successfully, it returns a string that contains the return code, policy status, connection status, security type, SSL protocol, the negotiated cipher, and the client user ID (if available). For example, the following string is an example of what is returned by the SIOCTTLSCTL function:

```
0 5 2 2 0300 05 userid 01
```

In the example, `0` is the return code, `5` is the policy status, `2` is the connection status, the second `2` is the security type, `0300` is the SSL protocol, the second `05` is the negotiated cipher, *userid* is the user ID that is associated with the client's certificate in the SAF database, and `01` is the FIPS 140 status.

The policy status is one of the following values:

1 AT-TLS function is off. The TCP/IP address space is not enabled to support AT-TLS.

2 No AT-TLS policy is defined for the connection.

3 A policy is defined for the connection, but AT-TLS is not enabled for the connection.

4 A policy is defined for the connection, and AT-TLS is enabled for the connection.

5 A policy is defined for the connection, and both AT-TLS and the ApplicationControlled parameter are enabled for this connection.

The connection status is one of the following values:

1 The connection is not secure.

2 The connection handshake is in progress.

3 The connection is secure.

The security type is one of the following values:

0 Unknown. The connection is not secure.

1 Client.

2 Server.

3 Server with client authentication and authentication type set to PASSTHRU.

4 Server with client authentication and authentication type set to FULL.

5 Server with client authentication and authentication type set to REQUIRED.

6 Server with client authentication and authentication type set to SAFCheck.

The SSL protocol is one of the following values:

0000 Unknown. The connection is not secure.

0200 SSL Version 2.

0300 SSL Version 3.

0301 TLS Version 1.0

0302 TLS Version 1.1

The value FF indicates that the cipher has not been negotiated. See the TTLSCipherParms statement description in *z/OS Communication Server: IP Configuration Reference* for additional cipher values.

The client user ID value is either the user ID associated with the client's certificate in the SAF database or the character string *NA*, which indicates that the client ID is unknown.

The FIPS 140 status is one of the following values:

00 No FIPS 140 support

01 FIPS 140 support

Rule: When using AT-TLS application control, you must ensure that no outstanding data resides in the socket receive buffers for the application. If data exists when AT-TLS is enabled, the negotiation will fail. To flush the receive buffers, you can issue a nonblocking RECV command on the socket before you issue the IOCTL command.

Tips:

- For TCP/IP socket error information concerning this command, see the Application Transparent TLS information in *z/OS Communications Server: IP Programmer's Guide and Reference*.
- For information about SSL error numbers, see *z/OS Cryptographic Services System Secure Sockets Layer Programming*.

ivalue
Additional information that is needed to run the requested command. The value of the *ivalue* parameter can be either input or output; it is independent of the *icmd* parameter.

idata
Additional information that is needed to run the requested command. The value of the *idata* parameter can be either input or output; it is independent of the *icmd* and *ivalue* parameter.

Returned value

The return code can be 0, a REXX socket API error number, or the REXX TCP/IP error number that is set by the socket command. The return code 0 indicates that the requested socket command was completed successfully.

See Appendix B, "Socket call error return codes," on page 885 for additional information about the numeric error codes that are returned by this command.

The following REXX TCP/IP error numbers can be returned:

- 9 EBADF
- 6 ENXIO
- 22 EINVAL
- 41 EPROTOTYPE
- 45 EOPNOTSUPP

The following REXX socket API error numbers can be returned:

- 2001 EINVALIDRXSOCKETCALL
- 2005 ESUBTASKNOTACTIVE
- 2009 ESOCKETNOTDEFINED

LE C/C++ equivalent

This command has no LE C/C++ equivalent.

Code example

See the EZARXS05 REXX sample for an example of using the IOCTL command.

LISTEN

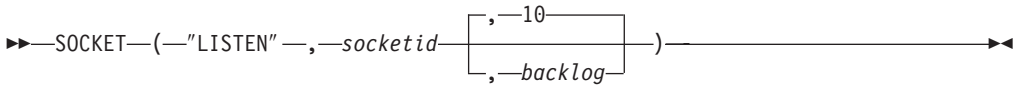
Use the LISTEN command to determine whether a socket is ready to accept client connection requests.

The LISTEN command applies only to stream sockets. The LISTEN command performs two actions:

1. The command completes the bind process, if it has not already been done explicitly.
2. Creates a connection request queue (the backlog queue). New connections received by the stack for this socket are placed on the backlog queue. The application then can issue the ACCEPT command to process these pending connections. If the backlog queue is full, the stack rejects new connection requests.

Guideline: Applications that issue the LISTEN command should bind to a well-known port using INADDR_ANY or IN6ADDR_ANY. If the LISTEN command completes the bind for IPv4, the socket is bound to AF_INET 0 INADDR_ANY. If the LISTEN command completes the bind for IPv6, the socket is bound to AF_INET 0 0 IN6ADDR_ANY 0.

Format



Parameters

socketid
The socket descriptor

backlog
The number of pending connection requests. This parameter can have a value in the range 0 to the maximum number that is specified by the SOMAXCONN parameter in the TCPIP profile. If the *backlog* parameter is set to 0, 1, or 2, then the backlog queue uses the default value of 2. If the *backlog* parameter is not specified, by default it is set to 10.

Returned value

The command returns a string that contains the return code. The return code can be 0, a REXX socket API error number, or the REXX TCP/IP error number that is set by the socket command. The return code 0 indicates that the requested socket command was completed successfully.

See Appendix B, "Socket call error return codes," on page 885 for additional information about the numeric error codes that are returned by this command.

The following REXX TCP/IP error numbers can be returned:

- 9 EBADF
- 22 EINVAL,
- 38 ENOTSOCK,
- 45 EOPNOTSUPP,

The following REXX socket API error numbers can be returned:

- 2001 EINVALIDRXSOCKETCALL
- 2005 ESUBTASKNOTACTIVE
- 2006 ESOCKETNOTALLOCATED
- 2009 ESOCKETNOTDEFINED
- 2012 EINVALIDNAME

LE C/C++ equivalent

This command has no LE C/C++ equivalent.

Code example

See "ACCEPT" on page 704 for an example of how to use the LISTEN command.

READ

Use the READ command to read data on the specified socket. The maximum amount of data to be read is specified by the *maxlength* parameter. If the socket is in blocking mode and data is not available on the socket, the command blocks until data arrives.

Consider the following additional information:

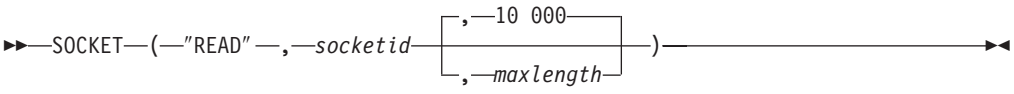
- If the socket is a stream socket and the length of the data returned is 0, the remote peer has closed its side of the connection.
- If the socket is a connected datagram socket, the command returns data up to the length specified by the *maxlength* parameter. The remainder of the datagram is discarded. To ensure that the entire datagram is received, set the *maxlength* parameter to 65 535 or greater.

Guidelines:

- For stream sockets, data is processed as streams of information with no boundaries separating the data. The application provides record management. Applications should place the command in a loop until all the data has been received.
- For nonblocking sockets, use the SELECT command to determine whether there is data to be read on the socket.

Tip: If the SO_ASCII socket option is enabled, then the data received is translated from EBCDIC to ASCII.

Format



Parameters

socketid
The socket descriptor.

maxlength
The maximum amount of data (in bytes) to be returned. The *maxlength* parameter can be a number in the range 0-100 000. By default, this parameter is set to 10 000.

Returned value

The command returns a string that contains the return code, the maximum length of the data returned, and the data, for example, `0 19 This is sample data`. The return code can be 0, a REXX socket API error number, or the REXX TCP/IP error number that is set by the socket command. The return code 0 indicates that the requested socket command was completed successfully. The data length 0 indicates that the connection was closed by the remote peer.

See Appendix B, "Socket call error return codes," on page 885 for additional information about the numeric error codes that are returned by this command.

The following REXX TCP/IP error numbers can be returned:

- 4 EITNR
- 5 EIO
- 9 EBADF
- 22 EINVAL
- 35 EWOULDBLOCK
- 38 ENOTSOCK
- 45 EOPNOTSUPP
- 54 ECONNRESET
- 57 ENOTCONN
- 60 ETIMEDOUT

The following REXX socket API error numbers can be returned:

- 2001 EINVALIDRXSOCKETCALL
- 2005 ESUBTASKNOTACTIVE
- 2009 ESOCKETNOTDEFINED

LE C/C++ equivalent

```
ssize_t read(int fs, void *buf, size_t N);
```

Code example

```
/* REXX EZARXR21 */
/*
 * This sample demonstrates the use of the READ and RECV
 * socket commands.
 *
 * To use the READ command, set the variable g_RECVCMD equal to "READ"
 * to use the RECV command, set the variable g_RECVCMD equal to "RECV"
 *
 * The program creates a listening socket and then goes into a
 * loop and blocks on the accept command. When a new connection is
 * ACCEPTED the program will issue the READ or RECV command until
 * the connection is terminated.
```

```
 *
 * If the data received is the string "DONE", then the
 * program will close the accepted socket and wait for a new
 * connection request.
 */
g_RECVCMD = "READ"
src = socket("INITIALIZE","MYSET01",10);
if perror(src,"INITIALIZE") = 0 then do
   src = socket("SOCKET","AF_INET6","STREAM");
   if perror(src,"SOCKET") = 0 then do
      parse var src . l_sockid
      l_name6 = "AF_INET6 54004 0 ::0 0";
      src = socket("BIND", l_sockid, l_name6);
      if perror(src,"BIND") = 0 then do
         src = socket("LISTEN", l_sockid);
         if perror(src,"LISTEN") = 0 then do
            say "Listening on socket "l_sockid;
            do forever
               src = socket("ACCEPT", l_sockid );
               if perror(src,"ACCEPT") = 0 then do
                  parse var src . l_newsockid . ;
                  l_datalen = -1;
                  l_Done = "FALSE";
                  l_totallen = 0;
                  l_packet = "";
                  /* ********************************************
                   * Loop around RECV|READ command until all data has
                   * has been received and the client closes the
                   * connection.
                   * ********************************************/
                  do until l_datalen = 0 | l_done = "TRUE"
                     src = socket(g_RECVCMD,l_newsockid,512);
                     if perror(src,g_RECVCMD) = 0 then do
                        parse var src l_retcode l_datalen l_data
                        if l_datalen > 0 then do
                           l_totallen = l_totallen + l_datalen;
                           if l_packet = "" then do
                              l_packet = l_data;
                              if l_packet = "DONE" then
                                 l_done = "TRUE";
                           end;
                           else l_packet = l_packet||l_data;
                        end;
                        else do
                        /* ************************************
                         * A data length of zero indicates the
                         * connection has been closed by the
                         * remote side
                         * ************************************/
                            Say "Connection has been closed",
                                "received "l_totallen" bytes";
                            l_done = "TRUE";
                        end;
                     end;
                     else do
                        l_done = "TRUE";
                     end;
                  end; /* DO READ */
                  src = socket("CLOSE",l_newsockid);
                  src = perror(src,"CLOSE");
               end; /* ACCEPT */
            end; /* DO FOREVER */
         end;
      end;
   end;
end; /* INITIALIZE */
src = perror(socket("TERMINATE","MYSET01"),"TERMINATE");
```

```
exit 0;

/* This routine returns -1 if the first word if arg 1 is not zero */
perror: if word(arg(1),1) = 0 then return 0; else
    Say arg(2) "Error : "arg(1);
    return -1;
```

Figure 159. READ command example

RECV

Use the RECV command to receive data on a specified socket. The RECV command can be issued only against connected sockets.

Consider the following additional information:

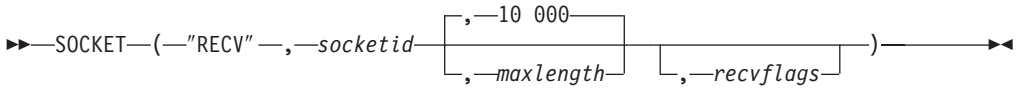
- If the socket is in blocking mode and data is not available, the command blocks until data arrives. If the socket is in nonblocking mode and data is not available, the command returns the `35 EWOULDBLOCK` error code.
- If the socket is a stream socket and the length of the data returned is 0, the remote peer has closed its side of the connection.
- If the socket is a connected datagram socket, the command returns data up to the length specified by the *maxlength* parameter. The remainder of the datagram is discarded. To ensure that the entire datagram is received, set the *maxlength* parameter to 65 535 or greater.

Guidelines:

- For stream sockets, data is processed as streams of information with no boundaries separating the data. The application provides record management. Applications should place the command in a loop until all the data has been received.
- For nonblocking sockets, use the SELECT command to determine whether there is data to be read on the socket.

Tip: If the SO_ASCII socket option is enabled, then the data received is translated from EBCDIC to ASCII.

Format



Parameters

socketid
The socket descriptor.

maxlength
The maximum amount of data (in bytes) to be returned. The *maxlength* parameter can be a number in the range 0-100 000. By default, this parameter is set to 10 000.

recvflags
An optional parameter. Specifies the following receive flags:

MSG_OOB, OOB
Receive out-of-band data (stream sockets only). Even if the OOB flag is not set, out-of-band data can be read if the SO_OOBINLINE option is set for the socket.

MSG_PEEK, PEEK
Peek at the data, but do not destroy data. If the peek flag is set, the next receive operation will read the same data.

MSG_WAITALL, WAITALL
Requests that the function block until the full amount of data requested can be returned (stream sockets only). The function may return a smaller amount of data if the connection is terminated, an error is pending, or SO_RCVTIMEO is set and the timer expired for the socket.

Returned value

The command returns a string that contains the return code, the maximum length of the data returned, and the data, for example, `0 19 This is sample data`. The return code can be 0, a REXX socket API error number, or the REXX TCP/IP error number that is set by the socket command. The return code 0 indicates that the requested socket command was completed successfully.

See Appendix B, "Socket call error return codes," on page 885 for additional information about the numeric error codes that are returned by this command.

The following REXX TCP/IP error numbers can be returned:
- 4 EITNR
- 5 EIO
- 9 EBADF
- 22 EINVAL
- 35 EWOULDBLOCK
- 38 ENOTSOCK
- 45 EOPNOTSUPP
- 54 ECONNRESET
- 57 ENOTCONN
- 60 ETIMEDOUT

The following REXX socket API error numbers can be returned:
- 2001 EINVALIDRXSOCKETCALL
- 2005 ESUBTASKNOTACTIVE
- 2009 ESOCKETNOTDEFINED

LE C/C++ equivalent

```
int recv(int socket, char *buffer, int length, int flags);
```

Code example

See "ACCEPT" on page 704 or "READ" on page 770. To use the RECV command, substitute the command RECV for the command READ.

RECVFROM

Use the RECVFROM command to receive data on the specified socket.

If the number of bytes is less than the number of bytes requested, the command returns the number of bytes that are available. If the socket is in blocking mode and data is not available on the socket, the command blocks until data arrives. When the socket is in nonblocking mode and data is not available, the command returns the `35 EWOULDBLOCK` return code .

Consider the following additional information:

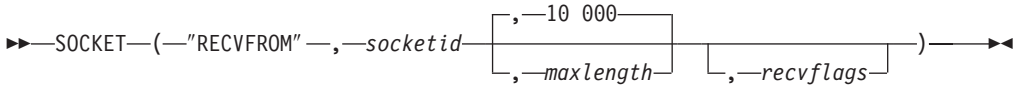
- If the socket is a stream socket and the length of the data returned is 0, the remote peer has closed its side of the connection.
- If the socket is a datagram socket, the command returns data up to the length specified by the *maxlength* parameter. The remainder of the datagram is discarded. If the socket is a datagram socket and the amount of data returned is 0, a datagram packet was received with no data.

Guidelines:

- Use the RECV command for stream and connected UDP sockets. For stream sockets, data is processed as streams of information with no boundaries separating the data. Applications should place the RECVFROM command in a loop until all the data has been received.
- If the socket is a datagram socket, the RECVFROM command returns the name of the remote partner. If the socket is a stream socket, use the command GETPEERNAME to determine the name of the remote partner.
- Use the SELECT command to determine whether there is data to be read on the socket.

Tip: If the SO_ASCII socket option is enabled, then the data received is translated from EBCDIC to ASCII.

Format



Parameters

socketid
The socket descriptor.

maxlength
The maximum amount of data (in bytes) to be returned. The *maxlength* parameter can be a number in the range 0-100 000. By default, this parameter is set to 10 000.

recvflags
An optional parameter. Specifies the following receive flags:

MSG_OOB, OOB
Receive out-of-band data (stream sockets only). Even if the OOB flag is not set, out-of-band data can be read if the SO_OOBINLINE option is set for the socket.

MSG_PEEK, PEEK
Peek at the data, but do not destroy data. If the peek flag is set, the next receive operation will read the same data.

MSG_WAITALL, WAITALL
Requests that the function block until the full amount of data requested can be returned (stream sockets only). The function may return a smaller amount of data if the connection is terminated, an error is pending, or SO_RCVTIMEO is set and the timer expired for the socket.

Returned value

The command returns a string that contains the return code, a NAME string, the maximum length of the data returned, and the data. The return code can be 0, a REXX socket API error number, or the REXX TCP/IP error number that is set by the socket command. The return code 0 indicates that the requested socket command was completed successfully.

The following list are examples of what is returned by the RECVFROM command.

IPv4 socket

```
0 AF_INET 54004 10.1.2.3 19 This is sample data
```

IPv6 socket

```
0 AF_INET6 54004 0 2001:10:1:2::3 0 19 This is sample data
```

In the examples, `0` is the return code, `AF_INET 54004 10.11.103.1` or `AF_INET6 54004 0 2001:10:1:2::3 0` is the socket name of the remote partner, `19` is the length of the data received, and `This is sample data` is the data that was received on the socket.

For information about the format of the NAME string, see "How structures are represented" on page 698. See Appendix B, "Socket call error return codes," on page 885 for additional information about the numeric error codes that are returned by this command.

The following REXX TCP/IP error numbers can be returned:

- 4 EITNR
- 5 EIO
- 9 EBADF
- 22 EINVAL
- 35 EWOULDBLOCK
- 38 ENOTSOCK
- 45 EOPNOTSUPP
- 54 ECONNRESET
- 57 ENOTCONN
- 60 ETIMEDOUT

The following REXX socket API error numbers can be returned:

- 2001 EINVALIDRXSOCKETCALL
- 2005 ESUBTASKNOTACTIVE
- 2009 ESOCKETNOTDEFINED

LE C/C++ equivalent

```
int recvfrom(int socket, char *buffer, int length, int flags,
struct sockaddr *address, int *address_length);
```

Code example

```
/* REXX EZARXR21 */
/*
 * This sample demonstrates the use of the READ and RECV
 * socket commands.
 *
 * To use the READ command, set the variable g_RECVCMD equal to "READ"
 * to use the RECV command, set the variable g_RECVCMD equal to "RECV"
 *
 * The program creates a listening socket and then goes into a
 * loop and blocks on the accept command. When a new connection is
 * ACCEPTED the program will issue the READ or RECV command until
 * the connection is terminated.
 *
 * If the data received is the string "DONE", then the
 * program will close the accepted socket and wait for a new
 * connection request.
 */
g_RECVCMD = "READ"
src = socket("INITIALIZE","MYSET01",10);
if perror(src,"INITIALIZE") = 0 then do
   src = socket("SOCKET","AF_INET6","STREAM");
   if perror(src,"SOCKET") = 0 then do
      parse var src . l_sockid
      l_name6 = "AF_INET6 54004 0 ::0 0";
      src = socket("BIND", l_sockid, l_name6);
      if perror(src,"BIND") = 0 then do
         src = socket("LISTEN", l_sockid);
         if perror(src,"LISTEN") = 0 then do
            say "Listening on socket "l_sockid;
            do forever
               src = socket("ACCEPT", l_sockid );
               if perror(src,"ACCEPT") = 0 then do
                  parse var src . l_newsockid . ;
                  l_datalen = -1;
                  l_Done = "FALSE";
                  l_totallen = 0;
                  l_packet = "";
                  /* ********************************************
                   * Loop around RECV|READ command until all data has
                   * has been received and the client closes the
                   * connection.
                   * ********************************************/
                  do until l_datalen = 0 | l_done = "TRUE"
                     src = socket(g_RECVCMD,l_newsockid,512);
                     if perror(src,g_RECVCMD) = 0 then do
                        parse var src l_retcode l_datalen l_data
                        if l_datalen > 0 then do
                           l_totallen = l_totallen + l_datalen;
                           if l_packet = "" then do
                              l_packet = l_data;
                              if l_packet = "DONE" then
                                 l_done = "TRUE";
```

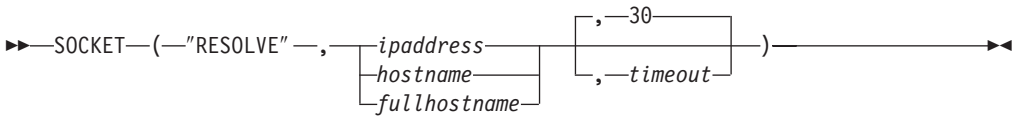
```
                        end;
                        else l_packet = l_packet||l_data;
                     end;
                     else do
                     /* ************************************
                      * A data length of zero indicates the
                      * connection has been closed by the
                      * remote side
                      * ************************************/
                        Say "Connection has been closed",
                            "received "l_totallen" bytes";
                        l_done = "TRUE";
                     end;
                  end;
                  else do
                     l_done = "TRUE";
                  end;
               end; /* DO READ */
               src = socket("CLOSE",l_newsockid);
               src = perror(src,"CLOSE");
            end; /* ACCEPT */
         end; /* DO FOREVER */
      end;
   end;
end;
end; /* INITIALIZE */
src = perror(socket("TERMINATE","MYSET01"),"TERMINATE");
exit 0;

/* This routine returns -1 if the first word if arg 1 is not zero */
perror: if word(arg(1),1) = 0 then return 0; else
    Say arg(2) "Error : "arg(1);
    return -1;
```

Figure 160. READ command example

RESOLVE

Use the RESOLVE command to resolve a host name or an IP address.

Format



Parameters

ipaddress
The IPv4 address of the system in dotted decimal format.

hostname
The host name, for example, BOB01. The maximum length is 255 characters.

Fullhostname
The fully qualified host name, for example, BOB01.THEWORLD.COM. The maximum length is 255 characters.

timeout
The resolver timeout value. By default, this is set to 30 seconds.

Returned value

The command returns a string that contains the return code, the IP address, and the host name. The return code can be 0, a REXX socket API error number, or the REXX TCP/IP error number that is set by the socket command. The return code 0 indicates that the requested socket command was completed successfully.

The following string is an example of what is returned by the RESOLVE command:

```
0 10.201.202.1 BOB01.THEWORLD.COM
```

In the example, 0 is the return code, 10.201.202.1 is the host IP address, and BOB01.THEWORLD.COM is the host name.

See Appendix B, "Socket call error return codes," on page 885 for additional information about the numeric error codes that are returned by this command.

The following REXX TCP/IP error number can be returned:

- 22 EINVAL

The following REXX socket API error numbers can be returned:

- 2001 EINVALIDRXSOCKETCALL
- 2005 ESUBTASKNOTACTIVE
- 2012 EINVALIDNAME
- 2016 EHOSTNOTFOUND

LE C/C++ equivalent

This command has no LE C/C++ equivalent.

Code example

```
/* REXX EZARXR23 */
/*
 * This sample demonstrates the use of the RESOLVE
 * socket command.
 */
src = socket("INITIALIZE","MYSET01");
src = socket("RESOLVE","your.hostname.here");
if word(src,1) = 0 then do
   Say "The host name is "WORD(src,3)
   Say "The IP Address is "WORD(src,2);
end;
src = socket("TERMINATE","MYSET01");
exit 0;
```

Figure 161. RESOLVE command example

SELECT

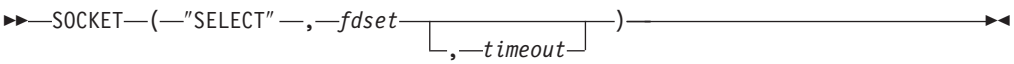
Use the SELECT command to monitor groups of sockets to determine when one or more of the sockets is ready for a read operation, is ready for a write operation, or has an exception pending.

Guidelines:

- A close on the other side of a socket connection is reported not as an exception but as a read event, which returns 0 bytes of data.

- When the CONNECT command is called with a socket descriptor in nonblocking mode, set up completion is reported as a write event on the socket.
- The SELECT command returns an exception pending when either a connection is reset or when a TAKESOCKET command is completed for a socket that was previously given using the GIVESOCKET command.

Format



Parameters

fdset

Specifies the set of socket descriptors to be monitored for activity. The *fdset* parameter is a string in the following format:

```
"READ" rdlist "WRITE" wrlist "EXCEPTION" exlist
```

where:

- The *rdlist* value is a space-delimited list of sockets to be monitored for reading.
- The *wrlist* value is a space-delimited list of sockets to be monitored for writing.
- The *exlist* value is a space-delimited list of sockets to be monitored for exceptions.

To specify that all sockets are monitored, set the value of the *rdlist*, *wrlist*, or *exlist* string to an asterisk (*).

For example, if you want to monitor the sockets with files descriptors 1, 2, and 3 to determine when the socket has data to be read, issue the following command:

```
SOCKET("SELECT","READ 1 2 3 WRITE EXCEPTION",120);
```

This code example also sets a *timeout* parameter of 120 seconds.

To specify that no sockets are monitored, issue the following command:

```
SOCKET("SELECT","READ WRITE EXCEPTION",);
```

timeout

A positive integer that indicates the maximum length of time (in seconds) that the SELECT command will monitor the sockets. If no *timeout* parameter is specified, the sockets are monitored indefinitely.

Returned value

The command returns a string that contains the return code, the number of ready sockets, and information about the ready sockets. The return code can be 0, a REXX socket API error number, or the REXX TCP/IP error number that is set by the socket command. The return code 0 indicates that the requested socket command was completed successfully.

The following string is an example of what is returned by the SELECT command:

```
0 2 READ 1 3 WRITE EXCEPTION
```

In this example, 0 is the return code, 2 is the number of ready sockets, and 1 and 3 are the sockets that ready for READ operations. There are no sockets ready for WRITE operations or sockets with pending exceptions.

See Appendix B, "Socket call error return codes," on page 885 for additional information about the numeric error codes that are returned by this command.

The following REXX TCP/IP error numbers can be returned:

- 9 EBADF
- 22 EINVAL
- 38 ENOTSOCK
- 45 EOPNOTSUPP

The following REXX socket API error numbers can be returned:

- 2001 EINVALIDRXSOCKETCALL
- 2005 ESUBTASKNOTACTIVE
- ESOCKETNOTDEFINED
- 2012 EINVALIDNAME

LE C/C++ equivalent

This command has no LE C/C++ equivalent.

Code example

```
/* REXX EZARXR24 */
/*
 * This is an example of a function command that can be used to
 * to determine if a connection is available. This procedure
 * would be called before calling the ACCEPT command.
 *
 * Two arguments are passed. The p_listensocketlist is a
 * list of 1 or more space-delimited socket descriptors to be
 * monitored. The p_timeout value is how long the SELECT
 * command should wait before returning.
 *
 * The monitored sockets can be BLOCKING or NON-BLOCKING
 * sockets.
 *
 * Example usage:
 *
 * INITIALIZE a socket set.
 * open a SOCKET descriptor.
 * BIND the socket to a well known port.
 * set the socket to passive mode using the LISTEN command.
 * LOOP:
 * Call the IsConnectionAvailable function
 * If a connection is available, ACCEPT the connection
 * and continue processing. Otherwise, do some other work,
 * and loop.
 *
 * Function Usage:
 *    l_retcode = IsConnectionAvailable(l_sockid,60);
 *
 * The function will return one of the following:
 *  - The list of socket descriptors that have
 *    connections pending.
 *
 *  - The string "TIMEOUT". This indicates the select command
 *    timed out before any connections arrived.
 *
 *  - the string "ERROR". This indicates an ERROR occurred
 *    when the SELECT command was issued.
 */
IsConnectionAvailable: PROCEDURE
Parse arg p_listensocketlist, p_timeout
l_fdset = "READ "p_listensocketlist" WRITE EXCEPTION";
l_retvalue = SOCKET("SELECT",l_fdset,p_timeout);
parse var l_retvalue l_retcode l_numSockets;
if l_retcode = 0 then do
   if l_numsocket > 0 then do
      parse value l_retvalue with 'READ' l_sockidrdlist 'WRITE' .;
      parse value l_retvalue with 'WRITE' l_sockidwrlist 'EXCEPTION' .
      parse value l_retvalue with 'EXCEPTION' l_sockidexlist;
      l_retcode = l_sockidrdlist;
   end
   else do
      Say "Select command timed out";
      l_retcode = "TIMEOUT"
   end;
end;
else do
   l_retcode = "ERROR";
end;
return l_retcode;
```

Figure 162. SELECT command example

Tip: See the IOCTL command for another example on how to use SELECT command.

SEND

Use the SEND command to send an outgoing message on the connected socket.

When the socket is a TCP socket, the following conditions apply:

- If the socket is in blocking mode and if the total amount of data to be sent cannot be processed by the stack when the command is issued, the command blocks until the data can be sent.
- If the socket is in nonblocking mode and if the total amount of data to be written cannot be processed by the stack when the command is issued, the command returns the number of bytes that were successfully written. If none of the data can be written, the command returns the value -1 and the `35 EWOULDBLOCK` error message .

When the socket is a connected UDP socket, the SEND command either is completed or failed. A connected UDP socket does not return the `35 EWOULDBLOCK` error message .

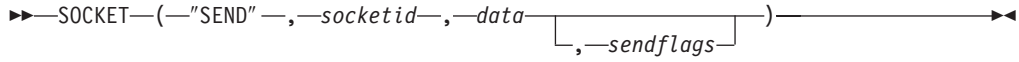
Guideline: Place the SEND command in a loop to ensure that all the data is written. For a TCP socket, a partial write operation might occur regardless of whether the socket is in blocking or nonblocking mode. A partial write operation occurs when the stack copies some but not all of the application data:

- If a partial write operation occurs on a socket in blocking mode, the blocking socket is interrupted. The return value contains the number of bytes written, and the return code contains the reason for the interruption. In such cases, consider ending the connection.
- If a partial write operation occurs on a socket in nonblocking mode, the return value indicates the number of bytes that were successfully sent. If this number is less than the number of bytes specified on the SEND command, repeat the SEND command until all data is written. The blocking condition can last for a long time, so use other strategies to ensure that the application does not remain in a busy loop sending data.

Tips:

- Use the SELECT command to determine whether a socket is ready to send additional data. To do so, test the socket for a WRITE event.
- If the SO_ASCII socket option is enabled, then the data received is translated from EBCDIC to ASCII.

Format



Parameters

socketid
The socket descriptor.

data
The data to be sent.

sendflags
Optional flags that specify how the data is sent. The following flags are supported:

MSG_OOB
Sends the data out-of-band. Out-of-band data is supported only for stream sockets created in the AF_INET domain. The values OOB or OUT_OF_BAND are supported also.

MSG_DONTROUTE
Specifies that the data is routed by the calling program. The value DONTROUTE is supported also.

Returned value

The command returns a string that contains the return code and the amount of data sent, for example, `0 19`. The return code can be 0, a REXX socket API error number, or the REXX TCP/IP error number that is set by the socket command. The return code 0 indicates that the requested socket command was completed successfully.

See Appendix B, "Socket call error return codes," on page 885 for additional information about the numeric error codes that are returned by this command.

The following REXX TCP/IP error numbers can be returned:
- 4 EINTR
- 9 EBADF
- 5 EIO
- 22 EINVAL
- 32 EPIPE
- 35 EWOULDBLOCK
- 38 ENOTSOCK
- 40 EMSGSIZE
- 45 EOPNOTSUPP
- 54 ECONNRESET
- 57 ENOTCONN

The following REXX socket API error numbers can be returned:
- 2001 EINVALIDRXSOCKETCALL
- 2005 ESUBTASKNOTACTIVE
- 2009 ESOCKETNOTDEFINED

LE C/C++ equivalent

```
int send(int socket, char *buffer, int length, int flags);
```

Code example

See the EZARXS03 REXX sample in the SEZAINST file for an example of using the SEND command.

SENDTO

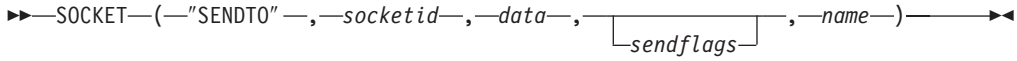
Use the SENDTO command to send an outgoing message on a socket descriptor. This command differs from the SEND command in that it includes the destination address as a parameter.

This command is used primarily to send data using connectionless protocols such as UDP or RAW. Use the SENDTO command to send datagrams on a UDP socket regardless of whether the socket is connected.

Guidelines:

- For TCP or connected UDP sockets, use the SEND command.
- If the SO_ASCII socket option is enabled, then the data received is translated from EBCDIC to ASCII.

Format



Parameters

socketid
The socket descriptor.

data
The data to be sent.

sendflags
Optional flags that specify how the data is sent. The following flag is supported:

MSG_DONTROUTE
Do not route the data. Routing is handled by the calling program. The DONTROUTE value is supported also.

name
The socket name of the remote host to which the data is sent.

The format for the *name* parameter depends on the socket type:

AF_INET sockets (IPv4)
name = "domain portid ipaddress"

AF_INET6 sockets (IPv6)
name = "domain portid flowinfo ipaddress scopeid"

where

- The *domain* value is the decimal number 2 for AF_INET and the decimal number 19 for AF_INET6.
- The *portid* value is the port number.
- The *ipaddress* value is the IP address of the remote host. It must be an IPv4 address for AF_INET and an IPv6 address for AF_INET6.
- The *flowinfo* value must be 0.
- The *scopeid* value identifies the interfaces that are applicable for the scope of the address that is specified in the *ipaddress* field. For a link-local IP address, the *scopeid* field can specify a link index, which identifies a set of interfaces.

For all other scopes, the *scopeid* field must be set to 0. Setting the *scopeid* field to 0 indicates that any address type and scope can be specified.

Returned value

The command returns a string that contains the return code and an integer that specifies the amount of data that was sent, for example, `0 192`. The return code can be 0, a REXX socket API error number, or the REXX TCP/IP error number that is set by the socket command. The return code 0 indicates that the requested socket command was completed successfully.

See Appendix B, "Socket call error return codes," on page 885 for additional information about the numeric error codes that are returned by this command.

The following REXX TCP/IP error numbers can be returned:

- 4 EINTR
- 9 EBADF
- 5 EIO
- 22 EINVAL
- 32 EPIPE
- 35 EWOULDBLOCK
- 38 ENOTSOCK
- 40 EMSGSIZE45 EOPNOTSUPP
- 54 ECONNRESET
- 57 ENOTCONN

The following REXX socket API error numbers can be returned:

- 2001 EINVALIDRXSOCKETCALL
- 2005 ESUBTASKNOTACTIVE
- 2009 ESOCKETNOTDEFINED

LE C/C++ equivalent

```
int sendto(int socket, char *buffer, int length, int flags, struct sockaddr
 *address, int address_len);
```

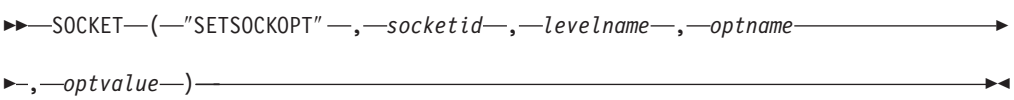
Code example

See "RECVFROM" on page 775 for an example of using the SENDTO command.

SETSOCKOPT

Use the SETSOCKOPT command to set socket options.

Format



Parameters

socketid
The socket descriptor.

levelname
The protocol level. The following protocol levels are supported:

IPPROTO_TCP
Set socket options at the TCP layer

IPPROTO_IP
Set IPv4 socket options at the IP layer

IPPROTO_IPV6
Set IPv6 socket options at the IP layer

SOL_SOCKET
Set socket options at the socket layer

optname
The option or options. The following rules apply:

- Options that begin with SO_ require the SOL_SOCKET protocol level.
- Options that begin with TCP_ require the IPPROTO_TCP protocol level.
- Options that begin with IP_ require the IPPROTO_IP protocol level.
- Options that begin with IPV6_ require the IPPROTO_IPV6 protocol level.
- Options that begin with MCAST require the IPPROTO_IP or IPPROTO_IPV6 protocol level.

The following values are supported for the *optname* parameter:

IP_ADD_MEMBERSHIP
(IPV4-only) Enables an application to join a multicast group on a specific interface. Applications in a multicast group can receive multicast datagrams. An application can join multiple multicast groups on the same interface or the same multicast group on multiple interfaces, but only one interface address can be specified with a single command. The *optvalue* parameter must be a string that contains the multicast address followed by the interface address on which the application wants to receive multicast datagrams, for example, ″224.224.224.1 10.11.13.4″. This command returns the return code or error number.

Tip: Use the IOCTL command with the SIOCGIFADDR option to determine the interface address.

IP_ADD_SOURCE_MEMBERSHIP
(IPV4-only) Enables an application to join a multicast group on a specific interface and a specific source address. The *optvalue* parameter must be a string that contains the multicast address, the interface address, and the source address, for example, ″224.224.224.1 10.11.16.103 10.11.107.1″. The source address represents a filter; the application only receives multicast packets if the source address matches the source address filter for the multicast group.

This command returns the return code or error number.

Restrictions:

- Only one interface address can be specified with a single call.
- The stack supports up to 64 source address filters for each multicast-group interface pair. If the number of filters exceeds the maximum, ENOBUFS is returned.

- You can specify only a single source address with each call. If you want to join a multicast group and receive data from two different source addresses, then issue the SETSOCKOPT command twice.

Guideline: Applications that want to receive multicast datagrams need to join multicast groups. Use this option when the application wants to receive multicast packets on a specific group from one or more senders

IP_BLOCK_SOURCE
(IPV4-only) Enables an application to block multicast packets that are sent from a specific address. The application must have previously joined the multicast group. The *optvalue* parameter must be a string that contains the multicast address, source address, and interface address, for example, "224.224.224.1 10.11.16.103 10.11.107.1". This option returns 0 if it is successfully completed; otherwise, it returns the error number.

IP_DROP_MEMBERSHIP
(IPV4-only) Enables an application to exit a multicast group. If source filtering is enabled, all source filters are deleted. The *optvalue* parameter must be a string that contains the multicast address and the interface address, for example, "224.224.224.1 10.11.13.4". This option returns 0 if it is successfully completed; otherwise, it returns the error number.

IP_DROP_SOURCE_MEMBERSHIP
(IPV4-only) Enables an application to leave a multicast-source multicast group. The application will no longer receive multicast packets from the group. The *optvalue* parameter must be a string that contains the multicast address, source address, and interface address, for example, "224.224.224.1 10.11.13.4 10.11.107.1". This option returns 0 if it is successfully completed; otherwise, it returns the error number.

IP_MULTICAST_IF
(IPV4-only) Sets the IPv4 interface address that is used to send outbound multicast datagrams. Multicast datagrams can be sent only on one interface at a time. The *optvalue* parameter is the IP address of the interface. This option returns 0 if it is successfully completed; otherwise, it returns the error number.

IP_MULTICAST_LOOP
(IPV4-only) Controls whether a multicast datagram is looped back on the outgoing interface by the IP layer for local delivery when datagrams are sent to a group to which the sending host belongs. By default, loopback is enabled. The *optvalue* parameter must be one of the following values: 0 (disabled) or 1 (enabled). This option returns 0 if it is successfully completed; otherwise, it returns the error number.

IP_MULTICAST_TTL
(IPV4-only) Sets the IP time-to-live of outgoing multicast datagrams. By default, this is set to 1; multicast is available only to the local subnet. The *optvalue* parameter must be an integer in the range 1-s255.

IP_UNBLOCK_SOURCE
(IPV4-only) Enables an application to unblock a previously blocked source address for an IPv4 multicast group. Only one interface address can be specified with a single call. The *optvalue* parameter must be a string that contains the multicast address, source address, and interface

address, for example, ″224.224.224.1 10.11.103.1 10.11.107.1″. This option returns 0 if it is successfully completed; otherwise, it returns the error number.

IPV6_ADDR_PREFERENCES
(AF_INET6 only) Sets the IPv6 address preferences to be used when selecting the source address. The following are the valid IPV6_ADDR_PREFERENCES flags:

IPV6_PREFER_SRC_HOME
A home IPv6 address is preferred over a care-of IPv6 address.

IPV6_PREFER_SRC_COA
A care-of IPv6 address is preferred over a home IPv6 address.

IPV6_PREFER_SRC_TMP
A temporary IPv6 address is preferred over a public IPv6 address.

IPV6_PREFER_SRC_PUBLIC
A public IPv6 address is preferred over a temporary IPv6 address.

IPV6_PREFER_SRC_CGA
A cryptographically generated IPv6 address is preferred over a non-cryptographically generated IPv6 address.

IPV6_PREFER_SRC_NONCGA
A non-cryptographically generated IPv6 address is preferred over a cryptographically generated IPv6 address.

You can specify a single flag or multiple flags that are separated by blanks.

Results:

- Combining contradictory flags, such as IPV6_PREFER_SRC_CGA and IPV6_PREFER_SRC_NONCGA, results in error code 2020 (EINVALIDCOMBINATION).
- The stack could assign a source IP address that does not conform to one or more of the IPV6_ADDR_PREFERENCES flags that you have set.

IPV6_JOIN_GROUP
(IPv6-only) Enables an application to join a multicast group on a specific interface. Only applications that want to receive multicast datagrams need to join multicast groups. An application can join multiple multicast groups on the same interface, or it can join the same multicast group on multiple interfaces. The *optvalue* parameter must be a string that contains the multicast address and the index of the interface on which the application wants to receive multicast datagrams, for example, ″FF02:225:9:10::11 3″. If the interface index is set to 0, the stack will chose the local address. This option returns 0 if it is successfully completed; otherwise, it returns the error number.

Guideline: Use the SIOCGIFNAMEINDEX function of the IOCTL command to determine the index number for an interface.

Restriction: Only one interface address can be specified in a single call. A multicast address can be associated with a real interface only.

IPV6_LEAVE_GROUP
(IPv6-only) Enables an application to leave a multicast group. The *optvalue* parameter must be a string that contains the multicast address and the interface address, for example, ″FF02:225:9:10::11 3″. The *optvalue* parameter must match the original IPV6_JOIN_GROUP parameters; for example, if the interface index specified for the IPV6_JOIN_GROUP was 0, then 0 also must be specified as the interface index for IPV6_LEAVE_GROUP command. This option returns 0 if it is successfully completed; otherwise, it returns the error number.

IPV6_MULTICAST_HOPS
(IPv6-only) Sets the hop limit that is used for outgoing multicast packets. The *optvalue* parameter is optional; if it is not issued, the hop limit is set to 1.

The *optvalue* parameter can have the following values:

-1 The default value for the stack is used.

0-255 The hop limit.

This option returns 0 if it is successfully completed; otherwise, it returns the error number.

Restriction: To set the hop limit value to be greater than the TCP/IP default value, a REXX-application user ID must have superuser authority.

IPV6_MULTICAST_IF
(IPv6-only) Sets the index of the IPv6 interface that is used to send outbound multicast datagrams from the socket application. The *optvalue* parameter must specify the interface index number, for example, 34. This option returns 0 if it is successfully completed; otherwise, it returns the error number.

IPV6_MULTICAST_LOOP
(IPv6-only) Controls whether a multicast datagram is looped back on the outgoing interface by the IP layer for local delivery when datagrams are sent to a group to which the sending host belongs. By default, multicast datagrams are looped back. The *optvalue* parameter must be one of the following values: 0 (disabled) or 1 (enabled). This option returns 0 if it is successfully completed; otherwise, it returns the error number.

IPV6_UNICAST_HOPS
(IPv6-only) Sets the hop limit that is used for outgoing unicast IPv6 packets. The *optvalue* parameter is optional; if it is not issued, the hop limit is set to 1.

The *optvalue* parameter can have the following values:

-1 The default value for the stack is used.

0-255 The hop limit.

This option returns 0 if it is successfully completed; otherwise, it returns the error number.

Restriction: An application must be APF authorized to set the hop limit value to be greater than the TCP/IP default value. This option is not valid when used in CICS applications. CICS applications cannot run as APF authorized.

IPV6_V6ONLY
(IPv6-only) Restricts a socket to sending and receiving IPv6 packets only. By default, a socket is not restricted. The *optvalue* parameter must be one of the following values: 0 (disabled) or 1 (enabled). This option returns 0 if it is successfully completed; otherwise, it returns the error number.

MCAST_BLOCK_SOURCE
Enables an application to block multicast packets from a specific source address. The multicast group must have been previously joined. The *optvalue* parameter must be a string that contains the interface index, the multicast address, and the source address. Specify the multicast address and source address using the NAME string. The following string is an example of what might be coded for the *optvalue* parameter:

```
"45 AF_INET6 54666 0 FF02::32:1 0 AF_INET6 0 0 2001:10:11:107::1 0"
```

For more information about the format of the NAME string, see "How structures are represented" on page 698. This option returns 0 if it is successfully completed; otherwise, it returns the error number.

Tip: This option is valid for both IPv4 and IPv6.

MCAST_JOIN_GROUP
Enables an application to join a multicast group on a specific interface. Only applications that want to receive multicast datagrams need to join multicast groups. The *optvalue* parameter must be a string that contains the interface index and a multicast address. Specify the multicast address using the socket address name format. The following string is an example of what you can code for the *optvalue* parameter:

″45 AF_INET 1234 224.224.224.1″

For more information about the format of the NAME string, see "How structures are represented" on page 698. This option returns 0 if it is successfully completed; otherwise, it returns the error number.

Tip: This option is valid for both IPv4 and IPv6.

MCAST_JOIN_SOURCE_GROUP
Enables an application to join a source multicast group on a specific interface and source address. Only applications that want to receive multicast datagrams need to join source multicast groups. The *optvalue* parameter must be a string that contains the interface index, the multicast address, and the source address. Specify the multicast address and source address the using socket address name format. The following string is an example of what you can code for the *optvalue* parameter:

```
"45 AF_INET6 1234 0 FF02::123:1 0 AF_INET6 0 0 2001:10:11:107::1 0"
```

For more information about the format of the NAME string, see "How structures are represented" on page 698. This option returns 0 if it is successfully completed; otherwise, it returns the error number.

Tip: This option is valid for both IPv4 and IPv6.

MCAST_LEAVE_GROUP
Enables an application to leave a multicast group or to leave all source multicast groups. The *optvalue* parameter must be a string that contains the interface index and the multicast address; specify the multicast address using the socket address name format. The following string is an example of what you can code for the *optvalue* parameter:

```
"45 AF_INET6 1234 0 FF02::123:1 0"
```

For more information about the format of the NAME string, see "How structures are represented" on page 698. This option returns 0 if it is successfully completed; otherwise, it returns the error number.

Tip: This option is valid for both IPv4 and IPv6.

MCAST_LEAVE_SOURCE_GROUP
Enables an application to leave a source multicast group. The *optvalue* parameter must be a string that contains the interface index, the multicast address, and the source address. Specify the multicast address and source address using the socket address name format. The following string (all on one line) is an example of what you can code for the *optvalue* parameter:

```
"45 AF_INET6 1234 0 FF02::123:1 0 AF_INET6 1234 0
  2001:10:11:103::1 0"
```

For more information about the format of the NAME string, see "How structures are represented" on page 698. This option returns 0 if it is successfully completed; otherwise, it returns the error number.

Tip: This option is valid for both IPv4 and IPv6.

MCAST_UNBLOCK_SOURCE
Enables an application to unblock multicast packets that are sent from a specific address. The multicast group must have been previously blocked. The *optvalue* parameter must be a string that contains the interface index, the multicast address, and the source address. Specify the multicast address and source address using the socket address name format. The following string is an example of what you can code for the

```
optvalue
```

parameter:

″45 AF_INET6 1234 0 FF02::123:1 0 AF_INET6 1234 0 2001:10:11:103::1 0″

For more information about the format of the NAME string, see "How structures are represented" on page 698. This option returns 0 if it is successfully completed; otherwise, it returns the error number.

Tip: This option is valid for both IPv4 and IPv6.

Restriction: Only one source address can be specified in a call.

SO_ASCII

(REXX only) Enables all incoming data to be translated from ASCII to EBCDIC, and all outgoing data to be translated from EBCDIC to ASCII. The *optvalue* parameter must be one of the following values: 0 (disabled) or 1 (enabled). This option returns a string that contains the error code and either ON (enabled) or OFF (disabled). If the option is enabled, the name of the translation table is returned also. The following string is an example of what might be returned: `0 ON MYTRANTB`.

The translation tables are searched in the following order:

1. *user_prefix*.*subtaskid*.TCPXLBIN
2. *user_prefix*.*userid*.TCPXLBIN
3. *system_prefix*.STANDARD.TCPXLBIN
4. *system_prefix*.RXSOCKET.TCPXLBIN
5. Internal tables

The following descriptions apply:

- The *user_prefix* value is either the user ID or the job name of the REXX program.
- The *system_prefix* value is either TCPIP or the DATASETPREFIX value from the *hlq*.TCPIP.DATA. You can change the *system_prefix* value to match your site convention.
- The *subtaskid* value is the name of the socket set.
- The *userid* value is the user ID under which the REXX EXEC is running.

When the internal tables are used, the data is converted in the following way:

ASCII to EBCDIC	second hex digit of byte of ASCII data														
	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
first hex digit of byte of ASCII data	0	00	01	02	03	37	2D	2E	2F	16	05	25	0B	0C	0D	0E	0F
	1	10	11	12	13	3C	3D	32	26	18	19	3F	27	1C	1D	1E	1F
	2	40	4F	7F	7B	5B	6C	50	7D	4D	5D	5C	4E	6B	60	4B	61
	3	F0	F1	F2	F3	F4	F5	F6	F7	F8	F9	7A	5E	4C	7E	6E	6F
	4	7C	C1	C2	C3	C4	C5	C6	C7	C8	C9	D1	D2	D3	D4	D5	D6
	5	D7	D8	D9	E2	E3	E4	E5	E6	E7	E8	E9	4A	E0	5A	5F	6D
	6	79	81	82	83	84	85	86	87	88	89	91	92	93	94	95	96
	7	97	98	99	A2	A3	A4	A5	A6	A7	A8	A9	C0	6A	D0	A1	07
	8	20	21	22	23	24	15	06	17	28	29	2A	2B	2C	09	0A	1B
	9	30	31	1A	33	34	35	36	08	38	39	3A	3B	04	14	3E	E1
	A	41	42	43	44	45	46	47	48	49	51	52	53	54	55	56	57
	B	58	59	62	63	64	65	66	67	68	69	70	71	72	73	74	75
	C	76	77	78	80	8A	8B	8C	8D	8E	8F	90	9A	9B	9C	9D	9E
	D	9F	A0	AA	AB	AC	AD	AE	AF	B0	B1	B2	B3	B4	B5	B6	B7
	E	B8	B9	BA	BB	BC	BD	BE	BF	CA	CB	CC	CD	CE	CF	DA	DB
	F	DC	DD	DE	DF	EA	EB	EC	ED	EE	EF	FA	FB	FC	FD	FE	FF

Figure 163. ASCII to EBCDIC

EBCDIC to ASCII	second hex digit of byte of EBCDIC data														
	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
first hex digit of byte of EBCDIC data	0	00	01	02	03	9C	09	86	7F	97	8D	8E	0B	0C	0D	0E	0F
	1	10	11	12	13	9D	85	08	87	18	19	92	8F	1C	1D	1E	1F
	2	80	81	82	83	84	0A	17	1B	88	89	8A	8B	8C	05	06	07
	3	90	91	16	93	94	95	96	04	98	99	9A	9B	14	15	9E	1A
	4	20	A0	A1	A2	A3	A4	A5	A6	A7	A8	5B	2E	3C	28	2B	21
	5	26	A9	AA	AB	AC	AD	AE	AF	B0	B1	5D	24	2A	29	3B	5E
	6	2D	2F	B2	B3	B4	B5	B6	B7	B8	B9	7C	2C	25	5F	3E	3F
	7	BA	BB	BC	BD	BE	BF	C0	C1	C2	60	3A	23	40	27	3D	22
	8	C3	61	62	63	64	65	66	67	68	69	C4	C5	C6	C7	C8	C9
	9	CA	6A	6B	6C	6D	6E	6F	70	71	72	CB	CC	CD	CE	CF	D0
	A	D1	7E	73	74	75	76	77	78	79	7A	D2	D3	D4	D5	D6	D7
	B	D8	D9	DA	DB	DC	DD	DE	DF	E0	E1	E2	E3	E4	E5	E6	E7
	C	7B	41	42	43	44	45	46	47	48	49	E8	E9	EA	EB	EC	ED
	D	7D	4A	4B	4C	4D	4E	4F	50	51	52	EE	EF	F0	F1	F2	F3
	E	5C	9F	53	54	55	56	57	58	59	5A	F4	F5	F6	F7	F8	F9
	F	30	31	32	33	34	35	36	37	38	39	FA	FB	FC	FD	FE	FF

Figure 164. EBCDIC to ASCII

SO_BROADCAST
Enables a program to send broadcast messages over the socket to destinations that can receive datagram messages. By default, this option is disabled. The *optvalue* parameter must be one of the following values: 0 (disabled) or 1 (enabled). This option returns 0 if it is successfully completed; otherwise, it returns the error number.

Restriction: This option is not valid for stream sockets.

SO_DEBUG
(REXX only) Control whether debugging information is recorded. By default, this option is disabled. The *optvalue* parameter must be either ON (enabled) or OFF (disabled). This option returns 0 if it is successfully completed; otherwise, it returns the error number. This option is valid only for stream sockets.

SO_DONTROUTE
Bypasses normal routing algorithms for outgoing packets on the socket. If the local interface cannot be determined, when a packet is sent using one of the SEND commands, then the 51 ENETUNREACH error number is returned. This option returns either 1 (enabled) or 0 (disabled).

SO_EBCDIC
(REXX only) Enables data to be translated to and from EBCDIC. This option is ignored by EBCDIC hosts. The *optvalue* parameter must be either ON (enabled) or OFF (disabled). This option returns a string that contains the error code and either ON (enabled) or OFF (disabled). If the option is enabled, the name of the translation table is returned also. The following string is an example of what might be returned:

```
0 ON MYTRANTB
```

SO_KEEPALIVE
Sets the keep alive mechanism to periodically send a packet on an otherwise idle connection for a stream socket. By default, this option is disabled. When enabled, if the remote TCP/IP does not respond to the packet or to retransmissions of the packet, then the connection is terminated with the `ETIMEDOUT` error. The *optvalue* parameter must be one of the following values: 0 (disabled) or 1 (enabled). This option returns 0 if it is successfully completed; otherwise, it returns the error number.

Tip: You also can enable the keep alive mechanism by modifying the TCPIP.PROFILE file.

SO_LINGER
Specifies how TCP/IP processes data that has not been transmitted when the CLOSE command is issued for the socket. When this option is enabled and the CLOSE command is issued, the calling program is blocked until either the data is successfully transmitted or the connection times out. When this option is disabled and the CLOSE command is issued, the CLOSE command returns without blocking the caller; then, TCP/IP continues to attempt to send data for a specified time, which usually provides sufficient time to complete the data transfer. By default, this option is disabled.

The *optvalue* parameter is a string in the following format:

```
linger = "onoff lingertime"
```

where

- The *onoff* value is either 0 (disabled) or 1 (enabled).
- The *lingertime* value is the number of seconds that TCP/IP tries to send data after the CLOSE command is issued.

This option returns 0 if it is successfully completed; otherwise, it returns the error number.

Restrictions:

- Using the SO_LINGER option does not guarantee that a data transfer will be completed, because TCP/IP waits only the amount of time that is specified.
- This option is valid only for stream sockets.

Guidelines:

- Avoid setting a linger time of 0. If you set the linger time to 0, the connection stops rather than closing in an orderly manner. This results in a RESET segment being sent to the connection partner. If the aborting socket is

in nonblocking mode, the CLOSE command is processed as though no linger option is set.

- Enable the SO_LINGER option only when necessary.

SO_OOBINLINE

Controls whether out-of-band data is received. When this option is enabled, out-of-band data is placed in the normal data input queue as it is received; this data is then available to RECV or RECVFROM commands, even if the OOB flag is not set. When this option is disabled, out-of-band data is placed in the priority data input queue as it is received; this data is then available to RECV or RECVFROM commands only if the OOB flag is set. By default, this option is disabled. The *optvalue* parameter must be one of the following values: 0 (disabled) or 1 (enabled). This option returns 0 if it is successfully completed; otherwise, it returns the error number.

Restriction: This option is valid only for stream sockets.

SO_RCVBUF

Controls the size of the data portion of the TCP/IP receive buffer. The size of the receive buffer is protocol specific and is based on the following values:

- (TCP socket) The TCPRCVBufrsize keyword on the TCPCONFIG statement in the PROFILE.TCPIP data set.
- (UDP socket) The UDPRCVBufrsize keyword on the UDPCONFIG statement in the PROFILE.TCPIP data set.
- (Raw socket) The default size 65 535.

The *optvalue* parameter must be either 0 (disabled) or a positive integer that specifies the size of the TCP/IP receive buffer. If you disable this option, the default system setting is used.This option returns 0 if it is successfully completed; otherwise, it returns the error number.

SO_RCVTIMEO

Sets the maximum length of time that a receive-type function can wait before it completes You can specify the number of seconds and microseconds that indicate the length of time to wait for a receive-type function to complete. If a receive-type function has blocked for this much time without receiving data, it returns with the errno EWOULDBLOCK. The value 0 (the default) indicates that a receive-type function does not time out. The optvalue parameter must be a string that contains the number of seconds followed by the number of microseconds. The GETSOCKOPT command returns the return code or error number. Specify a value in the range 0 – 2 678 400 (equal to 31 days) for the number of seconds. Specify a value in the range 0 – 1 000 000 (equal to 1 second) for the number of microseconds. Although you can specify the number of microseconds, the internal TCP/IP timers that are used to implement this function have a granularity of approximately 100 milliseconds. The following receive type commands are supported:

- READ
- RECV
- RECVFROM

SO_REUSEADDR

Controls whether local addresses are reused. Enabling this option alters the normal algorithm that is used with the BIND command. The

normal BIND algorithm permits each Internet address and port combination to be bound only once. If the address and port already have been bound, a subsequent BIND command fails with the 48 EADDRINUSE error. When this option is enabled, the following situations are supported:

- A server can bind the same port multiple times, if each invocation uses a different local IP address and the wild card address INADDR_ANY is used only one time for each port.
- A server with active client connections can be restarted and can bind to its port without having to close all of the client connections.
- For datagram sockets, multicasting is supported so that multiple BIND commands can be made to the same class D address and port number.

By default, this option is disabled. The *optvalue* parameter must be one of the following values: 0 (disabled) or 1 (enabled). This option returns 0 if it is successfully completed; otherwise, it returns the error number.

Tip: If you want to permit multiple servers to bind to INADDR_ANY or IN6ADDR_ANY and listen on the same port, use the SHAREPORT option on the PORT statement in TCPIP.PROFILE.

SO_SNDBUF

Controls the size of the data portion of the TCP/IP send buffer. The size of the send buffer is protocol specific and is based on the following values:

- (TCP socket) The TCPRCVBufrsize keyword on the TCPCONFIG statement in the PROFILE.TCPIP data set.
- (UDP socket) The UDPRCVBufrsize keyword on the UDPCONFIG statement in the PROFILE.TCPIP data set.
- (Raw socket) The default size 65 535.

The *optvalue* parameter must be either 0 (disabled) or a positive integer that specifies the size of the TCP/IP send buffer. If you disable this option, the default system setting is used. This option returns 0 if it is successfully completed; otherwise, it returns the error number.

SO_SNDTIMEO

Sets the maximum length of time that a send-type function can remain blocked before it completes. You can specify the number of seconds and microseconds that indicate the length of time to wait for a send-type function to complete. If a send-type function has blocked for this length of time, the function returns with a partial count or with an errno set to EWOULDBLOCK if no data is sent. The value 0 (the default) indicates that a send type function does not time out. The optvalue parameter must be a string that contains the number of seconds followed by the number of microseconds. The GETSOCKOPT command returns the return code or error number. Specify a value in the range 0 – 2 678 400 (equal to 31 days) for the number of seconds. Specify a value in the range 0 – 1 000 000 (equal to 1 second) for the number of microseconds. While the number of microseconds can be specified, the internal TCP/IP timers that are used to implement this function have a granularity of approximately 100 milliseconds. The following send-type commands are supported:

- SEND
- SENDTO

- WRITE

TCP_KEEPALIVE
Specifies whether a socket-specific timeout value (in seconds) is used instead of a configuration-specific value, when keep alive timing is active for the socket. When enabled, the socket-specific timeout value remains in effect until either the socket is closed or it is reset by a SETSOCKOPT command. The *optvalue* parameter must be either 0 (disabled) or the keep alive value. This options returns a string that contains the return code and the keep alive value. If the option is disabled, the keep alive value is 0.

TCP_NODELAY
Specifies whether the data that is sent over the socket is subject to the Nagle algorithm (RFC 896). When this option is enabled, TCP waits to send small amounts of data until the acknowledgment for the previous data sent is received. When this option is disabled, TCP sends data when it is presented. The *optvalue* parameter must be one of the following values: 0 (disabled) or 1 (enabled). This option returns 0 if it is successfully completed; otherwise, it returns the error number.

optvalue
Additional information that is needed to run the requested command.

Returned value

The return code can be 0, a REXX socket API error number, or the REXX TCP/IP error number that is set by the socket command. The return code 0 indicates that the requested socket command was completed successfully.

See Appendix B, "Socket call error return codes," on page 885 for additional information about the numeric error codes that are returned by this command.

The following REXX TCP/IP error numbers can be returned:
- 9 EBADF
- 22 EINVAL
- 38 ENOTSOCK
- 42 ENOPROTOOPT
- 45 EOPNOTSUPP
- 60 ETIMEDOUT

The following REXX socket API error numbers can be returned:
- 2001 EINVALIDRXSOCKETCALL
- 2005 ESUBTASKNOTACTIVE
- 2009 ESOCKETNOTDEFINED
- 2012 EINVALIDNAME

LE C/C++ equivalent

```
int setsockopt(int socket, int level, int option_name, char *option_value,
 int *option_length);
```

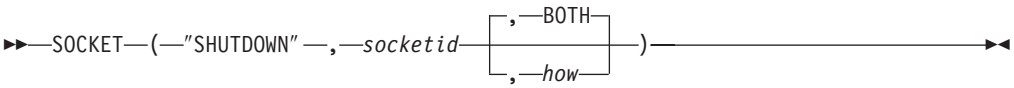
Code example

See the EZARXS01 REXX sample in the SEZAINST file for an example of using the SETSOCKOPT command.

SHUTDOWN

Use the SHUTDOWN command to shut down all or part of a duplex connection.

Format



Parameters

socketid
The socket descriptor of the connected socket.

how
Specifies which operations are to be ended. The following parameters are supported:

BOTH Ends further send and receive operation on the socket. By default, this is the value of the *how* parameter. The value 2 is supported also.

SEND Ends further send operations on the socket. The following values are supported also: 1, TO, SENDING, WRITE, WRITING.

READ Ends further receive operations on the socket. The following values are supported also: 0, FROM, READING, RECEIVE, RECEIVING.

Returned value

The return code can be 0, a REXX socket API error number, or the REXX TCP/IP error number that is set by the socket command. The return code 0 indicates that the requested socket command was completed successfully.

See Appendix B, "Socket call error return codes," on page 885 for additional information about the numeric error codes that are returned by this command.

The following REXX TCP/IP error numbers can be returned:

- 9 EBADF
- 22 EINVAL
- 38 ENOTSOCK
- 45 EOPNOTSUPP

The following REXX socket API error numbers can be returned:

- 2001 EINVALIDRXSOCKETCALL
- 2005 ESUBTASKNOTACTIVE
- 2009 ESOCKETNOTDEFINED
- 2012 EINVALIDNAME

LE C/C++ equivalent

```
long shutdown(int *s, int how);
```

Code example

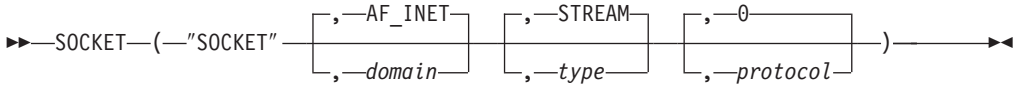
See the EZARXS02 REXX sample in the SEZAINST file for an example of using the SHUTDOWN command.

SOCKET

Use the SOCKET command to open a socket descriptor in the active socket set.

Restriction: If the socket type is SOCK_RAW or RAW, the user ID associated with the REXX socket application must have z/OS UNIX System Services superuser authority. The user ID must have the UID value 0 or have read access to the BPX.SUPERUSER security profile. An application can attempt to obtain superuser authority by issuing the z/OS UNIX System Services SYSCALLS command: `address syscall 'SETEUID 0'`. If this command fails, the user ID does not have the authorization needed to run the program; contact your security administrator.

Format



Parameters

domain
The address family of the socket. The supported families are AF_INET (2) and AF_INET6 (19). By default, the *domain* parameter is set to AF_INET.

type
An optional parameter that specifies the type of socket to be created. By default, this parameter is set to STREAM. The following values are supported:

- STREAM or SOCK_STREAM
- DATAGRAM or SOCK_DATAGRAM
- RAW or SOCK_RAW

protocol
An optional parameter that specifies the protocol that is requested. By default, the value to which this parameter is set depends on the *type* parameter. The default protocol for stream sockets is TCP. The default protocol for datagram sockets is UDP. There is no default for RAW sockets. To enable the stack to select the applicable protocol, set the *protocol* parameter to 0.

The following protocols are supported:

Stream sockets
IPPROTO_TCP or TCP

Datagram sockets
IPPROTO_UDP or UDP

RAW sockets

- IPPROTO_IP or IP
- IPPROTO_IPV6 or IPV6
- IPPROTO_ICMP or ICMP
- IPPROTO_ICMPV6 or ICMPV6
- IPPROTO_RAW or RAW

Returned value

The command returns a string that contains the return code and the new socket descriptor, for example, `0 6`. The return code can be 0, a REXX socket API error number, or the REXX TCP/IP error number that is set by the socket command. The return code 0 indicates that the requested socket command was completed successfully.

See Appendix B, "Socket call error return codes," on page 885 for additional information about the numeric error codes that are returned by this command.

The following REXX TCP/IP error numbers can be returned:

- 9 EBADF
- 22 EINVAL
- 38 ENOTSOCK
- 45 EOPNOTSUPP
- 139 EPERM

The following REXX socket API error numbers can be returned:

- 2001 EINVALIDRXSOCKETCALL
- 2005 ESUBTASKNOTACTIVE
- 2007 EMAXSOCKETSREACHED

LE C/C++ equivalent

```
int socket(int *domain, int type, int protocol);
```

Code example

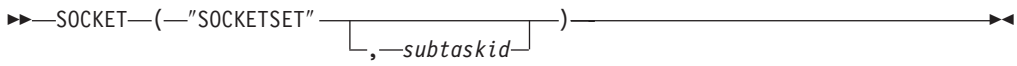
```
/*  REXX EZARXR26 */
/*
 * This sample demonstrates the use of the SOCKET
 * socket command.
 *
 * HINT: See other socket command descriptions for
 *       additional examples.
 */
src=SOCKET("INITIALIZE","MYSET01",20);
src=SOCKET("SOCKET","AF_INET","STREAM")
parse var src l_retcode l_socketid
if l_retcode = 0 then do
   Say "Socket Created Successfully.  Socket descriptor is" l_socketid;
   src=SOCKET("CLOSE",l_socketid);
   parse var src l_retcode .
   if l_retcode = 0 then
      say "Socket "l_socketid" closed successfully";
   else do
      say "Close of socket "l_socketid" failed.";
      say src;
   end;
end;
else do
   Say "Socket not created."
   Say "..."src;
end;
x=SOCKET("TERMINATE","MYSET01");
exit;
```

Figure 165. SOCKET command example

SOCKETSET

Use the SOCKETSET command to retrieve the name of the active socket set. If you specify the name of a socket set as a parameter, then that socket set becomes the active socket set.

Format



Parameters

subtaskid
The name of a socket set that was created with the INITIALIZE command

Returned value

The command returns a string that contains the return code and the name of the active socket set, for example, `0 MYSET`. The return code can be 0, a REXX socket API error number, or the REXX TCP/IP error number that is set by the socket command. The return code 0 indicates that the requested socket command was completed successfully.

See Appendix B, "Socket call error return codes," on page 885 for additional information about the numeric error codes that are returned by this command.

The following REXX TCP/IP error number can be returned:

- None

The following REXX socket API error number can be returned:

- 2005 ESUBTASKNOTACTIVE

LE C/C++ equivalent

This command has no LE C/C++ equivalent.

Code example

```
/*  REXX EZARXR27 */
/*
 * This sample demonstrates the use of the SOCKSET
 * socket command.
 */
src=socket("INITIALIZE","MYSET");
src=Socket("SOCKETSET");
Say src;
src=socket("TERMINATE","MYSET");
exit 0;
```

Figure 166. SOCKETSET command example

SOCKETSETLIST

Use the SOCKETSETLIST command to list the names of all available socket sets that are currently defined by the application.

Rule: All sockets sets are created with the INITIALIZE command.

Format

Parameters

This command has no parameters.

Returned value

If socket sets are defined, this command returns a string that contains 0 and names of the socket sets that are available to the application, for example, `0 subtask1 subtask2`. If no socket sets are defined, 0 is returned.

LE C/C++ equivalent

This command has no LE C/C++ equivalent.

Code example

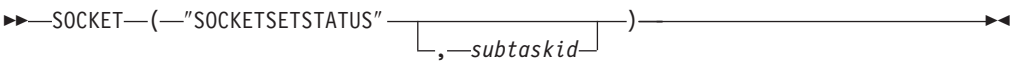
```
/* REXX EZARXR28 */
/*
 * This program demonstrates the use of the SOCKSETLIST
 * socket command. The program will initialize two socket
 * sets and then issue the SOCKSETLIST command to obtain
 * some information.
 */
src1=SOCKET("INITIALIZE","MYSET01",10);
Say "RC of INITIALIZATION of MYSET01 = "src1"
src2=SOCKET("INITIALIZE","MYSET02",29);
Say "RC of INITIALIZATION of MYSET02 = "src2"
src=SOCKET("SOCKETSETLIST");
parse var src l_retcode l_socketsets;
Say "Socket sets available are: "l_socketsets;
src=SOCKET("TERMINATE","MYSET01");
src=SOCKET("TERMINATE","MYSET02");
EXIT 0;
```

Figure 167. SOCKETSETLIST command example

SOCKETSETSTATUS

Use the SOCKETSETSTATUS command to list information about a socket set.

Format



Parameters

subtaskid

An optional parameter that specifies the name of the socket set. If this parameter is not specified, then the SOCKETSETSTATUS command returns the status of the active socket set.

Returned value

The command returns a string that contains the return code, the name of the socket set, the state of the socket set, the number of sockets that are available for use, and the number of sockets that currently are being used. The return code can be 0 or the REXX API error number. The return code 0 indicates that the requested socket command was completed successfully.

The state of a socket set is one of the following values:

CONNECTED
Indicates that the socket set has been initialized with the INITIALIZE command

SEVERED
Indicates that the socket set has been initialized using the INITIALIZE command, but a problem exists with the socket set

FREE Indicates that the socket set has not been initialized

The following string is an example of what is returned by the SOCKETSETSTATUS command:

```
0 MYSET Connected Free 15 Used 1
```

In the example, 0 is the return code, `MYSET` is the name of the socket set, `CONNECTED` is the status of the socket set, 15 is the number of the free sockets, and 1 is the number of sockets that are in use.

See Appendix B, "Socket call error return codes," on page 885 for additional information about the numeric error codes that are returned by this command.

The following REXX socket API error number can be returned::

- 2005 ESUBTASKNOTACTIVE

LE C/C++ equivalent

This command has no LE C/C++ equivalent.

Code example

```
/* REXX EZARXR29 */
/*
 * This sample demonstrates the use of the SOCKSETSTATUS
 * socket command. Error checking is not performed for the
 * socket commands as the intent is to show what the command
 * will return when multiple INITIALIZE commands are
 * issued.
 */
x1=socket("INITIALIZE","MYTEST",15);
x2=socket("SOCKETSET");
x3=socket("SOCKETSETSTATUS");
x4=socket("SOCKET","AF_INET");
parse var x4 l_retcode l_x4_socketid;
if l_retcode = 0 then do
   x5=socket("SOCKETSETSTATUS");
   Say "FIRST INITIALIZE command:"
   Say "   INITIALIZE      = "x1;
   Say "   SOCKETSET       = "x2;
   Say "   SOCKETSETSTATUS = "x3;
   Say "   SOCKET          = "l_retcode l_x4_socketid;
   Say "   SOCKETSETSTATUS = "x5;
   Say "*** END";
   y1=socket("INITIALIZE","REXXSET",15);
   y2=socket("SOCKETSET");
   y3=socket("SOCKETSETSTATUS");
   y4=socket("SOCKETSETSTATUS","MYTEST");
   y5=socket("SOCKET","AF_INET");
   parse var y5 l_retcode l_y5_socketid;
   if l_retcode = 0 then do
      y6=socket("SOCKETSETSTATUS");
      Say "SECOND INITIALIZE command:"
      Say "   INITIALIZE      = "y1;
      Say "   SOCKETSET       = "y2;
      Say "   SOCKETSETSTATUS = "y3;
      Say "   SOCKETSETSTATUS = "y4;
      Say "   SOCKET          = "l_retcode l_y5_socketid
      Say "   SOCKETSETSTATUS = "y6;
      Say "*** END";
      rc2=socket("CLOSE",l_y5_socketid);
      say "rc2 = "rc2;
      xx=socket("SOCKETSETSTATUS","MYTEST");
   end;
   rc1=socket("CLOSE",l_x4_socketid);
   Say "rc1 = "rc1;
end;
x=socket("TERMINATE","MYTEST");
x=socket("TERMINATE","REXXSET");
exit;
```

Figure 168. SOCKETSETSTATUS command example

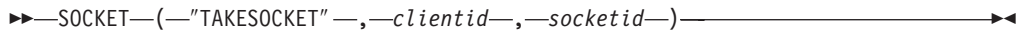
TAKESOCKET

Use the TAKESOCKET command to take a socket descriptor that is passed from another program using the GIVESOCKET command. A socket descriptor can be taken by an application only when the socket is in the same address family.

Guidelines: An application that issues the TAKESOCKET command needs to know both the client ID of the application that issued the GIVESOCKET command and the socket descriptor that was passed. REXX provides several techniques that can be used to pass this information to the application that issues the TAKESOCKET command:

- When the application that issues the GIVESOCKET command also will be the application to issue the TAKESOCKET command, the client ID and socket descriptor can be passed between the routines that are responsible for the two commands using standard REXX programming techniques. In this situation, consider setting the socket to nonblocking mode to permit additional socket processing to occur as needed. Use the SELECT command to determine when a socket is ready or when an exception occurred. Use this technique primarily during application development. If the socket descriptor is never given to a different application or subtask, avoid using the GIVESOCKET or TAKESOCKET commands.
- When the application that will take the socket descriptor is running in a different address space, consider using the following methods to pass the information:
  - Pass the *clientid* value through the program startup parameters or by using an external input stream
  - Use the z/OS UNIX System Services SYSCALLS interface and named pipes

Format



Parameters

clientid
Identifies the application that issued the GIVESOCKET command. The *clientid* parameter has the following format:

```
clientid = "domain jobname substaskid"
```

All three fields are required:

domain
The address family of the socket. The supported families are AF_INET (2) and AF_INET6 (19).

jobname
The job name of the application that issued the GIVESOCKET command.

substaskid
The name of the socket set used by the application that issued the GIVESOCKET command.

socketid
The socket descriptor that was given by the application that issued the GIVESOCKET command.

Returned value

The command returns a string that contains the return code and the socket descriptor, for example, `0 1`. The return code can be 0, a REXX socket API error number, or the REXX TCP/IP error number that is set by the socket command. The return code 0 indicates that the requested socket command was completed successfully.

Tip: The 13 EACCESS return code indicates that the application that issued the TAKESOCKET command is not authorized to take the socket descriptor. The *jobname* field of the *clientid* parameter for the GIVESOCKET command must match the *jobname* field of the *clientid* parameter for the TAKESOCKET command.

See Appendix B, "Socket call error return codes," on page 885 for additional information about the numeric error codes that are returned by this command.

The following REXX TCP/IP error numbers can be returned:

- 9 EBADF
- 13 EACCESS
- 22 EINVAL
- 38 ENOTSOCK
- 45 EOPNOTSUPP

The following REXX socket API error numbers can be returned:

- 2001 EINVALIDRXSOCKETCALL
- 2005 ESUBTASKNOTACTIVE
- 2009 ESOCKETNOTDEFINED
- 2012 EINVALIDNAME

LE C/C++ equivalent

This command has no LE C/C++ equivalent.

Code example

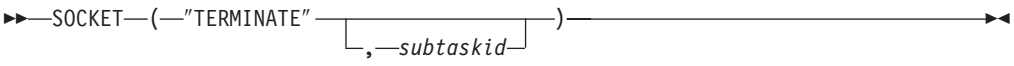
See the EZARXS06 REXX sample in the SEZAINST file for an example of using the TAKESOCKET command.

TERMINATE

Use the TERMINATE command to close all sockets in the specified socket set and to release the socket set.

A socket set is a number of preallocated sockets available to a single application. You can define multiple socket sets for one session, but only one socket set can be active at a time. When the active socket set is released, the next socket set in the stack becomes the active socket set.

Format



Parameters

subtaskid
An optional parameter that specifies the name of the socket set. If this parameter is not specified, then the active socket set is released.

Returned value

The command returns a string that contains the return code and the name of the socket set, for example, `0 MYTASKID`. The return code can be 0 or the REXX API error number. The return code 0 indicates that the requested socket command was completed successfully.

See Appendix B, "Socket call error return codes," on page 885 for additional information about the numeric error codes that are returned by this command.

The following REXX socket API error numbers can be returned:

- 2001 EINVALIDRXSOCKETCALL
- 2005 ESUBTASKNOTACTIVE

LE C/C++ equivalent

This command has no LE C/C++ equivalent.

Code example

```
/* REXX EZARXR30 */
/*
 * This sample demonstrates the use of the TERMINATE
 * socket command.
 */
src = socket("INITIALIZE","MYSET01",10);
if word(src,1) = 0 then say "INITIALIZE SUCCESSFUL";
src = socket("TERMINATE", "MYSET01");
say "TERMINATE = " src;
exit 0;
```

Figure 169. TERMINATE command example

VERSION

Use the VERSION command to retrieve the name, version number, and version date of the REXX socket library.

Format

Parameters

This command has no parameters.

Returned value

The command returns a string that contains the return code, version name, version number, and version date, for example, `0 REXX/SOCKETS z/OS V1R9 April 20, 2006`. A return code of 0 indicates that the requested socket command was completed successfully.

LE C/C++ equivalent

This command has no LE C/C++ equivalent.

Code example

```
/* REXX EZARXR31 */
/*
 * This sample demonstrates the use of the VERSION
 * socket command.
 */
src = socket("VERSION");
say "Version = " src;
exit 0;
```

Figure 170. VERSION command example

WRITE

Use the WRITE command to send an outgoing message on the connected socket. The WRITE command is similar to the SEND command, except that the WRITE command does not support the control flags that are available with the SEND command.

When the socket is a TCP socket, the following conditions apply:

- If the socket is in blocking mode and the total amount of data to be sent cannot be processed by the stack when the command is issued, then the command blocks until the data can be sent.
- If the socket is in nonblocking mode and the total amount of data to be written cannot be processed by the stack when the command is issued, then the command returns the number of bytes that were successfully written. If none of the data can be written, the command returns the value -1 and the `35 EWOULDBLOCK` error code.

When the socket is a connected UDP socket, the WRITE command either is completed or fails. A connected UDP socket does not return the `35 EWOULDBLOCK` error code.

Restriction: The WRITE command does not support send flags.

Guidelines: Place the WRITE command in a loop to ensure that all the data is written. For a TCP socket, a partial write operation might occur regardless of whether the socket is in blocking or nonblocking mode. A partial write operation occurs when the stack copies some but not all of the application data:

- If a partial write operation occurs on a socket in blocking mode, the blocking socket is interrupted. The return value contains the number of bytes written, and the return code contains the reason for the interruption. In such cases, consider ending the connection.
- If a partial write operation occurs on a socket in nonblocking mode, the return value indicates the number of bytes that were successfully sent. If this is less than the number of bytes specified on the WRITE command, repeat the WRITE operation until all data is written. The blocking condition might last for a long time, so consider other strategies to ensure that the application does not remain in a busy loop sending data.

Tips:

- Use the SELECT command to determine whether a socket is ready to send additional data. To do so, test the socket for a WRITE event.

- If the SO_ASCII socket option is enabled, then the data received is translated from EBCDIC to ASCII.

Format

Parameters

socketid
The socket descriptor

data
The string to be sent

Returned value

The command returns a string that contains the return code and the length of the data string, for example, `0 19`. The return code can be 0, a REXX socket API error number, or the REXX TCP/IP error number that is set by the socket command. The return code 0 indicates that the requested socket command was completed successfully.

See Appendix B, "Socket call error return codes," on page 885 for additional information about the numeric error codes that are returned by this command.

The following REXX TCP/IP error numbers can be returned:
- 4 EINTR
- 9 EBADF
- 5 EIO
- 22 EINVAL
- 32 EPIPE
- 35 EWOULDBLOCK
- 38 ENOTSOCK
- 40 EMSGSIZE
- 45 EOPNOTSUPP
- 54 ECONNRESET
- 57 ENOTCONN

The following REXX socket API error numbers can be returned:
- 2001 EINVALIDRXSOCKETCALL
- 2005 ESUBTASKNOTACTIVE
- 2009 ESOCKETNOTDEFINED

LE C/C++ equivalent

```
ssize_t send(int socket, const void *buffer, size_t length, int flags);
```

Code example

See the SEND command. Substitute the command WRITE for the command SEND.

REXX socket sample programs

This section provides information about the sample programs that show how to use the REXX socket API. These programs are provided as is.

Overview of REXX sample programs

The sample programs and the jobs that you can use to run them are located in the SEZAINST file.

The following information applies to the batch jobs:

- The batch job REXXAPI runs standalone socket EXECs and TCP/IP clients.
- The batch job REXXAPIS runs TCP/IP servers.
- The batch job REXXAPIT runs the subtask that is required to test the REXAPI04 program.

Table 21. REXX socket sample programs

Name	REXX EXEC	MVS batch job	APIs demonstrated	Notes
EZARXS01	REXAPI01	REXXAPI	INITIALIZE SOCKET GETSOCKOPT SETSOCKOPT CONNECT GETSOCKNAME SEND RECV TERMINATE	Client, requires server REXAPI05
EZARXS02	REXAPI02	REXXAPI	INITIALIZE SOCKET CONNECT GETSOCKNAME SEND RECV SHUTDOWN TERMINATE	Client, requires server REXAPI05
EZARXS03	REXAPI03	REXXAPI	INITIALIZE SOCKET CONNECT IOCTL SEND RECV CLOSE TERMINATE	Client, uses server REXAPI05 or REXAPI04 demonstrating AT-TLS
EZARXS04	REXAPI04	REXXAPIS	INITIALIZE SOCKET BIND LISTEN ACCEPT GETCLIENTID GIVESOCKET SELECT CLOSE	Server, not enabled for AT-TLS

Table 21. REXX socket sample programs (continued)

Name	REXX EXEC	MVS batch job	APIs demonstrated	Notes
EZARXS05	REXAPI05	REXXAPIS	INITIALIZE SOCKET BIND LISTEN ACCEPT IOCTL SEND RECV CLOSE TERMINATE	Server, supports AT-TLS
EZARXS06	REXAPI06	REXXAPIT	INITIALIZE TAKESOCKET GETPEERNAME RECV SEND CLOSE TERMINATE	Child server subtask
EZARXRSC	RSCLIENT	REXXAPI	INITIALIZE GETHOSTID SOCKET GETHOSTNAME CONNECT WRITE READ TERMINATE SOCKETSETSTATUS	IPv4 client
EZARXR6C	R6CLIENT	REXXAPI	INITIALIZE GETHOSTID SOCKET GETHOSTNAME GETADDRINFO CONNECT WRITE READ TERMINATE SOCKETSETSTATUS	IPv6 client
EZARXRSS	RSSERVER	REXXAPIS	INITIALIZE GETHOSTID SOCKET BIND LISTEN IOCTL SELECT ACCEPT RECV CLOSE SEND TERMINATE SETSOCKETSTATUS	IPv4 server

Table 21. REXX socket sample programs (continued)

Name	REXX EXEC	MVS batch job	APIs demonstrated	Notes
EZARXR6S	R6SERVER	REXXAPIS	INITIALIZE GETHOSTNAME GETADDRINFO SOCKET BIND LISTEN IOCTL SELECT ACCEPT GETNAMEINFO RECV CLOSE SEND TERMINATE SETSOCKETSTATUS	IPv6 server
EZARXJ01	n/a	REXXAPI	MVS sample job control	MVS job control for REXXAPI
EZARXJ02	n/a	REXXAPIS	MVS sample job control	MVS job control for REXXAPIS
EZARXJ03	n/a	REXXAPIT	MVS sample job control	MVS job control for REXXAPIT

The REXX-EXEC RSCLIENT sample program for IPv4

The client sample program is a REXX socket program that shows you how to use the commands that are provided by the REXX sockets API. The program connects to the server sample program and receives data, which is displayed on the screen. It uses sockets in blocking mode.

After parsing and testing the input parameters, the RSCLIENT EXEC program obtains a socket set using the INITIALIZE command and a socket using the SOCKET command. The program then connects to the server and writes the user ID, the node ID, and the number of lines requested on the connection to the server. It reads data in a loop; the data is displayed on the screen until the data length is 0, which indicates that the server has closed the connection. If an error occurs, the client program lists the return code, determines the status of the socket set, and ends the socket set.

The server adds the EBCDIC new-line character to the end of each record, and the client uses this character to determine the start of a new record. If the connection is abnormally closed, the records that were partially received are not displayed.

The REXX-EXEC RSSERVER sample program for IPv4

The server sample program shows an example of how to use sockets in nonblocking mode. The program waits for connect requests from client programs, accepts the requests, and then sends the data. The sample can handle multiple client requests in parallel processing.

The server program sets up a socket to accept connection requests from clients and then waits in a loop for events reported by the SELECT command. If a socket event occurs, it is processed. A read event can occur on the original socket for

accepting connection requests and on sockets for accepted socket requests. A write event can occur only on sockets for accepted socket requests.

A read event on the original socket for connection requests means that a connection request from a client occurred. Read events on other sockets indicate that there is either data to receive or that the client has closed the socket. Write events indicate that the server can send more data. The server program sends only one line of data in response to a write event.

The server program keeps a list of sockets to which it wants to write. It keeps this list to avoid unwanted socket events. The TCP/IP protocol is not designed for one single-threaded program communicating on many different sockets, but for multithread applications where one thread processes only the events that originate from a single socket.

The REXX-EXEC R6CLIENT sample program for IPv6

The client sample program is a REXX socket program that shows you how to use the commands that are provided by the REXX sockets API. The program connects to the server sample program and receives data, which is displayed on the screen. It uses sockets in blocking mode.

After parsing and testing the input parameters, the R6CLIENT EXEC sample program obtains a socket set using the INITIALIZE command and a socket using the SOCKET command. The program then connects to the server and writes the user ID, the node ID, and the number of lines requested on the connection to the server. It reads data in a loop; the data is displayed on the screen until the data length is 0, which indicates that the server has closed the connection. If an error occurs, the client program lists the return code, determines the status of the socket set, and ends the socket set.

The server adds the EBCDIC new-line character to the end of each record, and the client uses this character to determine the start of a new record. If the connection is abnormally closed, the partially received records are not displayed.

The REXX-EXEC R6SERVER sample program for IPv6

The server sample program shows an example of how to use sockets in nonblocking mode. The program waits for connect requests from client programs, accepts the requests, and then sends data. The sample can handle multiple client requests in parallel processing.

The server program sets up a socket to accept connection requests from clients and waits in a loop for events that are reported by the SELECT command. If a socket event occurs, it is processed. A read event can occur on the original socket for accepting connection requests and on sockets for accepted socket requests. A write event can occur only on sockets for accepted socket requests.

A read event on the original socket for connection requests means that a connection request from a client occurred. Read events on other sockets indicate that there is either data to receive or that the client has closed the socket. Write events indicate that the server can send more data. The server program sends only one line of data in response to a write event.

The server program keeps a list of sockets to which it wants to write. It keeps this list to avoid unwanted socket events. The protocol is not designed for one

single-threaded program communicating on many different sockets, but for multithread applications where one thread processes events only from a single socket.

AT-TLS security definitions for REXX samples

When Application Transparent Transport Layer Security (AT-TLS) is enabled on the TCP/IP stack, you must define the REXX sample applications to the Policy Agent.

The user must supply the necessary key rings. For information about creating certificates and key rings, see the TLS/SSL security information in *z/OS Communications Server: IP Configuration Guide*. These AT-TLS security definitions assume that the REXXAPI and REXXAPIS sample jobs are being used.

Running the REXX sample programs

This topic describes how to run the REXX sample programs.

About this task

To run the REXX sample programs, complete the following steps:

1. Uncomment the MVS job control EXEC card.
2. Run the REXX EXEC.

Testing the GIVESOCKET and TAKESOCKET commands

This topic describes how to test the GIVESOCKET and TAKESOCKET commands using the sample programs.

About this task

To test the GIVESOCKET and TAKESOCKET commands, complete the following steps:

1. Uncomment REXAPI04 from the job REXXAPIS and submit the sample job control to the JES reader.
2. Submit job REXXAPI using REXAPI03.
3. Submit REXXAPIT. REXXAPIT assumes that the socket being passed is 3 and that the client ID is AF_INET6 REXAPI TCPSVT.

Chapter 15. Pascal application programming interface

This information describes the Pascal language for IPv4 socket application program interface (API) that is provided with TCP/IP. This interface allows programmers to write application programs that use the TCP, UDP, and IP layers of the TCP/IP protocol suite. Topics include:

- Software requirements
- Data structures
- Using procedure calls
- Pascal return codes
- Procedure calls
- Sample Pascal program

To use the Pascal language API, you should have experience in Pascal language programming and be familiar with the principles of internetwork communication.

Your program uses procedure calls to initiate communication with the TCP/IP address space. Most of these procedure calls return with a code that indicates success or the type of failure incurred by the call. The TCP/IP address space starts asynchronous communication by sending you notification.

Note: The Pascal API is not enhanced for IPv6 support.

Steps for Pascal language API procedure calls

Before you begin: To use the Pascal language API, you should have experience in Pascal language programming and be familiar with the principles of internetwork communication.

Perform the following steps to write the Pascal program.

1. Start TCP/UDP/IP service (BeginTcpIp).

   _____

2. Specify the set of notifications that TCP/UDP/IP can send you (Handle).

   _____

3. Establish a connection (TcpOpen, UdpOpen, RawIpOpen, and TcpWaitOpen).

   Note: If using TcpOpen, communication must wait for the appropriate notification of connection.

   _____

4. Transfer a data buffer to or from the TCP/IP address space (TcpSend, TcpFSend, TcpWaitSend, TcpReceive, TcpFReceive, TcpWaitReceive, UdpSend, UdpNReceive, RawIpSend, UdpReceive, and RawIpReceive).

   Notes:

   a. TcpWaitReceive and TcpWaitSend are synchronous calls.
   b. TcpFSend and TcpSend are the asynchronous ways of sending data on a TCP connection. Both procedures return to your program immediately. TcpSend does not wait under any circumstance.

© Copyright IBM Corp. 1989, 2010

c. TcpSend and TcpFSend differ in how they handle the situation when TCP/IP address space has insufficient buffer space to accept the data being sent.
d. In the case of insufficient buffer space, TCP/IP responds to TcpSend with the return code NObufferSPACE. This return code is sent back to the application. It is the application's responsibility to wait for BUFFERspaceAVAILABLE notification and resend the data.
e. In the case of TcpFSend with insufficient buffer space, the PASCAL API blocks until buffer space becomes available or an error is detected. This is the only condition under which TcpFSend blocks.

5. Check the status returned from TCP/IP in the form of notifications (GetNextNote).

6. Repeat the data transfer operations (Steps 4 and 5) until the data is exhausted.

7. Terminate the connection (TcpClose, UdpClose, and RawIpClose).

   Note: If you are using TcpClose, you must wait for the connection to terminate.

8. Terminate the communication service (EndTcpIp).

You know you are done when control is returned to you. Control is returned, in most instances, after the initiation of your request. When appropriate, some procedures have alternative wait versions that return only after request completion.

A sample program is supplied with TCP/IP. See "Sample Pascal program" on page 860, for a listing of the sample program.

Pascal language API software requirements

To develop programs in Pascal that interface directly to the TCP, UDP, and IP protocol boundaries, you must have the IBM VS Pascal Compiler and Library (5668-767).

Pascal API header files

The following is a list of the headers used by Pascal applications:
- cmclien
- cmcomm
- cminter
- cmresglb

Pascal language API compatibility considerations

Unless noted in *z/OS Communications Server: New Function Summary*, an application program that is compiled and link edited on a release of z/OS Communications Server IP can be used on higher level releases. That is, the API is upward compatible.

Application programs that are compiled and link edited on a release of z/OS Communications Server IP cannot be used on older releases. That is, the API is not downward compatible.

Pascal language API data structures

Programs containing Pascal language API calls must include the appropriate data structures. The data structures are declared in CMCOMM and CMCLIEN. To include these data sets in your program source, enter:

```
%include CMCOMM
%include CMCLIEN
```

Additional include statements are required in programs that use certain calls. The following list shows the members that need to be included for the various calls:

- CMRESGLB for GetHostResol
- CMINTER for GetHostNumber, GetHostString, IsLocalAddress, and IsLocalHost

The load modules are in the SEZACMTX data set. Include this data set in your SYSLIB concatenation when you are creating a load module to link an application program. You must specify SEZACMTX before the Pascal libraries when linking TCP/IP programs.

Connection state

ConnectionState is the current state of the connection. See Figure 171 for the Pascal declaration of the ConnectionStateType data type. ConnectionStateType is used in StatusInfoType and NotificationInfoType. It defines the client program view of the state of a TCP connection, in a form more readily usable than the formal TCP connection state defined by RFC 793. See Table 22 on page 820 for the mapping between TCP states and ConnectionStateType.

```
ConnectionStateType =
(
      CONNECTIONclosing,
      LISTENING,
      NONEXISTENT,
      OPEN,
      RECEIVINGonly,
      SENDINGonly,
      TRYINGtoOPEN
);
```

Figure 171. Pascal declaration of connection state type

CONNECTIONclosing
Indicates that no more data can be transmitted on this connection, because it is going through the TCP connection closing sequence.

LISTENING
Indicates that you are waiting for a foreign site to open a connection.

NONEXISTENT
Indicates that a connection no longer exists.

OPEN
Indicates that data can go either way on the connection.

RECEIVINGonly
Indicates that data can be received, but cannot be sent on this connection, because the client has done a TcpClose.

SENDINGonly
Indicates that data can be sent out, but cannot be received on this connection, because the foreign application has done a TcpClose or equivalent.

TRYINGtoOPEN
Indicates that you are trying to contact a foreign site to establish a connection.

Table 22 lists the TCP connection states.

Table 22. TCP connection states

TCP State	ConnectionStateType
CLOSED	NONEXISTENT
LAST-ACK, CLOSING, TIME-WAIT	If there is incoming data that the client program has not received, then RECEIVINGonly, otherwise CONNECTIONclosing.
CLOSE-WAIT	If there is incoming data that the client program has not received, then OPEN, otherwise SENDINGonly.
ESTABLISHED	OPEN
FIN-WAIT-1, FIN-WAIT-2	RECEIVINGonly
LISTEN	LISTENING
SYN-SENT, SYN-RECEIVED	TRYINGtoOPEN

Connection information record

The connection information record is used as a parameter in several of the procedure calls. It enables you and the TCP/IP program to exchange information about the connection. The Pascal declaration is shown in Figure 172.

```
StatusInfoType =
    record
    Connection: ConnectionType;
    OpenAttemptTimeout: integer;
    Security: SecurityType;
    Compartment: CompartmentType;
    Precedence: PrecedenceType;
    BytesToRead: integer;
    UnackedBytes: integer;
    ConnectionState: ConnectionStateType;
    LocalSocket: SocketType;
    ForeignSocket: SocketType;
    end;
```

Figure 172. Pascal declaration of connection information record

Connection
A number identifying the connection that is described. This connection number is different from the connection number displayed by the NETSTAT command.

OpenAttemptTimeout
The number of seconds that TCP continues to attempt to open a connection. You specify this number. If the limit is exceeded, TCP stops trying to open the connection and shuts down any partially open connection.

BytesToRead
The number of data bytes received from the foreign host by TCP, but not yet delivered to the client. TCP maintains this value.

UnackedBytes
The number of bytes sent by your program, but not yet sent to the foreign TCP, or the number of bytes sent to the foreign TCP, but not yet acknowledged.

ConnectionState

The current state of the connection. ConnectionStateType defines the client program view of the state of a TCP connection, in a form more readily usable than the formal TCP connection state defined by RFC 793.

LocalSocket
The local internet address and local port. Together, these form one end of a connection. The foreign socket forms the other end. See Figure 173 for the Pascal declaration of the SocketType record.

ForeignSocket
The foreign, or remote, internet address and its associated port. These form one end of a connection. The local socket forms the other end. Figure 173 shows the Pascal declaration of a socket type.

```
InternetAddressType = UnsignedIntegerType;
PortType = UnsignedHalfWordType;
SocketType =
    record
    Address: InternetAddressType;
    Port: PortType;
    end;
```

Figure 173. Pascal declaration of socket type

Address
The internet address.
Port The port.

Notification record

The notification record is used to provide event information. You receive this information by using the GetNextNote call. If it is a variant record, the number of fields depends on the type of notification. See Figure 174 on page 822 for the Pascal declaration of this record.

```
NotificationInfoType =
      record
      Connection: ConnectionType;
      Protocol: ProtocolType;
      case NotificationTag: NotificationEnumType of
            BUFFERspaceAVAILABLE:
                  (
                  AmountOfSpaceInBytes: integer
                  );
            CONNECTIONstateCHANGED:
                  (
                  NewState: ConnectionStateType;
                  Reason: CallReturnCodeType
                  );
            DATAdelivered:
                  (
                  BytesDelivered: integer;
                  LastUrgentByte: integer;
                  PushFlag: Boolean
                  );
```

Figure 174. Notification record (Part 1 of 2)

```
FSENDresponse:
    (
    SendTurnCode: CallReturnCodeType;
    SendRequestErr: Boolean;
    );
PINGresponse:
    (
    PingTurnCode: CallReturnCodeType;
    ElapsedTime: TimeStampType
    );
RAWIPpacketsDELIVERED:
    (
    RawIpDataLength: integer;
    RawIpFullLength: integer;
    );
RAWIPspaceAVAILABLE:
    (
    RawIpSpaceInBytes: integer;
    );
SMSGreceived: ();
TIMERexpired:
    (
    Datum: integer;
    AssociatedTimer: TimerPointerType
    );
UDPdatagramDELIVERED:
    (
    DataLength: integer;
    ForeignSocket: SocketType;
    FullLength: integer
    );
UDPdatagramSPACEavailable: ();
URGENTpending:
    (
    BytesToRead: integer;
    UrgentSpan: integer
    );
USERdefinedNOTIFICATION:
    (
    UserData: UserNotificationDataType
    );
end;
```

Figure 174. Notification record (Part 2 of 2)

Connection
The client's connection number to which the notification applies. In the case of USERdefinedNOTIFICATION, this field is as supplied by the user in the AddUserNote call.

Protocol
In the case of USERdefinedNOTIFICATION, this field is as supplied by the user in the AddUserNote call. For all other notifications, this field is reserved.

NotificationTag
The type of notification being sent. A set of fields depends on the value of the tag. Possible tag values relevant to the TCP/UDP/IP interface and the corresponding fields are:

BUFFERspaceAVAILABLE
Notification given when space becomes available on a connection for which TcpSend previously returned NObufferSPACE.

AmountOfSpaceInBytes
The minimum number of bytes that the TCP/IP service has available for buffer space for this connection. The actual amount of buffer space might be more than this number.

CONNECTIONstateCHANGED
Indicates that a TCP connection has changed state.

NewState
The new state for this connection.

Reason
The reason for the state change. This field is meaningful only if the NewState field has a value of NONEXISTENT.

Notes:

1. The following is the sequence of state notifications for a connection.
   For active open:
   - OPEN
   - RECEIVINGonly or SENDINGonly
   - CONNECTIONclosing
   - NONEXISTENT

   For passive open:
   - OPEN
   - RECEIVINGonly or SENDINGonly
   - CONNECTIONclosing
   - NONEXISTENT

   Your program should be prepared for any intermediate step or steps to be skipped.
2. The normal TCP connection closing sequence can lead to a connection staying in CONNECTIONclosing state for up to two minutes, corresponding to the TCP state TIME-WAIT.
3. Reason codes giving the reason for a connection changing to NONEXISTENT are:
   - OK
   - UNREACHABLEnetwork
   - TIMEOUTopen
   - OPENrejected
   - REMOTEreset
   - WRONGsecORprc
   - FATALerror
   - TCPipSHUTDOWN

DATAdelivered
Notification given when your buffer (named in an earlier TcpReceive or TcpFReceive request) contains data.

Note: The data delivered should be treated as part of a byte stream, not as a message. There is no guarantee that the data sent in one TcpSend (or equivalent) call on the foreign host is delivered in a single DATAdelivered notification, even if the PushFlag is set.

BytesDelivered
Number of bytes of data delivered to you.

LastUrgentByte
Number of bytes of urgent data remaining, including data just delivered.

PushFlag
TRUE if the last byte of data was received with the push bit set.

FSENDresponse
Notification given when a TcpFSend request is completed, successfully or unsuccessfully.

SendTurnCode
The status of the send operation.

PINGresponse
Notification given when a PINGresponse is received.

PingTurnCode
The status of the PING operation.

ElapsedTime
The time elapsed between the sending of a request and the reception of a response. This field is valid only if PingTurnCode has a value of OK.

RAWIPpacketsDELIVERED
Notification given when your buffer (indicated in an earlier RawIpReceive request) contains a datagram. Only one datagram is delivered on each notification. Your buffer contains the entire IP header, plus as much of the datagram as fits in your buffer.

RawIpDataLength
The actual data length delivered to your buffer. If this is less than RawIpFullLength, the datagram was truncated.

RawIpFullLength
Length of the packet, from the TotalLength field of the IP header.

RAWIPspaceAVAILABLE
When space becomes available after a client does a RawIpSend and receives a NObufferSPACE return code, the client receives this notification to indicate that space is now available.

RawIpSpaceInBytes
The amount of space available always equals the maximum size IP datagram.

RESOURCESavailable
Notice given when resources needed for a TcpOpen or TcpWaitOpen are available. This notification is sent only if a previous TcpOpen or TcpWaitOpen returned ZEROresources.

SMSGreceived
Notification given when one or more special messages (Smsgs) arrive. The GetSmsg call is used to retrieve queued Smsgs.

TIMERexpired
Notification given when a timer set through SetTimer expires.

Datum
The data specified when SetTimer was called.

AssociatedTimer
The address of the timer that expired.

UDPdatagramDELIVERED
Notification given when your buffer, indicated in an earlier UdpNReceive or UdpReceive request, contains a datagram. Your buffer contains the datagram excluding the UDP header.

Note: If UdpReceive was used, your buffer contains the entire datagram excluding the header, with the length indicated by DataLength. If UdpNReceive was used, and DataLength is less than FullLength, your buffer contains a truncated datagram. The reason is that your buffer was too small to contain the entire datagram.

DataLength
Length of the data delivered to your buffer.

ForeignSocket
The source of the datagram.

FullLength
The length of the entire datagram, excluding the UDP header. This field is set only if UdpNReceive was used.

UDPdatagramSPACEavailable
Notification given when buffer space becomes available for a datagram for which UdpSend previously returned NObufferSPACE because of insufficient resources.

URGENTpending
Notification given when there is urgent data pending on a TCP connection.

BytesToRead
The number of incoming bytes not yet delivered to the client.

UrgentSpan
Number of bytes that are not delivered to the last known urgent pointer. No urgent data is pending if this is negative.

USERdefinedNOTIFICATION
Notice generated from data passed to AddUserNote by your program.

UserData
A 40-byte field supplied by your program through AddUserNote. Connection and protocol fields also are set from the values supplied to AddUserNote.

File specification record

The file specification record is used to fully specify a data set. The Pascal declaration is shown in Figure 175 on page 827.

```
SpecOfFileType =
          record
          Owner: DirectoryNameType;
          Case SpecOfSystemType of
         VM:
          (
                VirtualAddress:VirtualAddressType;
                NewVirtualAddress:VirtualAddressType;
                DiskPassword: DirectoryNameType;
                Filename: DirectoryNameType;
                Filetype: DirectoryNameType;
                Filemode: FilemodeType
         );
         MVS:
         (
                DatasetPassword: DirectoryNameType;
                FullDatasetName: DatasetNameType;
                MemberName: MemberNameType;
                DDName: DDNameType
         );
         end;
```

Figure 175. Pascal declaration of file specification record

Pascal language API: using procedure calls

Your program uses procedure calls to initiate communication with the TCP/IP address space. Most of these procedure calls return with a code, which indicates success or the type of failure incurred by the call. See Table 23 on page 829 for an explanation of the return codes.

Before invoking any of the other interface procedures, use BeginTcpIp to start the TCP/UDP/IP service. Once the TCP/UDP/IP service has begun, use the Handle procedure to specify a set of notifications that the TCP/UDP/IP service can send you. To terminate the TCP/UDP/IP service, use the EndTcpIp procedure.

Notifications

The TCP/IP address space notifies you of asynchronous events. Also, some notifications are generated in your address space by the TCP interface. Notifications can be received only after BeginTcIp.

The notifications are received by the TCP interface and kept in a queue. Use GetNextNote to get the next notification. The notifications are in Pascal variant record form. See Figure 174 on page 822 for more information.

TCP initialization procedures

The TCP Initialization procedures affect all present and future connections. Use these procedures to initialize the TCP environment for your program.

TCP termination procedure

The Pascal API has one termination procedure call. Use the EndTcpIp call when you have finished with the TCP/IP services.

TCP communication procedures

The TCP communication procedures apply to a particular client connection. Use these procedures to establish a connection and to communicate. You must call the BeginTcpIp initialization routine before you can begin using TCP communication procedures.

PING interface

The Ping interface lets a client send an ICMP echo request to a foreign host. You must call the BeginTcpIp initialization routine before you can begin using the PING Interface.

Monitor procedures

The MonQuery monitor procedure provides a mechanism for querying the TCP/IP address space.

Any program using this monitor procedure must include CMCOMM and CMCLIEN.

UDP communication procedures

The UDP communication procedures describe the programming interface for the User Datagram Protocol (UDP) provided in the TCP/IP product.

Raw IP interface

The Raw IP interface lets a client program send and receive arbitrary IP datagrams on any IP Internet protocol except TCP and UDP. Only one client can use any given protocol at one time. Only clients that are APF-authorized can use the Raw IP interface.

Timer routines

The timer routines are used with the TCP/UDP/IP interface. You must call the BeginTcpIp initialization routine before you can begin using the timer routines.

Host lookup routines

The host lookup routines (with the exception of GetHostResol) are declared in the CMINTER member of the SEZACMAC data set. The host lookup routine GetHostResol is declared in the CMRESGLB member of the SEZACMAC data set. Any program using these procedures must include CMINTER or CMRESGLB after the INCLUDE statements for CMCOMM and CMCLIEN.

Assembler calls

AddUserNote is provided and can be called directly from an assembler language interrupt handler.

Other routines

This group includes the following procedures.

- GetSmsg
- ReadXlateTable
- SayCalRe
- SayConSt
- SayIntAd
- SayIntNum

- SayNotEn
- SayPorTy
- SayProTy

Pascal return codes

When using Pascal procedure calls, check to determine whether the call has been completed successfully. Use the SayCalRe function (see "SayCalRe" on page 843) to convert the ReturnCode parameter to a printable form.

The SayCalRe function converts a return value into a descriptive message. For example, if SayCalRe is invoked with the return value BADlengthARGUMENT, it returns the message `invalid length specified`. See Table 23 for a description of Pascal return codes and their equivalent message text from SayCalRe.

Most return values are self-explanatory in the context where they occur. The return codes you see as a result of issuing a TCP/UDP/IP request are in the range –128 to 0.

Table 23. Pascal language return codes

Return Value	Return Code	Message Text
OK	0	OK.
ABNORMALcondition	–1	Abnormal condition due to CSA storage shortage.
ALREADYclosing	–2	Connection is already closing.
BADlengthARGUMENT	–3	Length specified that is not valid.
CANNOTsendDATA	–4	Cannot send data.
CLIENTrestart	–5	Client reinitialized TCP/IP service.
CONNECTIONalreadyEXISTS	–7	Connection already exists.
ERRORinPROFILE	–8	Error in profile data set. Details are in PROFILE.TCPERROR or the //SYSERROR DD file.
FATALerror	–9	Fatal error; not valid user parameter (storage key).
HASnoPASSWORD	–10	No password is in the RACF directory.
INCORRECTpassword	–11	TCPIP is not authorized to access the data set.
INVALIDrequest	–12	Request not valid.
INVALIDuserID	–13	User ID not valid.
INVALIDvirtualADDRESS	–14	Virtual address not valid.
LOCALportNOTavailable	–16	The requested local port is not available.
NObufferSPACE	–19	No more space for data currently available. This applies to this connection only; space might still be available for other connections.
NONlocalADDRESS	–21	The internet address is not local to this host.
NOoutstandingNOTIFICATIONS	–22	No outstanding notifications.
NOsuchCONNECTION	–23	No such connection.
NOtcpIPservice	–24	No TCP/IP service is available.
NOTyetBEGUN	–25	TCP/IP service not yet begun.

Table 23. Pascal language return codes (continued)

Return Value	Return Code	Message Text
NOTyetOPEN	–26	The connection is not yet open.
OPENrejected	–27	Foreign host rejected the open attempt.
PARAMlocalADDRESS	–28	TcpOpen error: local address not valid.
PARAMstate	–29	TcpOpen error: initial state not valid.
PARAMtimeout	–30	Timeout parameter not valid.
PARAMunspecADDRESS	–31	TcpOpen error: unspecified foreign address in active open.
PARAMunspecPORT	–32	TcpOpen error: unspecified foreign port in active open.
PROFILEnotFOUND	–33	TCPIP cannot read PROFILE data set.
RECEIVEstillPENDING	–34	Receive is still pending on this connection.
REMOTEclose	–35	Foreign host unexpectedly closed the connection.
REMOTEreset	–36	Foreign host abended the connection.
SOFTWAREerror	–37	Software error in TCP/IP.
TCPipSHUTDOWN	–38	TCP/IP is being shut down.
TIMEOUTopen	–40	Foreign host did not respond within OPEN timeout.
TOOmanyOPENS	–41	Too many open connections exist already.
UNAUTHORIZEDuser	–43	You are not authorized to issue this command.
UNIMPLEMENTEDrequest	–45	TCP/IP request not implemented.
UNREACHABLEnetwork	–47	Destination network cannot be reached.
UNSPECIFIEDconnection	–48	Connection not specified.
VIRTUALmemoryTOOsmall	–49	Client address space has too little storage.
WRONGsecORprc	–50	Foreign host disagreed on security or precedence.
ZEROresources	–56	TCP cannot handle more connections now.
UDPlocalADDRESS	–57	Local address for UDP not correct.
UDPunspecADDRESS	–59	Address was not specified; specification is necessary.
UDPunspecPORT	–60	Port was unspecified; specification is necessary.
FSENDstillPENDING	–62	FSend still pending on this connection.
ERRORopeningORreadingFILE	–80	Error opening or reading data set.
FILEformatINVALID	–81	File format is not valid.
SAYCALRE*	–130	Unknown TCP return code.

* Return codes that are not valid (out of the range -128 to 0) return Unknown TCP return codes when translated using SAYCALRE.

Pascal language API procedure calls

This information provides the syntax, parameters, and other appropriate information for each Pascal procedure call supported by TCP/IP.

AddUserNote

This procedure can be called from assembler language code to add a USERdefinedNOTIFICATION notification to the note queue and cause the initiation of GetNextNote if it is waiting for a notification. Figure 176 shows a sample calling sequence.

```
          LA    R13,PASCSAVE
          LA    R1,PASCPARM
          L     R15,=V(ADDUSERN)
          BALR  R14,R15
                 .
                 .
PASCSAVE  DS    18F     Register save area
ENV       DC    F'0'    Zero initially.  It is filled with
                        an environment address.  Pass it unchanged
                        in subsequent calls to ADDUSERN.
DATA1     DS    H       Data for Connection field of notification.
DATA2     DS    C       Data for Protocol field of notification.
DATA3     DS    XL40    Data for UserData field of notification.
RC        DS    F       AddUserNote stores return code here.

PASCPARM  DC    A(ENV)
          DC    A(DATA1)
          DC    A(DATA2)
          DC    A(DATA3)
          DC    A(RC)
```

Figure 176. Sample calling sequence

Parameter **Description**

ReturnCode (RC)
Indicates the success or failure of the call. Possible return values are:
- OK
- NObufferSPACE

BeginTcpIp

Use BeginTcpIp to inform the TCP/IP address space that you want to start using its services as show in Figure 177.

```
procedure BeginTcpIp
          (
     var    ReturnCode: integer
          );
          external;
```

Figure 177. BeginTcpIp example

Parameter **Description**

ReturnCode Indicates success or failure of call. Possible return values are:
- OK
- ABNORMALcondition
- FATALerror
- NOtcpIPservice
- TCPipSHUTDOWN
- VIRTUALmemoryTOOsmall

For a description of the Pascal return codes, see Table 23 on page 829.

ClearTimer

This procedure resets the timer to prevent it timing out as shown in Figure 178.

```
procedure  ClearTimer
           (
                T:  TimerPointerType
           );
           external;
```

Figure 178. ClearTimer example

Parameter	Description
T	A timer pointer, as returned by a previous CreateTimer call.

CreateTimer

This procedure allocates a timer. The timer is not set in any way. See "SetTimer" on page 845 to activate the timer. Figure 179 shows an example.

```
procedure  CreateTimer
           (
      var      T:  TimerPointerType
           );
           external;
```

Figure 179. Create timer example

Parameter	Description
T	Set to a timer pointer that can be used in subsequent SetTimer, ClearTimer, and DestroyTimer calls.

DestroyTimer

This procedure deallocates (frees) a timer you created. Figure 180 shows an example.

```
procedure  DestroyTimer
           (
      var      T:  TimerPointerType
           );
           external;
```

Figure 180. Destroy timer example

Parameter	Description
T	A timer pointer, as returned by a previous CreateTimer call.

EndTcpIp

Use EndTcpIp when you have finished with the TCP/IP services. The procedure shown in Figure 181 on page 833 releases ports and protocols in use that are not permanently reserved. It causes TCP to clean up the data structures it has associated with your commands.

```
procedure  EndTcpIp;
           external;
```

Figure 181. EndTcpIp example

GetHostNumber

The GetHostNumber procedure resolves a host name into an internet address. This is shown in Figure 182.

GetHostNumber uses a table lookup to convert the name of a host (alphanumeric name or dotted decimal number) to an internet address, and returns this address in the HostNumber field. When the name is a dotted decimal number, GetHostNumber returns the integer represented by that dotted decimal. The dotted decimal representation of a 32-bit number has 1 decimal integer for each of the 4 bytes, separated by dots. For example, `14.0.0.7` for X'0E000007'. See *z/OS Communications Server: IP Configuration Reference* for information about how to create host lookup tables.

The HostNumber field is set to NOhost if the host is not found.

```
procedure  GetHostNumber
           (
      const      Name:  string;
      var          HostNumber:  InternetAddressType
           );
           external;
```

Figure 182. GetHostNumber example

Parameter	Description
Name	The name or dotted decimal number to be converted. The maximum name length is 128 characters.
HostNumber	Set to the converted address, or NOhost if conversion fails.

GetHostResol

The GetHostResol procedure converts a host name into an internet address by using a name server. Figure 183 on page 834 shows an example.

GetHostResol passes the query to the remote name server through the resolver. The name server converts the name of a host (alphanumeric name or dotted decimal number) to an internet address, and returns this address in the HostNumber field. If the name server does not respond or does not find the name, the host name is converted to a host number by table lookup. When the name is a dotted decimal number, the integer represented by that dotted decimal is returned. The dotted decimal representation of a 32-bit number has 1 decimal integer for each of the 4 bytes, separated by dots. For example, `14.0.0.7` for X'0E000007'.

The HostNumber field is set to NOhost if the host is not found.

```
procedure GetHostResol
        (
    const    Name: string;
    var        HostNumber: InternetAddressType
        );
        external;
```

Figure 183. GetHostResol example

Parameter	Description
Name	The name or dotted decimal number to be converted. The maximum length is 255 characters.
HostNumber	Set to the converted address, or NOhost if conversion fails.

GetHostString

The GetHostString procedure call uses a table lookup to convert an internet address dotted decimal format to a host name, and returns this string in the Name field. The first host name found in the lookup is returned. If no host name is found, a gateway or network name is returned. If no gateway or network name is found, a null string is returned. An example is shown in Figure 184.

```
procedure GetHostString
        (
            Address: InternetAddressType;
    var     Name: SiteNameType
        );
        external;
```

Figure 184. GetHostString example

Parameter	Description
Address	The address to be converted. The address must be in dotted decimal format.
Name	Set to the corresponding host, gateway, or network name, or to null string if a match is not found. The maximum length is 24 characters.

GetIdentity

This procedure returns the following information:

- The user ID of the MVS user
- The host machine name
- The network domain name
- The user ID of the TCP/IP address space

The host machine name and domain name are extracted from the HostName and DomainOrigin statements, respectively, in TCPIP.DATA. If a HostName statement is not specified, then the default host machine name is the name specified by the TCP/IP installer during installation (the name from the line containing the definition, VMCF,MVPXSSI,nodename, in the IEFSSNxx member of PARMLIB). The TCP/IP address space user ID is extracted from the TcpipUserid/TcpipJobname statement in TCPIP.DATA; if the statement is not specified, the default is TCPIP. See *z/OS Communications Server: IP Configuration Reference* for information about TCPIP.DATA search order.

Figure 185 shows the GetIdentity procedure.

```
procedure GetIdentity
        (
    var     UserId:   DirectoryNameType;
    var     HostName, DomainName: String;
    var     TcpIpServiceName: DirectoryNameType;
    var     Result: integer
        );
        external;
```

Figure 185. GetIdentity example

Parameter	Description
UserId	The user ID of the TSO user or the job name of a batch job that has invoked GetIdentity.
HostName	The host machine name.
DomainName	The network domain name.
TcpIpServiceName	The user ID of the TCP/IP address space.
Result	Indicates success or failure of the call.

GetNextNote

Use this procedure to retrieve notifications from the queue. This procedure returns the next notification queued for you. Figure 186 shows an example of the GetNextNote procedure.

```
procedure GetNextNote
        (
    var     Note: NotificationInfoType;
              ShouldWait: Boolean;
    var     ReturnCode: integer
        );
        external;
```

Figure 186. GetNextNote example

Parameter	Description
Note	Next notification is stored here when ReturnCode is OK.
ShouldWait	Set ShouldWait to `TRUE` if you want GetNextNote to wait until a notification becomes available. Set ShouldWait to `FALSE` if you want GetNextNote to return immediately. When ShouldWait is set to `FALSE`, ReturnCode is set to NOoutstandingNOTIFICATIONS if notification is not currently queued.
ReturnCode	Indicates success or failure of call. Possible return values are: • OK • NOoutstandingNOTIFICATIONS • NOTyetBEGUN

For a description of Pascal return codes, see Table 23 on page 829.

GetSmsg

Your program should call this procedure after receiving an SMSGreceived notification. Each call to GetSmsg retrieves one queued Smsg. Your program should exhaust all queued Smsgs by calling GetSmsg repeatedly until the Success field returns with a value of FALSE. After a value of FALSE is returned, do not call GetSmsg again until you receive another SMSGreceived notification. Figure 187 shows an example of the GetSmsg procedure.

```
procedure GetSMsg
          (
     var     Smsg: SmsgType;
     var     Success: Boolean;
          );
          external;
```

Figure 187. GetSmsg example

Parameter	Description
Smsg	Set to the returned Smsg if Success is set to TRUE.
Success	If Smsg returned TRUE; otherwise FALSE.

Handle

Use the Handle procedure to specify that you want to receive notifications in the given set as shown in Figure 188. You must always use it after calling the BeginTcpIp procedure and before accessing the TCP/IP services. This Pascal set of notifications can contain any of the NotificationEnumType values shown in Figure 174 on page 822.

```
procedure Handle
          (
               Notifications: NotificationSetType;
     var     ReturnCode: integer
          );
          external;
```

Figure 188. Handle example

Parameter	Description
Notifications	The set of notification types to be handled.
ReturnCode	Indicates success or failure of the call. Possible return values are: • OK • NOTyetBEGUN

For a description of Pascal return codes, see Table 23 on page 829.

IsLocalAddress

This procedure queries the TCP/IP address space to determine whether the HostAddress is one of the addresses recognized for this host. If the address is local, it returns OK. If the address is not local, it returns NONlocalADDRESS. Figure 189 on page 837 shows an example.

```
procedure IsLocalAddress
        (
              HostAddress: InternetAddressType;
    var     ReturnCode: integer
        );
        external;
```

Figure 189. IsLocalAddress example

Parameter	Description
HostAddress	The host address to be tested.
ReturnCode	Indicates whether the host address is local, or it might indicate an error. Possible return values are: • OK • NONlocalADDRESS • TCPipSHUTDOWN • FATALerror • SOFTWAREerror

For a description of Pascal return codes, see Table 23 on page 829.

IsLocalHost

This procedure returns the correct host class for Name, which can be a host name or a dotted decimal address. Figure 190 shows an example of the IsLocalHost procedure.

The host classes are:

HOSTlocal
An internet address for the local host

HOSTloopback
One of the dummy internet addresses used to designate various levels of loopback testing

HOSTremote
A known host name for some remote host

HOSTunknown
An unknown host name (or other error)

```
procedure IsLocalHost
        (
    const   Name: string;
    var       Class: HostClassType
        );
        external;
```

Figure 190. IsLocalHost example

Parameter	Description
Name	The host name. The maximum name length is 255 characters.
Class	The host class

MonQuery

The MonQuery procedure is used to obtain status information or to request TCP/IP to perform certain actions.

Restriction: When you use this function, the total number of IPv4 IP addresses that can be configured to the TCP/IP stack is limited to 255 IP addresses. This limitation of 255 IP addresses applies to all IPv4 IP addresses, including loopback and dynamic VIPA addresses.

```
procedure MonQuery
          (
              QueryRecord: MonQueryRecordType;
              Buffer: integer;
              BufSize: integer;
      var     ReturnCode: integer;
      var     Length: integer
          );
          external;
```

Figure 191. MonQuery example

Parameter	Description
Buffer	The address of the buffer to receive data.
BufSize	The size of the buffer.
ReturnCode	Indicates success or failure of the call. Possible return values are: • OK • FATALerror • NOTyetBEGUN • TCPipSHUTDOWN • UNIMPLEMENTEDrequest • UNAUTHORIZEDuser • SOFTWAREerror
Length	The length of the data returned in the buffer.
QueryRecord	Your program sets up a QueryRecord to specify the type of status information to be retrieved. The MonQueryRecordType is shown in Figure 192.

```
MonQueryRecordType =
          record
          case QueryType:  MonQueryType of
                        QUERYhomeONLY: ();
          end; { MonQueryRecordType }
```

Figure 192. Monitor query record

The only QueryType values available for customer use is:

QUERYhomeONLY
Used to obtain a list of the home Internet addresses (up to 255) recognized by TCP/IP. Your program sets the Buffer to the address of a variable of type HomeOnlyListType, and the BufSize to its length. When MonQuery returns, Length is set to the length of the Buffer that was used, if ReturnCode is OK. Divide the Length by size of the InternetAddressType to get the number of the home addresses that are returned.

For a description of Pascal return codes, see Table 23 on page 829.

PingRequest

Use this procedure to send an ICMP echo request to a foreign host. When a response is received or the timeout limit is reached, you receive a PingResponse notification.

```
procedure PingRequest
          (
               ForeignAddress: InternetAddressType;
               Length: integer;
               Timeout: integer;
     var       ReturnCode: integer
          );
          external;
```

Figure 193. PingRequest example

Parameter	Description
ForeignAddress	The address of the foreign host to receive an ICMP echo request.
Length	Indicates the length of the ICMP packet, excluding the IP header. The range of values for this field is 8—65507 bytes.
Timeout	The amount of time to wait for a response, in seconds.
ReturnCode	Indicates success or failure of a call. Possible return values are: • OK • ABNORMALcondition • BADlengthARGUMENT • CONNECTIONalreadyEXISTS • VIRTUALmemoryTOOsmall • NOTyetBEGUN • TIMEOUTopen • PARAMtimeout • SOFTWAREerror • TCPipSHUTDOWN • UNAUTHORIZEDuser

For a description of Pascal return codes, see Table 23 on page 829.

Note: CONNECTIONalreadyEXISTS, in this context, means a PING request is outstanding.

RawIpClose

This procedure tells the TCP/IP address space that the client does not handle the protocol any longer. Any queued incoming packets are discarded. Figure 194 on page 840 shows an example of the RawIpClose procedure.

When the client is not handling the protocol, a return code of NOsuchCONNECTION is received.

```
procedure RawIpClose
          (
               ProtocolNo: integer;
     var       ReturnCode: integer
          );
          external;
```

Figure 194. RawIpClose example

Parameter	Description
ProtocolNo	The number of the Internet protocol.
ReturnCode	Indicates the success or failure of a call. Possible return values are: • OK • NOsuchCONNECTION • NOTyetBEGUN • SOFTWAREerror • TCPipSHUTDOWN • UNAUTHORIZEDuser

For a description of Pascal return codes, see Table 23 on page 829.

RawIpOpen

This procedure tells the TCP/IP address space that the client wants to send and receive packets of the specified protocol. Figure 195 shows an example.

Do not use protocols 6 and 17. They specify the TCP (6) and UDP (17) protocols. When you specify 6, 17, or a protocol that has been opened by another address space, you receive the LOCALportNOTavailable return code.

```
procedure RawIpOpen
          (
               ProtocolNo: integer;
     var       ReturnCode: integer
          );
          external;
```

Figure 195. RawIpOpen example

Parameter	Description
ProtocolNo	The number of the Internet protocol.
ReturnCode	Indicates success or failure of a call. Possible return values are: • OK • LOCALportNOTavailable • NObufferSPACE • NOTyetBEGUN • SOFTWAREerror • TCPipSHUTDOWN • UNAUTHORIZEDuser

For a description of Pascal return codes, see Table 23 on page 829.

Note: You can open the ICMP protocol, but your program receives only those ICMP packets not interpreted by the TCP/IP address space.

RawIpReceive

Use the procedure shown in Figure 196 to specify a buffer to receive Raw IP datagrams of the specified protocol. You get the notification RAWIPpacketsDELIVERED when a packet is put in the buffer.

```
procedure  RawIpReceive
           (
                ProtocolNo:  integer;
                Buffer:  Address31Type;
                BufferLength:  integer;
      var       ReturnCode:  integer
           );
           external;
```

Figure 196. RawIpReceive example

Parameter	Description
ProtocolNo	The number of the Internet protocol.
Buffer	The address of your buffer.
BufferLength	The length of your buffer. If you specify a length greater than 65535 bytes, only the first 65535 bytes are used.
ReturnCode	Indicates success or failure of a call. Possible return values are: • OK • NOsuchCONNECTION • NOTyetBEGUN • SOFTWAREerror • TCPipSHUTDOWN • UNAUTHORIZEDuser • INVALIDvirtualADDRESS

For a description of Pascal return codes, see Table 23 on page 829.

RawIpSend

This procedure shown in this example sends IP datagrams of the given protocol number. The entire packet, including the IP header, must be in the buffer. The TCP/IP address space uses the total length field of the IP header to determine where each packet ends. Subsequent packets begin at the next doubleword (eight-byte) boundary within the buffer.

The packets in your buffer are transmitted unchanged with the following exceptions:

- They can be fragmented; the fragment offset and flag fields in the header are filled.
- The version field in the header is filled.
- The `checksum` field in the header is filled.
- The source address field in the header is filled.

You get the return code NOsuchCONNECTION if the client is not handling the protocol, or if a packet in the buffer has another protocol. The return code BADlengthARGUMENT is received when:

- The DataLength is fewer than 40 bytes, or greater than 65535 bytes.
- NumPackets is 0.

- All packets do not fit into DataLength.

A ReturnCode value of NObufferSPACE indicates that the data is rejected, because TCP/IP is out of buffers. When buffer space is available, the notification RAWIPspaceAVAILABLE is sent to the client.

```
procedure RawIpSend
          (
               ProtocolNo: integer;
               Buffer: Address31Type;
               DataLength: integer;
               NumPackets: integers;
     var       ReturnCode: integer
          );
          external;
```

Figure 197. RawIpSend example

Parameter	Description
ProtocolNo	The number of the Internet protocol.
Buffer	The address of your buffer containing packets to send.
DataLength	The total length of data in your buffer.
NumPackets	The number of packets in your buffer.
ReturnCode	Indicates the success or failure of a call. Possible return values are: • OK • BADlengthARGUMENT • NObufferSPACE • NOsuchCONNECTION • NOTyetBEGUN • SOFTWAREerror • TCPipSHUTDOWN • UNAUTHORIZEDuser • INVALIDvirtualADDRESS

Note: If your buffer contains multiple packets waiting to be sent, some of the packets might have been sent even if ReturnCode is not OK.

For a description of Pascal return codes, see Table 23 on page 829.

ReadXlateTable

The procedure shown in Figure 198 on page 843 reads the binary translation table data set specified by TableName, and fills in the AtoETable and EtoATable translation tables.

```
procedure  ReadXlateTable
           (
      var      TableName: DirectoryNameType;
      var      AtoETable: AtoEType;
      var      EtoATable: EtoAType;
      var      TranslateTableSpec: SpecOfFileType;
      var      ReturnCode: integer
           );
           external;
```

Figure 198. ReadXlateTable example

Parameter	Description
TableName	The name of the translate table. ReadXlateTable tries to read *user_id*.TableName.TCPXLBIN. If that data set exists but it has an incorrect format, ReadXlateTable returns with a ReturnCode FILEformatINVALID. If *user_id*.TableName.TCPXLBIN does not exist, ReadXlateTable tries to read *hlq*.TableName.TCPXLBIN. ReturnCode reflects the status of reading that data set.
AtoETable	Filled with ASCII-to-EBCDIC table if return code is OK.
EtoATable	Filled with EBCDIC-to-ASCII table if return code is OK.
TranslateTableSpec	If ReturnCode is OK, TranslateTableSpec contains the complete specification of the data set that ReadXlateTable used. If ReturnCode is not OK, TranslateTableSpec contains the complete specification of the last data set that ReadXlateTable tried to use.
ReturnCode	Indicates success or failure of a call. Possible return values are: • OK • ERROROpeningORreadingFILE • FILEformatINVALID

SayCalRe

This function returns a printable string describing the return code passed in CallReturn. Figure 199 shows an example.

```
function  SayCalRe
          )
               CallReturn: integer
          ):
          WordType;
          external;
```

Figure 199. SayCalRe example

Parameter	Description
CallReturn	The return code to be described.

SayConSt

This function returns a printable string describing the connection state passed in State. For example, if SayConSt is invoked with the type identifier RECEIVINGonly, it returns the message `Receiving only`. Figure 200 on page 844 shows an example of this procedure.

```
function SayConSt
        (
              State: ConnectionStateType
        ):
        Wordtype;
        external;
```

Figure 200. SayConSt example

Parameter	Description
State	The connection state to be described.

SayIntAd

This function converts the Internet address specified by InternetAddress to a printable string. If the address can be resolved to a name by use of local host tables, the name is returned. The address to name resolution depends on how the resolver is configured and if any local host tables exist. See *z/OS Communications Server: IP Configuration Guide* for information about configuring the resolver and how local host tables can be used. If the address cannot be resolved to a name, the dotted decimal format of the address is returned. Figure 201 shows an example of this procedure.

```
function SayIntAd
        (
              InternetAddress: InternetAddressType
        ):
        WordType;
        external;
```

Figure 201. SayIntAd example

Parameter	Description
InternetAddress	The internet address to be converted.

SayIntNum

This function converts the internet address specified by InternetAddress to a printable string, in dotted decimal form as shown in Figure 202.

```
function SayIntNum
        (
              InternetAddress: InternetAddressType
        ):
        Wordtype;
        external;
```

Figure 202. SayIntNum example

Parameter	Description
InternetAddress	The internet address to be converted.

SayNotEn

This function returns a printable string describing the notification enumeration type passed in Notification. For example, if SayNotEn is invoked with the type

identifier FSENDreponse, it returns the message ″Fsend response″.

```
function SayNotEn
        (
              Notification: NotificationEnumType
        );
        Wordtype;
        external;
```

Figure 203. SayNotEn example

Parameter	Description
Notification	The notification enumeration type to be described.

SayPorTy

This function returns a printable string describing the port number passed in Port, if it is a well-known port number such as port number 23, the Telnet port. Otherwise, the EBCDIC representation of the number is returned. Figure 204 shows an example of this function.

```
function SayPorTy
        (
              Port: PortType
        ):
        WordType;
        external;
```

Figure 204. SayPorTy example

Parameter	Description
Port	The port number to be described.

SayProTy

This function converts the protocol type specified by Protocol to a printable string, if it is a well-known protocol number, such as 6 (TCP). Otherwise, the EBCDIC representation of the number is returned. Figure 205 shows an example of this function.

```
function SayProTy
        (
              Protocol: ProtocolType
        ):
        WordType;
        external;
```

Figure 205. SayProTy example

Parameter	Description
Protocol	The number of the protocol to be described.

SetTimer

The procedure shown in Figure 206 on page 846 sets a timer to expire after a specified time interval. Specify the amount of time in seconds. When it times out, you receive the TIMERexpired notification, which contains the data and the timer pointer.

Note: This procedure resets any previous time interval set on this timer.

```
procedure SetTimer
          (
               T: TimerPointerType;
               AmountOfTime: integer;
               Data: integer
          );
          external;
```

Figure 206. SetTimer example

Parameter	Description
T	A timer pointer, as returned by a previous CreateTimer call.
AmountOfTime	The time interval in seconds.
Data	An integer value to be returned with the TIMERexpired notification.

TcpAbort

Use the procedure shown in Figure 207 to shut down a specific connection immediately. Data sent by your application on the abended connection might be lost. TCP sends a reset packet to notify the foreign host that you have abended the connection, but there is no guarantee that the reset will be received by the foreign host.

```
procedure TcpAbort
          (
               Connection: ConnectionType;
     var       ReturnCode: integer
          );
          external;
```

Figure 207. TcpAbort example

Parameter	Description
Connection	The connection number, as returned by TcpOpen or TcpWaitOpen in the Connection field of the StatusInfoType record.
ReturnCode	Indicates success or failure of call. Possible return values are: • OK • ABNORMALcondition • FATALerror • NOsuchCONNECTION • NOTyetBEGUN • TCPipSHUTDOWN • SOFTWAREerror • REMOTEreset

The connection is fully terminated when you receive the notification CONNECTIONstateCHANGED with the NewState field set to NONEXISTENT.

For a description of Pascal return codes, see Table 23 on page 829.

TcpClose

Use the procedure shown in Figure 208 to begin the TCP one-way closing sequence. During this closing sequence, you, the local client, cannot send any more data. Data might be delivered to you until the foreign application also closes. TcpClose also causes all data sent on that connection by your application, and buffered by TCPIP, to be sent to the foreign application immediately.

```
procedure  TcpClose
           (
                Connection: ConnectionType;
      var       ReturnCode: integer
           );
           external;
```

Figure 208. TcpClose example

Parameter	Description
Connection	The connection number, as returned by TcpOpen or TcpWaitOpen in the Connection field of the StatusInfoType record.
ReturnCode	Indicates success or failure of call. Possible return values are: • OK • ABNORMALcondition • ALREADYclosing • NOsuchCONNECTION • NOTyetBEGUN • TCPipSHUTDOWN • SOFTWAREror • REMOTEreset

For a description of Pascal return codes, see Table 23 on page 829.

Notes:

1. If you receive the notification CONNECTIONstateCHANGED with a NewState of SENDINGonly, the remote application has done TcpClose (or an equivalent function) and is receiving only. Respond with TcpClose when you finish sending data on the connection.
2. The connection is fully closed when you receive the notification CONNECTIONstateCHANGED, with a NewState field set to NONEXISTENT.

TcpFReceive, TcpReceive, and TcpWaitReceive

The examples in this material illustrate TcpFReceive, TcpReceive, and TcpWaitReceive.

TcpFReceive and TcpReceive are the asynchronous ways of specifying a buffer to receive data for a given connection. Both procedures return to your program immediately. The return code OK means that the request has been accepted. When received data has been placed in your buffer, your program receives a DATAdelivered notification.

TcpWaitReceive is the synchronous interface for receiving data from a TCP connection. TcpWaitReceive does not return to your program until data has been received into your buffer or until an error occurs. Therefore, it is not necessary that TcpWaitReceive receive a notification when data is delivered. The BytesRead parameter is set to the number of bytes received by the data delivery, but if the

number is less than 0, the parameter indicates an error.

```
procedure  TcpFReceive
           (
                 Connection: ConnectionType;
                 Buffer: Address31Type;
                 BytesToRead: integer;
          var    ReturnCode: integer
           );
           external;
```

Figure 209. TcpFReceive example

```
procedure  TcpReceive
           (
                 Connection: ConnectionType;
                 Buffer: Address31Type;
                 BytesToRead: integer;
      var        ReturnCode: integer
           );
           external;
```

Figure 210. TcpReceive example

```
procedure  TcpWaitReceive
           (
                 Connection: ConnectionType;
                 Buffer: Address31Type;
                 BytesToRead: integer;
      var        BytesRead: integer
           );
           external;
```

Figure 211. TcpWaitReceive example

Parameter	Description
Connection	The connection number, as returned by TcpOpen or TcpWaitOpen in the Connection field of the StatusInfoType record.
Buffer	The address of the buffer to contain the received data.
BytesToRead	The size of the buffer. TCP/IP usually buffers the incoming data until this many bytes are received. Data is delivered sooner if the sender specified the PushFlag, or if the sender does a TcpClose or equivalent. **Note:** The order of TcpFReceive or TcpReceive calls on multiple connections and the order of DATAdelivered notifications among the connections are not necessarily related.
BytesRead	Set when TcpWaitReceive returns. If it is greater than 0, it indicates the number of bytes received into your buffer. If it is less than or equal to 0, it indicates an error. Possible BytesRead values are: • OK+ • ABNORMALcondition • FATALerror • TIMEOUTopen+ • UNREACHABLEnetwork+

- BADlengthARGUMENT
- NOsuchCONNECTION
- NOTyetBEGUN
- NOTyetOPEN
- OPENrejected+
- RECEIVEstillPENDING
- REMOTEreset+
- TCPipSHUTDOWN+
- REMOTEclose

ReturnCode Indicates success or failure of call. Possible return values are:
- OK
- ABNORMALcondition
- BADlengthARGUMENT
- FATALerror
- NOsuchCONNECTION
- NOTyetBEGUN
- NOTyetOPEN
- RECEIVEstillPENDING
- REMOTEclose
- TCPipSHUTDOWN
- INVALIDvirtualADDRESS
- SOFTWAREerror

For a description of Pascal return codes, see Table 23 on page 829.

(TcpWaitReceive):

1. For BytesRead OK, the function was initiated, but the connection is no longer receiving for an unspecified reason. Your program does not have to issue TcpClose, but the connection is not completely terminated until a NONEXISTENT notification is received for the connection.
2. For BytesRead REMOTEclose, the foreign host has closed the connection. Your program should respond with TcpClose.
3. If you receive any of the codes marked with (+), the function was initiated but the connection has now been terminated (see 2 on page 824). Your program should not issue TcpClose, but the connection is not completely terminated until NONEXISTENT notification is received for the connection.
4. TcpWaitReceive is intended to be used by programs that manage a single TCP connection. It is not suitable for use by multiple connection servers.
5. A return code of TCPipSHUTDOWN can be returned either because the connection initiation has failed, or because the connection has been terminated because of shutdown. In either case, your program should not issue any more TCP/IP calls.

TcpFSend, TcpSend, and TcpWaitSend

The examples in this material illustrate TcpFSend, TcpSend, and TcpWaitSend.

TcpFSend and TcpSend are the asynchronous ways of sending data on a TCP connection. Both procedures return to your program immediately (do not wait under any circumstance).

TcpWaitSend is a simple synchronous method of sending data on a TCP connection. It does not return immediately if the TCPIP address space has insufficient space to accept the data being sent.

In the case of insufficient buffer space, when space becomes available a BUFFERspaceAVAILABLE notification is received.

Your program can issue successive TcpWaitSend calls. Buffer shortage conditions are handled transparently. Errors at this point are most likely unable to recover or are caused by a terminated connection.

If you receive any of the codes listed for Reason in the CONNECTIONstateCHANGED notification, except for OK, the connection was terminated for the indicated reason. Your program should not issue a TcpClose, but the connection is not completely terminated until your program receives a NONEXISTENT notification for the connection.

```
procedure  TcpFSend
           (
                Connection: ConnectionType;
                Buffer: Address31Type;
                BufferLength: integer;
                PushFlag: Boolean;
                UrgentFlag: Boolean;
      var       ReturnCode: integer
           );
           external;
```

Figure 212. TcpFSend example

```
procedure  TcpSend
       (
                Connection: ConnectionType;
                Buffer: Address31Type;
                BufferLength: integer;
                PushFlag: Boolean;
                UrgentFlag: Boolean;
           var  ReturnCode: integer
       );
       external;
```

Figure 213. TcpSend example

```
procedure  TcpWaitSend
           (
                Connection: ConnectionType;
                Buffer: Address31Type;
                BufferLength: integer;
                PushFlag: Boolean;
                UrgentFlag: Boolean;
      var       ReturnCode: integer
           );
           external;
```

Figure 214. TcpWaitSend example

Parameter	Description
Connection	The connection number, as returned by TcpOpen or TcpWaitOpen in the Connection field of the StatusInfoType record.
Buffer	The address of the buffer containing the data to send.

BufferLength The size of the buffer.

PushFlag Set to force the data, and previously queued data, to be sent immediately to the foreign application.

UrgentFlag Is set to mark the data as *urgent*. The semantics of urgent data depends on your application.

Note: Use urgent data with caution. If the foreign application follows the Telnet-style use of urgent data, it might flush all urgent data, until a special character sequence is encountered.

ReturnCode Indicates success or failure of call:
- OK
- ABNORMALcondition
- BADlengthARGUMENT
- CANNOTsendDATA
- FATALerror
- NObufferSPACE (TcpSend and TcpFSend)
- NOsuchCONNECTION
- NOTyetBEGUN
- NOTyetOPEN
- TCPipSHUTDOWN
- INVALIDvirtualADDRESS
- SOFTWAREerror
- REMOTEreset

For a description of Pascal return codes, see Table 23 on page 829.

Notes:

1. A successful TcpFSend, TcpSend, and TcpWaitSend means that TCP has received the data to be sent and stored it in its internal buffers. TCP then puts the data in packets and transmits it when the conditions permit.
2. Data sent in a TcpFSend, TcpSend, or TcpWaitSend request can be split into numerous packets by TCP, or the data can wait in TCP's buffer space and share a packet with other TcpFSend, TcpSend, or TcpWaitSend requests.
3. The PushFlag is used to expedite when TCP sends the data.

   Setting the PushFlag to `FALSE` allows TCP to buffer the data and wait until it has enough data to transmit so as to use the transmission line more efficiently. There can be some delay before the foreign host receives the data.

   Setting the PushFlag to `TRUE` instructs TCP to put data into packets and transmit any buffered data from previous Send requests along with the data in the current TcpFSend, TcpSend, or TcpWaitSend request without delay or consideration of transmission line efficiency. A successful send does not imply that the foreign application has actually received the data, only that the data will be sent as soon as possible.
4. TcpWaitSend is intended for programs that manage a single TCP connection. It is not suitable for use by multiple connection servers.

TcpNameChange

Use the procedure shown in Figure 215 on page 852 if the address space running the TCP/IP program is not named TCPIP and is not the same as specified in the TcpipUserid statement of the TCPIP.DATA data set. (See *z/OS Communications Server: IP Configuration Reference*.)

If required, this procedure must be called before the BeginTcpIp procedure.

```
procedure TcpNameChange
          (
               NewNameOfTcp: DirectoryNameType
          );
          external;
```

Figure 215. TcpNameChange example

Parameter **Description**

NewNameOfTcp
The name of the address space running TCP/IP.

TcpOpen and TcpWaitOpen

The examples in this material illustrate TcpOpen and TcpWaitOpen.

Use TcpOpen or TcpWaitOpen to initiate a TCP connection. TcpOpen returns immediately, and connection establishment proceeds asynchronously with your program's other operations. The connection is fully established when your program receives a CONNECTIONstateCHANGED notification with NewState set to OPEN. TcpWaitOpen does not return until the connection is established, or until an error occurs.

There are two types of TcpOpen calls: passive open and active open. A passive open call sets the connection state to LISTENING. An active open call sets the connection state to TRYINGtoOPEN.

```
procedure TcpOpen
          (
     var     ConnectionInfo: StatusInfoType;
     var     ReturnCode: integer
          );
          external;
```

Figure 216. TcpOpen example

```
procedure TcpWaitOpen
          (
     var     ConnectionInfo: StatusInfoType;
     var     ReturnCode: integer
          );
          external;
```

Figure 217. TcpWaitOpen example

Parameter **Description**

ConnectionInfo
A connection information record.

Connection Set this field to UNSPECIFIEDconnection. When the call returns, the field contains the number of the new connection if ReturnCode is OK.

ConnectionState
For active open, set this field to TRYINGtoOPEN. For passive open, set this field to LISTENING.

OpenAttemptTimeout
Set this field to specify how long, in seconds, TCP is to continue attempting to open the connection. If the connection is not fully established during that time, TCP reports the error to you. If you used TcpOpen, you receive a notification. The type of notification that you receive is CONNECTIONstateCHANGED. It has a new state of NONEXISTENT and a reason of TIMEOUTopen. If you used TcpWaitOpen, it returns with ReturnCode set to TIMEOUTopen.

Security This field is reserved. Set it to DEFAULTsecurity.

Compartment This field is reserved. Set it to DEFAULTcompartment.

Precedence This field is reserved. Set it to DEFAULTprecedence.

LocalSocket **Active Open:** You can use an address of UNSPECIFIEDaddress (TCP/IP uses the home address corresponding to the network interface used to route to the foreign address) and a port of UNSPECIFIEDport (TCP/IP assigns a port number, in the range of 1000 - 65 535). You can specify the address, the port, or both if particular values are required by your application. The address must be a valid home address for your node, and the port must be available (not reserved, and not in use by another application).

Passive Open: You usually specify a predetermined port number, known by another program, which can do an active open to connect to your program. Alternatively, you can use UNSPECIFIEDport to let TCP/IP assign a port number, obtain the port number through TcpStatus, and transmit it to the other program through an existing TCP connection or manually. You generally specify an address of UNSPECIFIEDaddress, so that the active open to your port succeeds, regardless of the home address to which it was sent.

ForeignSocket **Active Open:** The address and port must both be specified, because TCP/IP cannot actively initiate a connection without knowing the destination address and port.

Passive Open: If your program is offering a service to anyone who wants it, specify an address of UNSPECIFIEDaddress and a port of UNSPECIFIEDport. You can specify a particular address and port if you want to accept an active open only from a certain foreign application.

ReturnCode Indicates success or failure of call. Possible return values are:

- OK
- ABNORMALcondition
- FATALerror
- LOCALportNOTavailable
- NObufferSPACE
- NOsuchCONNECTION
- NOTyetBEGUN
- OPENrejected (TcpWaitOpen Only)
- PARAMlocalADDRESS
- PARAMstate
- PARAMtimeout
- PARAMunspecADDRESS
- PARAMunspecPORT
- REMOTEreset (TcpWaitOpen Only)
- SOFTWAREerror
- TCPipSHUTDOWN
- TIMEOUTopen (TcpWaitOpen Only)
- TOOmanyOPENS
- UNAUTHORIZEDuser (TcpWaitOpen Only)
- UNREACHABLEnetwork (TcpWaitOpen Only)
- ZEROresources

For a description of Pascal return codes, see Table 23 on page 829.

TcpOption

Use the procedure shown in Figure 218 to set an option for a TCP connection.

```
procedure  TcpOption
           (
           Connection: ConnectionType
           OptionName: integer
           OptionValue: integer;
     var   ReturnCode: integer;
           ); external;
```

Figure 218. TcpOption example

Parameter **Description**

Connection The connection number, as returned by TcpOpen or TcpWaitOpen in the Connection field of the StatusInforType record.

OptionName The code for the option.

Name **Description**

OPTIONtcpKEEPALIVE
If OptionValue is nonzero, then the keep-alive mechanism is activated for connection. If OptionValue is 0, then the keep-alive mechanism is deactivated for the connection. When activated, the keep-alive mechanism periodically sends a packet on an otherwise idle connection. If the remote TCP does not respond to the packet or to retransmissions of the packet, then the connection state is changed to NONEXISTENT, with reason TIMEOUT connection.

OptionValue The value for the option.

ReturnCode Indicates success or failure of call.

Possible return values are:
- OK
- NOsuchCONNECTION
- NOTyetBEGUN
- TCPipSHUTDOWN
- INVALIDrequest
- SOFTWAREerror
- REMOTEreset

For a description of Pascal return codes, see Table 23 on page 829.

TcpStatus

Use TcpStatus to obtain the current status of a TCP connection. Your program sets the Connection field of the ConnectionInfo record to the number of the connection whose status you want. Figure 219 shows an example of TcpStatus.

```
procedure  TcpStatus
           (
      var      ConnectionInfo: StatusInfoType;
      var      ReturnCode: integer
           );
           external;
```

Figure 219. TcpStatus example

Parameter **Description**

ConnectionInfo
If ReturnCode is OK, the following fields are returned.

OpenAttemptTimeout
If the connection is in the process of being opened (including a passive open), this field is set to the number of seconds remaining before the open is terminated if it has not completed. Otherwise, it is set to WAITforever.

BytesToRead
The number of bytes of incoming data queued for your program (waiting for TcpReceive, TcpFReceive, or TcpWaitReceive).

UnackedBytes
The number of bytes sent by your program but not yet sent to the foreign TCP, or the number of bytes sent to the foreign TCP, but not yet acknowledged.

ConnectionState
The current connection state.

LocalSocket
The local socket, consisting of a local address and a local port.

ForeignSocket
The foreign socket, consisting of a foreign address and a foreign port.

ReturnCode Indicates the success or failure of the call. Possible return values are:
- OK
- NOsuchCONNECTION
- NOTyetBEGUN
- TCPipSHUTDOWN
- REMOTEreset
- SOFTWAREerror

For a description of Pascal return codes, see Table 23 on page 829.

Note: Your program cannot monitor connection state changes exclusively through polling with TcpStatus. It must receive CONNECTIONstateCHANGED notifications through GetNextNote for the TCP interface to work properly.

UdpClose

The procedure shown in Figure 220 closes the UDP socket specified in the ConnIndex field. All incoming datagrams on this connection are discarded.

```
procedure UdpClose
          (
               ConnIndex: ConnectionIndexType;
     var       ReturnCode: CallReturnCodeType
          );
          external;
```

Figure 220. UdpClose example

Parameter	Description
ConnIndex	The ConnIndex value returned from UdpOpen.
ReturnCode	Indicates success or failure of a call. Possible return values are: • OK • NOsuchCONNECTION • NOTyetBEGUN • TCPipSHUTDOWN • SOFTWAREerror

For a description of Pascal return codes, see Table 23 on page 829.

UdpNReceive

The procedure shown in Figure 221 on page 857 notifies the TCP/IP address space that you are willing to receive UDP datagram data. This call returns immediately. The data buffer is not valid until you receive a UDPdatagramDELIVERED notification.

```
procedure  UdpNReceive
           (
                ConnIndex: ConnectionIndexType;
                BufferAddress: integer;
                BufferLength: integer;
      var       ReturnCode: CallReturnCodeType
           );
           external;
```

Figure 221. UdpNReceive example

Parameter	Description
ConnIndex	The ConnIndex value returned from UdpOpen.
BufferAddress	The address of your buffer that is filled with a UDP datagram.
BufferLength	The length of your buffer. If you specify a length larger than 65 507 bytes, only the first 65 507 bytes are used.
ReturnCode	Indicates success or failure of a call. Possible return values are: • OK • ABNORMALcondition • FATALerror • NOsuchCONNECTION • NOTyetBEGUN • RECEIVEstillPENDING • TCPipSHUTDOWN • SOFTWAREerror • BADlengthARGUMENT • INVALIDvirtualADDRESS

For a description of Pascal return codes, see Table 23 on page 829.

UdpOpen

This procedure requests acceptance of UDP datagrams on the specified socket and allows datagrams to be sent from the specified socket. When the socket port is unspecified, UDP selects a port and returns it to the socket port field. When the socket address is unspecified, UDP uses the default local address. If specified, the address must be a valid home address for your node.

Note: When the local address is specified, only the UDP datagrams addressed to it are delivered.

If the ReturnCode indicates the open was successful, use the returned ConnIndex value on any further actions pertaining to this UDP socket. Figure 222 on page 858 shows an example.

```
procedure UdpOpen
          (
     var  LocalSocket: SocketType;
     var  ConnIndex: ConnectionIndexType;
     var  ReturnCode: CallReturnCodeType
          );
          external;
```

Figure 222. UdpOpen example

Parameter	Description
LocalSocket	The local socket (address and port pair).
ConnIndex	The ConnIndex value returned from UdpOpen.
ReturnCode	Indicates success or failure of a call. Possible return values are: • OK • ABNORMALcondition • FATALerror • LOCALportNOTavailable • NObufferSPACE • NOTyetBEGUN • SOFTWAREerror • TCPipSHUTDOWN • UDPlocalADDRESS • TOOmanyOPENS • UNAUTHORIZEDuser

For a description of Pascal return codes, see Table 23 on page 829.

UdpReceive

The procedure shown in Figure 223 notifies the TCP/IP address space that you are willing to receive UDP datagram data.

UdpReceive is for compatibility with old programs only. New programs should use the UdpNReceive procedure, which allows you to specify the size of your buffer.

If you use UdpReceive, TCP/IP can put a datagram as large as 2012 bytes in your buffer. If a larger datagram is sent to your port when UdpReceive is pending, the datagram is discarded without notification.

Note: No data is transferred from the TCP/IP address space in this call. It only tells TCP/IP that you are waiting for a datagram. Data has been transferred when a UDPdatagramDELIVERED notification is received.

```
procedure UdpReceive
          (
               ConnIndex: ConnectionIndexType;
               DatagramAddress: integer;
     var       ReturnCode: CallReturnCodeType
          );
          external;
```

Figure 223. UdpReceive example

Parameter	Description
ConnIndex	The ConnIndex value returned from UdpOpen.
DatagramAddress	The address of your buffer that is filled with a UDP datagram.
ReturnCode	Indicates success or failure of a call: • OK • ABNORMALcondition • FATALerror • NOsuchCONNECTION • NOTyetBEGUN • SOFTWAREerror • TCPipSHUTDOWN • INVALIDvirtualADDRESS

For a description of Pascal return codes, see Table 23 on page 829.

UdpSend

The procedure shown in Figure 224 sends a UDP datagram to the specified foreign socket. The source socket is the local socket selected in the UdpOpen that returned the ConnIndex value that was used. The buffer does not include the UDP header. This header is supplied by TCP/IP.

When there is no buffer space to process the data, an error is returned. In this case, wait for a subsequent UDPdatagramSPACEavailable notification.

```
procedure UdpSend
          (
               ConnIndex: ConnectionIndexType;
               ForeignSocket: SocketType;
               BufferAddress: integer;
               Length: integer;
        var    ReturnCode: CallReturnCodeType
          );
          external;
```

Figure 224. UdpSend example

Parameter	Description
ConnIndex	The ConnIndex value returned from UdpOpen.
ForeignSocket	The foreign socket (address and port) to which the datagram is to be sent.
BufferAddress	The address of your buffer containing the UDP datagram to be sent, excluding UDP header.
Length	The length of the datagram to be sent, excluding UDP header. Maximum is 65507 bytes.
ReturnCode	Indicates success or failure of a call. Possible return values are: • OK • BADlengthARGUMENT • NObufferSPACE • NOsuchCONNECTION • NOTyetBEGUN

- SOFTWAREerror
- TCPipSHUTDOWN
- UDPunspecADDRESS
- UDPunspecPORT
- INVALIDvirtualADDRESS

For a description of Pascal return codes, see Table 23 on page 829.

Unhandle

Use the procedure shown in Figure 225 when you no longer want to receive notifications in the given set.

If you request to unhandle the DATAdelivered notification, the Unhandle procedure returns with a code of INVALIDrequest.

```
procedure Unhandle
          (
               Notifications: NotificationSetType;
     var       ReturnCode: integer
          );
          external;
```

Figure 225. Unhandle example

Parameter	Description
Notifications	The set of notifications that you no longer want to receive.
ReturnCode	Indicates success or failure of call. Possible return values are: • OK • NOTyetBEGUN • INVALIDrequest

For a description of Pascal return codes, see Table 23 on page 829.

Sample Pascal program

This information contains an example of a Pascal application program. The source code can be found in the SEZAINST data set.

Building the sample Pascal API module

The following steps describe how to build the Pascal API module:

1. Compile the sample Pascal program.
2. Link-edit the object code module to form an executable module sample.

Running the sample module

The following steps describe how to run the sample module:

1. Run the Pascal API sample program with the Receive option (shown in Figure 226 on page 861).

   Run PSAMPLE to start the sample program on the TSO command line. The following example is a typical response:

```
ENTER TSO COMMAND, CLIST, OR REXX EXEC BELOW:

===> psample

Transfer Mode: (Send or Receive) receive

Host Name or Internet Address: mvs1

mvs1
Transfer rate 483884. Bytes/sec.
Transfer rate 442064. Bytes/sec.
Transfer rate 478802. Bytes/sec.
Transfer rate 549568. Bytes/sec.
Transfer rate 635116. Bytes/sec.
Program terminated successfully.
***
```

Figure 226. Sample Pascal API with receive option

2. Run the Pascal API sample program with the Send option on a second TSO ID (shown in Figure 227).

   Run PSAMPLE on the TSO command line to start the sample program. The following example is a typical response:

```
ENTER TSO COMMAND, CLIST, OR REXX EXEC BELOW:

===> psample

Transfer Mode: (Send or Receive) send

Host Name or Internet Address: mvs1

mvs1
Transfer rate 516540. Bytes/sec.
Transfer rate 487030. Bytes/sec.
Transfer rate 427816. Bytes/sec.
Transfer rate 566186. Bytes/sec.
Transfer rate 612128. Bytes/sec.
Program terminated successfully.
***
```

Figure 227. Sample Pascal API with send option

Sample Pascal application program

The following is an example of a Pascal application program.

```
%UHEADER 5647-A01 (C) IBM CORP 1991, 2002. &SYSPARM EZABB01S PSAMPLE
{
   TCP/IP for MVS
   SMP/E Distribution Name: EZABB01V (for PSAMPLE source in SEZAINST)
                            EZABB01S (for PSAMPLE module in SEZAMOD1)

      Licensed Materials - Property of IBM
      This product contains "Restricted Materials of IBM"
      5694-A01 (C) Copyright IBM Corp. 1991, 2002
      All rights reserved.
      US Government Users Restricted Rights -
      Use, duplication or disclosure restricted by GSA ADP Schedule
      Contract with IBM Corp.
      See IBM Copyright Instructions.
/*  Change Activity -                                                 */
/*  CFD List:                                                         */
/*                                                                    */
/* $L1=D45MDEYE HTCP320 960205 KAA: RAS DCR - Module Eyecatchers      */
/* $L2=D109     HTCP340 971024 KDJ: OS/390 Copyright                  */
/* $A1=PQ11420  HTCP340 971210 SLHUANG: Remove FRECEIVEerror and      */
/*                                      replace SendTurnCode          */
/* $N1=PMV24171 CSV1R4  011128 SLHUANG: Ignore Bufferspaceavailable   */
/*                                      notification                  */
/*                                                                    */
/*  End CFD List:                                                     */

}
{********************************************************************}
{*                                                                   *}
{* Memory-to-memory Data Transfer Rate Measurement                   *}
{*                                                                   *}
{* Pseudocode:  Establish access to TCP/IP Services                  *}
{*              Prompt user for operation parameters                 *}
{*              Open a connection (Sender:active, Receiver:passive)  *}
{*              If Sender:                                           *}
{*                Send 5M of data using TcpFSend                     *}
{*                Use GetNextNote to know when Send is complete      *}
{*                Print transfer rate after every 1M of data         *}
{*              else Receiver:                                       *}
{*                Receive 5M of data using TcpFReceive               *}
{*                Use GetNextNote to know when data is delivered     *}
{*                Print transfer rate after every 1M of data         *}
{*              Close connection                                     *}
{*              Use GetNextNote to wait until connection is closed   *}
{*                                                                   *}
{********************************************************************}
program PSAMPLE;

%include CMALLCL
%include CMINTER
%include CMRESGLB

const
   BUFFERlength = 8192;             { same as MAXdataBUFFERsize      }
```

Figure 228. Sample Pascal application program (Part 1 of 6)

```
   PORTnumber   = 999;              { constant on both sides         }
   CLOCKunitsPERthousandth = '3E8000'x;

static
   Buffer         : packed array (.1..BUFFERlength.) of char;
   BufferAddress  : Address31Type;
   ConnectionInfo : StatusInfoType;
   Count          : integer;
   DataRate       : real;
   Difference     : TimeStampType;
   HostAddress    : InternetAddressType;
   IbmSeconds     : integer;
   Ignored        : integer;
   Line           : string(80);
   Note           : NotificationInfoType;
   PushFlag       : boolean;        { for TcpFSend                   }
   RealRate       : real;
   ReturnCode     : integer;
   SendFlag       : boolean;        { are we sending or receiving    }
   StartingTime   : TimeStampType;
   Thousandths    : integer;
   TotalBytes     : integer;
   UrgentFlag     : boolean;        { for TcpFSend                   }

 var RoundRealRate : integer;

   {*****************************************************************}
   {* Print message, release resources and reset environment         *}
   {*****************************************************************}
   procedure Restore ( const Message: string;
                       const ReturnCode: integer );
   %UHEADER
   begin
      Write(Message);
      if ReturnCode <> OK then
    {*   Write(SayCalRe(ReturnCode));
      Writeln('');                   *}
         Msg1(Output,1, addr(SayCalRe(ReturnCode)) )
      else Msg0(Output,2);

      EndTcpIp;
      Close (Input);
      Close (Output);
   end;


begin
   TermOut (Output);
   TermIn (Input);

   { Establish access to TCP/IP services }
   BeginTcpIp (ReturnCode);
   if ReturnCode <> OK then begin
   {* Writeln('BeginTcpip: ',SayCalRe(ReturnCode)); *}
      Msg1(Output,4, addr(SayCalRe(ReturnCode)) );
```

Figure 228. Sample Pascal application program (Part 2 of 6)

```
      return;
   end;

   { Inform TCPIP which notifications will be handled by the program }
   Handle ((.DATAdelivered, BUFFERspaceAVAILABLE,
            CONNECTIONstateCHANGED,
            FSendResponse.), ReturnCode);
   if ReturnCode <> OK then begin
      Restore ('Handle: ', ReturnCode);
      return;
   end;

   { Prompt user for operation parameters                            }
{* Writeln('Transfer mode: (Send or Receive)'); *}
   Msg0(Output,5);
   ReadLn (Line);
   if (Substr(Ltrim(Line),1,1) = 's')
   or (Substr(Ltrim(Line),1,1) = 'S') then
      SendFlag := TRUE
   else
      SendFlag := FALSE;

{* Writeln('Host Name or Internet Address :'); *}
   Msg0(Output,6);
   ReadLn (Line);
   GetHostResol (Trim(Ltrim(Line)), HostAddress);
   if HostAddress = NOhost then begin
      Restore ('GetHostResol failed. ', OK);
      return;
   end;

   { Open a TCP connection: active for Send and passive for Receive }
   {   - Connection value will be returned by TcpIp                 }
   {   - initialize IBM reserved fields:  Security, Compartment     }
   {     and Precedence                                             }
   { for Active open  - set Connection State to TRYINGtoOPEN        }
   {                  - must initialize foreign socket              }
   { for Passive open - set ConnectionState to LISTENING            }
   {                  - may leave foreign socket uninitialized to   }
   {                    accept any open attempt                     }
   with ConnectionInfo do begin
      Connection         := UNSPECIFIEDconnection;
      OpenAttemptTimeout := WAITforever;
      Security           := DEFAULTsecurity;
      Compartment        := DEFAULTcompartment;
      Precedence         := DEFAULTprecedence;
      if SendFlag then begin
         ConnectionState       := TRYINGtoOPEN;
         LocalSocket.Address   := UNSPECIFIEDaddress;
         LocalSocket.Port      := UNSPECIFIEDport;
         ForeignSocket.Address := HostAddress;
         ForeignSocket.Port    := PORTnumber;
      end
      else begin
         ConnectionState       := LISTENING;
```

Figure 228. Sample Pascal application program (Part 3 of 6)

```
      LocalSocket.Address   := HostAddress;
      LocalSocket.Port      := PORTnumber;
      ForeignSocket.Address := UNSPECIFIEDaddress;
      ForeignSocket.Port    := UNSPECIFIEDport;
   end;
end;
TcpWaitOpen (ConnectionInfo, ReturnCode);
if ReturnCode <> OK then begin
   Restore ('TcpWaitOpen: ', ReturnCode);
   return;
end;

{ Initialization }
BufferAddress := Addr(Buffer(.1.));
StartingTime  := ClockTime;
TotalBytes    := 0;
Count         := 0;
PushFlag      := false;     { let TcpIp buffer data for efficiency }
UrgentFlag    := false;              { none of out data is Urgent }

{ Issue first TcpFSend or TcpFReceive }
if SendFlag then
   TcpFSend (ConnectionInfo.Connection, BufferAddress,
               BUFFERlength, PushFlag, UrgentFlag, ReturnCode)
else
   TcpFReceive (ConnectionInfo.Connection, BufferAddress,
                  BUFFERlength, ReturnCode);

if ReturnCode <> OK then begin
{* Writeln('TcpSend/Receive: ',SayCalRe(ReturnCode));  *}
   Msg1(Output,7, addr(SayCalRe(ReturnCode)) );
   return;
end;


{ Repeat until 5M bytes of data have been transferred }
while (Count < 5) do begin
   { Wait until previous transfer operation is completed }
   GetNextNote(Note, True, ReturnCode);
   if ReturnCode <> OK then begin
      restore('GetNextNote :',ReturnCode);
      return;
   end;

   { Proceed with transfer according to the Notification received   }
   { Notifications Expected :                                       }
   {  DATAdelivered - TcpFReceive function call is now complete     }
   {                - receive buffer contains data                  }
   {  FSENDresponse - TcpFSend function call is now complete        }
   {                - send buffer is now available for use          }
   case Note.NotificationTag of
      DATAdelivered:
         begin
            TotalBytes := TotalBytes + Note.BytesDelivered;
            {issue next TcpFReceive                              }
```

Figure 228. Sample Pascal application program (Part 4 of 6)

```
            TcpFReceive (ConnectionInfo.Connection, BufferAddress,
                  BUFFERlength, ReturnCode);
            if ReturnCode <> OK then begin
               Restore('TcpFReceive: ', ReturnCode);
               return;
            end;
         end;
      FSENDresponse:
         begin
            if Note.SendTurnCode <> OK then begin
               Restore('FSENDresponse: ',Note.SendTurnCode);
               return;
            end
            else begin
               {issue next TcpFSend                        }
               TotalBytes := TotalBytes + BUFFERlength;
               TcpFSend (ConnectionInfo.Connection, BufferAddress,
                   BUFFERlength, PushFlag, UrgentFlag, ReturnCode);
               if ReturnCode <> OK then begin
                  Restore('TcpFSend: ', ReturnCode);
                  return;
               end;
            end;
         end;
      BUFFERspaceAVAILABLE:
         { do nothing };
      OTHERWISE
         begin
            Restore('UnExpected Notification ',OK);
            return;
         end;
   end; { Case on Note.NotificationTag }


   { is it time to print transfer rate? }
   if TotalBytes < 1048576 then
      continue;

   { Print transfer rate after every 1M bytes of data transferred }
   DoubleSubtract (ClockTime, StartingTime, Difference);
   DoubleDivide (Difference, CLOCKunitsPERthousandth, Thousandths,
                 Ignored);
   RealRate := (TotalBytes/Thousandths) * 1000.0;
{* Writeln('Transfer Rate ', RealRate:1:0,' Bytes/sec.'); *}
   RoundRealRate := Round(RealRate);
   Msg1(Output,8, addr(RoundRealRate) );

   StartingTime := ClockTime;
   TotalBytes   := 0;
   Count        := Count + 1;
end; {Loop while Count < 5 }

{ Close TCP connection and wait till partner also drops connection }
TcpClose (ConnectionInfo.Connection, ReturnCode);
if ReturnCode <> OK then begin
```

Figure 228. Sample Pascal application program (Part 5 of 6)

```
      Restore ('TcpClose: ', ReturnCode);
      return;
   end;

   { when partner also drops connection, program will receive         }
   {  CONNECTIONstateCHANGED notification with NewState = NONEXISTENT }
   repeat
      GetNextNote (Note, True, ReturnCode);
      if ReturnCode <> OK then begin
         Restore ('GetNextNote: ', ReturnCode);
         return;
      end;
   until (Note.NotificationTag = CONNECTIONstateCHANGED) &
         ((Note.NewState = NONEXISTENT) |
            (Note.NewState = CONNECTIONclosing));

   Restore ('Program terminated successfully. ', OK);
end.
```

Figure 228. Sample Pascal application program (Part 6 of 6)

Appendix A. Multitasking C socket sample program

The first sample program is the server in the C language. It allocates a socket, binds to a port, calls listen() to perform a passive open, and uses select() to block until a client request arrives. When a client requests a connection, select() returns and accept() is called to establish the connection.

Note: Some hosts have more than one network address. By specifying a particular network address for the bind() call, a server specifies that it wants to honor connections from one particular network address only. If the server specifies the constant INADDR_ANY for this address, it accepts connections from any of the machine's network addresses.

This program uses the Multitasking Facility (MTF). The server has started a number of subtasks with the MTF task initialization service tinit(). When the server has accepted a connection, it calls tsched() to start the subtask that will handle the client. The server then uses givesocket() and takesocket() to pass the connection to the subtask. When the connection has been passed to the subtask, the main loop blocks in select() waiting for another client.

The second program is the subtask in C. When it begins, it does a takesocket(). It was passed two 8-byte names that define the parent task from which it will obtain the socket. After it gets the socket, it sends a message to this new client and then waits for the client to send a message back.

The third program is the client in C. It allocates a socket, binds to a port, and connects to a server port that is passed as the second parameter port number 691. Then it has a conversation with the server (actually the server's subtask) sending and receiving messages alternatively.

Notes:

1. When you compile the C sample programs, use DEF(MVS) in the CPARM list.
2. When you run the server program, specify PARM='9999' to use port 9999.
3. When you run the client program, specify PARM='MVSF 9999' to use port 9999. Replace MVSF with the host name of your MVS system.

Server sample program in C

The following C socket server program is the MTCSRVR member in the SEZAINST data set.

© Copyright IBM Corp. 1989, 2010

```
/*** IBMCOPYR ************************************************************/
/*                                                                       */
/* Component Name: MTCSRVR (alias EZAEC047)                              */
/*                                                                       */
/*                                                                       */
/* Copyright:    Licensed Materials - Property of IBM                    */
/*                                                                       */
/*               "Restricted Materials of IBM"                           */
/*                                                                       */
/*               5647-A01                                                */
/*                                                                       */
/*               (C) Copyright IBM Corp. 1977, 1998                      */
/*                                                                       */
/*               US Government Users Restricted Rights -                 */
/*               Use, duplication or disclosure restricted by            */
/*               GSA ADP Schedule Contract with IBM Corp.                */
/*                                                                       */
/* Status:       CSV2R6                                                  */
/*                                                                       */
/*  SMP/E Distribution Name: EZAEC049                                    */
/*                                                                       */
/*                                                                       */
/*** IBMCOPYR ************************************************************/

/*************************************************************************/
/* C socket Server Program                                               */
/*                                                                       */
/* This code performs the server functions for multitasking, which       */
/* include                                                               */
/*      . creating subtasks                                              */
/*      . socket(), bind(), listen(), accept()                           */
/*      . getclientid                                                    */
/*      . givesocket() to TCP/IP in preparation for the subtask          */
/*                     to do a takesocket()                              */
/*      . select()                                                       */
/*                                                                       */
/* There are three test tasks running:                                   */
/*      . server master                                                  */
/*      . server subtask - separate TCB within server address space      */
/*      . client                                                         */
/*                                                                       */
/*************************************************************************/

static char ibmcopyr[] =
   "MTCSRVR - Licensed Materials - Property of IBM. "
   "This module is \"Restricted Materials of IBM\" "
   "5647-A01 (C) Copyright IBM Corp. 1994, 1996. "
   "See IBM Copyright Instructions.";

#include <manifest.h>
#include <bsdtypes.h>
#include <in.h>
#include <netdb.h>
```

Figure 229. MTCSRVR C socket server program sample (Part 1 of 7)

```
#include <socket.h>
#include <inet.h>
#include <fcntl.h>
#include <errno.h>
#include <tcperrno.h>
#include <bsdtime.h>
#include <mtf.h>
#include <stdio.h>

int  dotinit(void);
void getsock(int *s);
int  dobind(int *s, unsigned short port);
int  dolisten(int *s);
int  getname(char *myname, char *mysname);
int  doaccept(int *s);
int  testgive(int *s);
int  dogive(int *clsocket, char *myname);

/*
 * Server Main.
 */
main(argc, argv)
int argc;
char **argv;
{
    unsigned short port;       /* port server for bind                */
    int s;                     /* socket for accepting connections    */
    int rc;                    /* return code                         */
    int count;                 /* counter for number of sockets       */
    int clsocket;              /* client socket                       */
    char myname[8];            /* 8 char name of this addres space    */
    char mysname[8];           /* my subtask name                     */

    /*
     * Check arguments. Should be only one: the port number to bind to.
     */
    if (argc != 2) {
        fprintf(stderr, "Usage: %s port\n", argv[0]);
        exit(1);
    }

    /*
     * First argument should be the port.
     */
    port = (unsigned short) atoi(argv[1]);
    fprintf(stdout, "Server: port = %d \n", port);

    /*
     * Create subtasks
     */
    rc = dotinit();
    if (rc < 0)
        perror("Srvr: error for tinit");
    printf("rc from tinit is %d\n", rc);
```

Figure 229. MTCSRVR C socket server program sample (Part 2 of 7)

```
getsock(&s);
printf("Srvr: socket = %d\n", s);

rc = dobind(&s, port);
if (rc < 0)
    tcperror("Srvr: error for bind");
printf("Srvr: rc from bind is %d\n", rc);

rc = dolisten(&s);
if (rc < 0)
    tcperror("Srvr: error for listen");
printf("Srvr: rc from listen is %d\n", rc);

/************************************
 * To do nonblocking mode,
 *  uncomment out this code.
 *
rc = fcntl(s, F_SETFL, FNDELAY);
if (rc != 0)
    tcperror("Error for fcntl");
printf("rc from fcntl is %d\n", rc);

************************************/

rc = getname(myname, mysname);
if (rc < 0)
    tcperror("Srvr: error for getclientid");
printf("Srvr: rc from getclientid is %d\n", rc);

/*-------------------------------------------------------------------*/
/* . issue accept(), waiting for client connection                   */
/* . issue givesocket() to pass client's socket to TCP/IP            */
/* . issue select(), waiting for subtask to complete takesocket()    */
/* . close our local socket associated with client's socket          */
/* . loop on accept(), waiting for another client connection         */
/*-------------------------------------------------------------------*/
rc    = 0;
count = 0;          /* number of sockets */
while (rc == 0) {
    clsocket = doaccept(&s);
    printf("Srvr: clsocket from accept is %d\n", clsocket);
    count = count + 1;
    printf("Srvr: ###number of sockets is %d\n", count);
    if (clsocket != 0) {
        rc = dogive(&clsocket, myname);
        if (rc < 0)
            tcperror("Srvr: error for dogive");
        printf("Srvr: rc from dogive is %d\n", rc);
        if (rc == 0) {
            rc = tsched(MTF_ANY,"csub", &clsocket,
                        myname, mysname);
            if (rc < 0)
                perror("error for tsched");
            printf("Srvr: rc from tsched is %d\n", rc);
```

Figure 229. MTCSRVR C socket server program sample (Part 3 of 7)

```
                rc = testgive(&clsocket);
                printf("Srvr: rc from testgive is %d\n", rc);

                sleep(60); /*** do simplified situation first ***/

                printf("Srvr: closing client socket %d\n", clsocket);
                rc = close(clsocket);   /* give back this socket */
                if (rc < 0)
                    tcperror("error for close of clsocket");
                printf("Srvr: rc from close of clsocket is %d\n", rc);
                /*************************************************/
                exit(0); /*** do  this simplified situation first ***/
                /*************************************************/
            } /** end of if (rc == 0)       ****/
        }   /**** end of if (clsocket != 0) ****/
    }   /******** end of while (rc == 0)    ****/
}   /************ end of main           ********/

/*--------------------------------------------------------------------*/
/*    dotinit()                                                       */
/*    Call tinit() to ATTACH subtask and fetch() subtask load module  */
/*--------------------------------------------------------------------*/
int dotinit(void)
{
    int rc;
    int numsubs = 1;
    printf("Srvr: calling __tinit\n");
    rc = __tinit("mtccsub", numsubs);
    return rc;
}

/*--------------------------------------------------------------------*/
/*    getsock()                                                       */
/*    Get a socket                                                    */
/*--------------------------------------------------------------------*/
void getsock(int *s)
{
    int temp;
    temp = socket(AF_INET, SOCK_STREAM, 0);
    *s = temp;
    return;
}

/*--------------------------------------------------------------------*/
/*    dobind()                                                        */
/*    Bind to all interfaces                                          */
/*--------------------------------------------------------------------*/
int dobind(int *s, unsigned short port)
{
    int rc;
    int temps;
    struct sockaddr_in tsock;
    memset(&tsock, 0, sizeof(tsock));   /* clear tsock to 0's */
    tsock.sin_family      = AF_INET;
    tsock.sin_addr.s_addr = INADDR_ANY; /* bind to all interfaces */
```

Figure 229. MTCSRVR C socket server program sample (Part 4 of 7)

```
    tsock.sin_port        = htons(port);

    temps = *s;
    rc = bind(temps, (struct sockaddr *)&tsock, sizeof(tsock));
    return rc;
}

/*--------------------------------------------------------------------*/
/*    dolisten()                                                      */
/*    Listen to prepare for client connections.                       */
/*--------------------------------------------------------------------*/
int dolisten(int *s)
{
    int rc;
    int temps;
    temps = *s;
    rc = listen(temps, 10);     /* backlog of 10 */
    return rc;
}

/*--------------------------------------------------------------------*/
/*    getname()                                                       */
/*    Get the identifiers by which TCP/IP knows this server.          */
/*--------------------------------------------------------------------*/
int getname(char *myname, char *mysname)
{
    int rc;
    struct clientid cid;
    memset(&cid, 0, sizeof(cid));
    rc = getclientid(AF_INET, &cid);
    memcpy(myname,  cid.name,        8);
    memcpy(mysname, cid.subtaskname, 8);
    return rc;
}

/*--------------------------------------------------------------------*/
/*    doaccept()                                                      */
/*    Select() on this socket, waiting for another client connection. */
/*    If connection is pending, issue accept() to get client's socket */
/*--------------------------------------------------------------------*/
int doaccept(int *s)
{
    int temps;
    int clsocket;
    struct sockaddr clientaddress;
    int addrlen;
    int maxfdpl;
    struct fd_set readmask;
    struct fd_set writmask;
    struct fd_set excpmask;
    int rc;
    struct timeval time;

    temps = *s;
    time.tv_sec  = 1000;
```

Figure 229. MTCSRVR C socket server program sample (Part 5 of 7)

```
    time.tv_usec = 0;
    maxfdpl = temps + 1;

    FD_ZERO(&readmask);
    FD_ZERO(&writmask);
    FD_ZERO(&excpmask);

    FD_SET(temps, &readmask);

    rc = select(maxfdpl, &readmask, &writmask, &excpmask, &time);
    printf("Srvr: rc from select is %d\n", rc);
    if (rc < 0) {
        tcperror("error from select");
        return rc;
    }
    else if (rc == 0) {  /* time limit expired */
        return rc;
    }
    else {              /* this socket is ready */
        addrlen = sizeof(clientaddress);
        clsocket = accept(temps, &clientaddress, &addrlen);
        return clsocket;
    }
}

/*--------------------------------------------------------------------*/
/*    testgive()                                                      */
/*    Issue select(), checking for an exception condition, which      */
/*    indicates that takesocket() by the subtask was successful.      */
/*--------------------------------------------------------------------*/
int testgive(int *s)
{
    int temps;
    struct sockaddr clientaddress;
    int addrlen;
    int maxfdpl;
    struct fd_set readmask;
    struct fd_set writmask;
    struct fd_set excpmask;
    int rc;
    struct timeval time;

    temps = *s;
    time.tv_sec  = 1000;
    time.tv_usec = 0;
    maxfdpl = temps + 1;

    FD_ZERO(&readmask);
    FD_ZERO(&writmask);
    FD_ZERO(&excpmask);

 /* FD_SET(temps, &readmask); */
 /* FD_SET(temps, &writmask); */
    FD_SET(temps, &excpmask);
```

Figure 229. MTCSRVR C socket server program sample (Part 6 of 7)

```
    rc = select(maxfdpl, &readmask, &writmask, &excpmask, &time);
    printf("Srvr: rc from select for testgive is %d\n", rc);
    if (rc < 0) {
        tcperror("Srvr: error from testgive");
    }
    else
        rc = 0;

    return rc;
}

/*--------------------------------------------------------------------*/
/*    dogive()                                                        */
/*    Issue givesocket() for giving client's socket to subtask.       */
/*--------------------------------------------------------------------*/
int dogive(int *clsocket, char *myname)
{
    int rc;
    struct clientid cid;
    int temps;

    temps = *clsocket;
    memset(&cid, 0, sizeof(cid));
    cid.domain = AF_INET;

    memcpy(cid.name,       myname,     8);
    memcpy(cid.subtaskname,"        ", 8);
    printf("Srvr: givesocket socket is %d\n", temps);
    printf("Srvr: givesocket name is %s\n", cid.name);

    rc = givesocket(temps, &cid);
    return rc;
}
```

Figure 229. MTCSRVR C socket server program sample (Part 7 of 7)

The subtask sample program in C

The following C socket server program is the MTCCSUB member in the SEZAINST data set.

```
/*** IBMCOPYR ************************************************************/
/*                                                                       */
/* Component Name: MTCCSUB                                               */
/*                                                                       */
/* Copyright:    Licensed Materials - Property of IBM                    */
/*                                                                       */
/*               "Restricted Materials of IBM"                           */
/*                                                                       */
/*               5647-A01                                                */
/*                                                                       */
/*               (C) Copyright IBM Corp. 1977, 1998                      */
/*                                                                       */
/*               US Government Users Restricted Rights -                 */
/*               Use, duplication or disclosure restricted by            */
/*               GSA ADP Schedule Contract with IBM Corp.                */
/*                                                                       */
/* Status:       CSV2R6                                                  */
/*                                                                       */
/*                                                                       */
/*  SMP/E Distribution Name: EZAEC048                                    */
/*                                                                       */
/*                                                                       */
/*** IBMCOPYR ************************************************************/

/*********************************************************************/
/* C Socket Server Subtask Program                                   */
/*                                                                   */
/* This code is started by the tsched() routine of C/370 MTF.        */
/* Its purpose is to do a takesocket() and then send/recv with the   */
/* client process.                                                   */
/*********************************************************************/
#pragma runopts(noargparse,plist(mvs),noexecops)

static char ibmcopyr[] =
   "MTCCSUB - Licensed Materials - Property of IBM. "
   "This module is \"Restricted Materials of IBM\" "
   "5647-A01 (C) Copyright IBM Corp. 1994, 1996. "
   "See IBM Copyright Instructions.";

#include <manifest.h>
#include <bsdtypes.h>
#include <in.h>
#include <netdb.h>
#include <socket.h>
#include <inet.h>
#include <fcntl.h>
#include <errno.h>
#include <tcperrno.h>
#include <bsdtime.h>
#include <stdio.h>

/*
 * Server subtask
```

Figure 230. MTCCSUB C socket server program sample (Part 1 of 3)

```
 */
csub(int *clsock,         /* address of socket passed  */
     char *tskname,       /* address of caller's name  */
     char *tsksname)      /* address of caller's sname */
{
    int temps;                /*                                  */
    int sendbytes;            /* # bytes sent                     */
    int recvbytes;            /* # bytes received                 */
    int clsocket;             /* client socket                    */
    int rc;                   /*                                  */
    char xtskname[8];         /* caller's name                    */
    char xtsksname[8];        /* caller's subtask name            */

    clsocket = *clsock;
    memcpy(&xtskname,  tskname,  8);      /* local copy */
    memcpy(&xtsksname, tsksname, 8);      /* local copy */
    rc = doget(&clsocket, xtskname, xtsksname);
    printf("Csub: returned from doget()\n");
    if (rc < 0)
        tcperror("Csub: Error from doget");
    printf("Csub: rc from doget is %d\n", rc);

    temps = rc;         /* new socket number */
    if (temps > -1) do {
        sendbytes = dosend(&temps);
        recvbytes = dorecv(&temps);
    } while (0);
 /* } while (recvbytes > 0); do simplified situation first ***/
 fflush(stdout);
 sleep(30);
}



/*-----------------*/
/*    doget()      */
/*-----------------*/
int doget(int *clsocket, char *xtskname, char *xtsksname)
{
    int rc;
    int temps;
    struct clientid cid;

    memset(&cid, 0, sizeof(cid));
    temps = *clsocket;
    memcpy(cid.name,        xtskname,  8);
    memcpy(cid.subtaskname, xtsksname, 8);
    cid.domain = AF_INET;
    rc = takesocket(&cid, temps);
    *clsocket = temps;
    return rc;
}

/*-----------------*/
```

Figure 230. MTCCSUB C socket server program sample (Part 2 of 3)

```
/*    dosend()     */
/*-----------------*/
int dosend(int *clsocket)
{
    int temps;
    int sendbytes;
    char data[80] = "Message from subtask: I sent this data";

    /*****************************************************
          note: stream mode means that data is not sent
                as a record and can therefore flow in
                variable sized chunks across the network.
                This example is a simplified situation.
    *****************************************************/
    temps = *clsocket;
    sendbytes = send(temps, data, sizeof(data), 0);
    printf("Csub: sendbytes = %d\n", sendbytes);
    return sendbytes;
}

/*-----------------*/
/*    dorecv()     */
/*-----------------*/
int dorecv(int *clsocket)
{
    int temps;
    int recvbytes;
    char data[80];
    char *datap;

    /*****************************************************
          note: stream mode means that data is not sent
                as a record and can therefore flow in
                variable sized chunks across the network.
                This example is a simplified situation.
    *****************************************************/
    temps = *clsocket;
    recvbytes = recv(temps, data, sizeof(data), 0);
    if (recvbytes > 0)
        printf("Csub: data recv: %s\n", data);
    else
        printf("Csub: client stopped sending data\n");
    printf("Csub: recvbytes = %d\n", recvbytes);
    return recvbytes;
}
```

Figure 230. MTCCSUB C socket server program sample (Part 3 of 3)

The client sample program in C

The following C socket server program is the MTCCLNT member in the SEZAINST data set.

```
/*** IBMCOPYR ************************************************************/
/*                                                                       */
/* Component Name: MTCCLNT                                               */
/*                                                                       */
/*                                                                       */
/* Copyright:    Licensed Materials - Property of IBM                    */
/*                                                                       */
/*               "Restricted Materials of IBM"                           */
/*                                                                       */
/*               5647-A01                                                */
/*                                                                       */
/*               (C) Copyright IBM Corp. 1977, 1998                      */
/*                                                                       */
/*               US Government Users Restricted Rights -                 */
/*               Use, duplication or disclosure restricted by            */
/*               GSA ADP Schedule Contract with IBM Corp.                */
/*                                                                       */
/* Status:       CSV2R6                                                  */
/*                                                                       */
/*  SMP/E Distribution Name: EZAEC047                                    */
/*                                                                       */
/*                                                                       */
/*** IBMCOPYR ************************************************************/

/*********************************************************************/
/* C Socket Client Program                                           */
/*                                                                   */
/* This code sends and receives mgs with the server subtask.         */
/*********************************************************************/

static char ibmcopyr[] =
   "MTCCLNT - Licensed Materials - Property of IBM. "
   "This module is \"Restricted Materials of IBM\" "
   "5647-A01 (C) Copyright IBM Corp. 1994, 1996. "
   "See IBM Copyright Instructions.";

#include <manifest.h>
#include <bsdtypes.h>
#include <in.h>
#include <netdb.h>
#include <socket.h>
#include <inet.h>
#include <errno.h>
#include <tcperrno.h>
#include <bsdtime.h>
#include <stdio.h>

int dosend(int *s);
int dorecv(int *s);
int doconn(int *s, unsigned long *octaddrp, unsigned short port);
void getsock(int *s);
```

Figure 231. MTCCLNT C socket server program sample (Part 1 of 4)

```
/*
 * Client
 */
main(int argc, char **argv)
{
    int gotbytes;              /* number of bytes received           */
    int sndbytes;              /* number of bytes sent               */
    int s;                     /* socket descriptor                  */
    int rc;                    /* return code                        */
    struct in_addr octaddr;    /* host internet address (binary)     */
    unsigned short port;       /* port number sent as parameter      */
    char * charaddr;           /* host internet address (dotted dec) */
    struct hostent *hostnm;    /* server host name information       */

    /*
     * Check Arguments Passed. Should be hostname and port.
     */
    if (argc != 3) {
        fprintf(stderr, "Usage: %s hostname port\n", argv[0]);
        exit(1);
    }
    /*
     * The host name is the first argument. Get the server address.
     */
    hostnm = gethostbyname(argv[1]);
    if (hostnm == (struct hostent *) 0) {
        fprintf(stderr, "Gethostbyname failed\n");
        exit(2);
    }
    octaddr.s_addr = *((unsigned long *)hostnm->h_addr);

    /*
     * The port is the second argument.
     */
    port = (unsigned short) atoi(argv[2]);
    fprintf(stdout, "Clnt: port = %d\n", port);

    getsock(&s);
    printf("Clnt: our socket is %d\n", s);

    charaddr = inet_ntoa(octaddr);
    printf("Clnt: address of host is %8s\n", charaddr);

    rc = doconn(&s, &octaddr.s_addr, port);
    if (rc < 0)
        tcperror("Clnt: error for connect");
    else {
        printf("Clnt: rc from connect is %d\n", rc);
        do {
            gotbytes = dorecv(&s);
            sndbytes = dosend(&s);
        } while (0);
     /* } while (sndbytes > 0); do simplified situation first ***/
        sleep(15);
    }
```

Figure 231. MTCCLNT C socket server program sample (Part 2 of 4)

```
}

/*-----------------*/
/*    getsock()    */
/*-----------------*/
void getsock(int *s)
{
    int temp;
    temp = socket(AF_INET, SOCK_STREAM, 0);
    *s = temp;
    return;
}

/*-----------------*/
/*    doconn()     */
/*-----------------*/
int doconn(int *s, unsigned long *octaddrp, unsigned short port)
{
    int rc;
    int temps;
    struct sockaddr_in tsock;

    memset(&tsock, 0, sizeof(tsock));
    tsock.sin_family      = AF_INET;
    tsock.sin_port        = htons(port);
    tsock.sin_addr.s_addr = *octaddrp;

    temps = *s;
    rc = connect(temps, (struct sockaddr *)&tsock, sizeof(tsock));
    return rc;
}

/*-----------------*/
/*    dorecv()     */
/*-----------------*/
int dorecv(int *s)
{
    int temps;
    int gotbytes;
    char data[100];

    temps = *s;

    gotbytes = recv(temps, data, sizeof(data), 0);
    if (gotbytes < 0) {
        tcperror("Clnt: error for recv");
    }
    else
        printf("Clnt: data recv: %s\n", data);
    return gotbytes;
}

/*-----------------*/
/*    dosend()     */
/*-----------------*/
```

Figure 231. MTCCLNT C socket server program sample (Part 3 of 4)

```
int dosend(int *s)
{
    int temps;
    int sndbytes;
    char data[50];

    temps = *s;
    gets(data);
    printf("clnt: data to send: %s\n", data);
    sndbytes = send(temps, data, sizeof(data), 0);
    if (sndbytes < 0) {
        tcperror("Clnt: error for send");
    }
    else
        printf("Clnt: sent %d bytes to server subtask\n", sndbytes);
    return sndbytes;
}
```

Figure 231. MTCCLNT C socket server program sample (Part 4 of 4)

Appendix B. Socket call error return codes

This information contains error return codes for socket calls. The error codes apply to all of the following socket APIs:

- TCP/IP C socket API
- X/Open Transport Interface
- Macro API for IPv4 or IPv6 that is written in z/OS assembler language
- Call instruction API for IPv4 or IPv6 socket applications
- z/OS Communications Server socket API for REXX
- Pascal language for IPv4 socket API

It also contains sockets extended return codes that apply only to the macro, call instruction, and REXX socket APIs.

If the return code is not listed in this information, it is a return code that is received from z/OS UNIX. See *z/OS UNIX System Services Messages and Codes* for the z/OS UNIX ERRNOs.

See "User abend U4093" on page 909 for a description of user abend U4093.

System error codes for socket calls

This information contains the error codes and the message names that refer to the following APIs:

- C sockets
- Macro
- Call instruction
- REXX sockets

The names in the Socket Type column are identifiers that apply to all of the above APIs and do not follow the naming convention for any specific API. These message numbers and codes are in the TCPERRNO.H include file.

When a socket call is processed, both a return code and an error number are returned to your program. If the return code is 0 or a positive number, the call completed normally. If the return code is a negative number, the call did not complete normally and an error number is returned. See the following table for the meaning of the error number that is returned.

For the following error conditions, a name is returned by C socket calls and a number is returned by the sockets extended interface calls. The error condition return codes can originate from the socket application programming interface or from a peer server program.

Sockets return codes (ERRNOs)

This section provides the system-wide message numbers and codes set by the system calls. These message numbers and codes are in the TCPERRNO.H include file supplied with TCP/IP Services.

© Copyright IBM Corp. 1989, 2010

Table 24. Sockets ERRNOs

Error number	Message name	Socket API type	Error description	Programmer's response
1	EAI_NONAME	GETADDRINFO GETNAMEINFO	NODE or HOST cannot be found.	Ensure the NODE or HOST name can be resolved.
1	EDOM	All	Argument too large.	Check parameter values of the function call.
1	EPERM	All	Permission is denied. No owner exists.	Check that TPC/IP is still active; check protocol value of socket () call.
1	EPERM	IOCTL (SIOCGPARTNERINFO)	Both endpoints do not reside in the same security domain.	Check and modify the security domain name for the endpoints. After you correct the security domain name, the application might need to close the connection if the IOCTL is needed.
1	EPERM	IOCTL (SIOCGPARTNERINFO, SIOCSPARTNERINFO)	The security domain name is not defined.	Define the security domain name on both endpoints. After you define the security domain name, the application might need to close the connection if the IOCTL is needed.
1	EPERM	IOCTL (SIOCTTLSCTL requesting both TTLS_INIT_ CONNECTION and TTLS_RESET_ SESSION or both TTLS_INIT_ CONNECTION and TTLS_RESET_ CIPHER)	The combination of requests specified is not permitted.	Request TTLS_RESET_SESSION and TTLS_RESET_CIPHER only when TTLS_INIT_ CONNECTION has been previously requested for the connection.
1	EPERM	IOCTL (SIOCTTLSCTL)	Denotes one of the following error conditions: • The TTLS_INIT_ CONNECTION option was requested with either TTLS_RESET_ SESSION, TTLS_RESET_ CIPHER or TTLS_STOP_ CONNECTION • The TTLS_STOP_ CONNECTION option was requested along with TTLS_RESET_ SESSION or TTLS_RESET_ CIPHER • The TTLS_ALLOW_ HSTIMEOUT option was requested without TTLS_INIT_ CONNECTION	Request TTLS_RESET_SESSION and TTLS_RESET_CIPHER only when TTLS_INIT_ CONNECTION and TTLS_STOP_ CONNECTION are not requested. Always request TTLS_INIT_ CONNECTION when TTLS_ALLOW_ HSTIMEOUT is requested. Use seperate SIOCTTLSCTL ioctls to request TTLS_INIT_ CONNECTION and TTLS_STOP_ CONNECTION.

Table 24. Sockets ERRNOs (continued)

Error number	Message name	Socket API type	Error description	Programmer's response
2	EAI_AGAIN	FREEADDRINFO GETADDRINFO GETNAMEINFO	For GETADDRINFO, NODE could not be resolved within the configured time interval. For GETNAMEINFO, HOST could not be resolved within the configured time interval. The Resolver address space has not been started. The request can be retried later.	Ensure the Resolver is active, then retry the request.
2	ENOENT	All	The data set or directory was not found.	Check files used by the function call.
2	ERANGE	All	The result is too large.	Check parameter values of the function call.
3	EAI_FAIL	FREEADDRINFO GETADDRINFO GETNAMEINFO	This is an unrecoverable error. NODELEN, HOSTLEN, or SERVLEN is incorrect. For FREEADDRINFO, the resolver storage does not exist.	Correct the NODELEN, HOSTLEN, or SERVLEN. Otherwise, call your system administrator.
3	ESRCH	All	The process was not found. A table entry was not located.	Check parameter values and structures pointed to by the function parameters.
4	EAI_OVERFLOW	GETNAMEINFO	The output buffer for the host name or service name was too small.	Increase the size of the buffer to 255 characters, which is the maximum size permitted.
4	EINTR	All	A system call was interrupted.	Check that the socket connection and TCP/IP are still active.
5	EAI_FAMILY	GETADDRINFO GETNAMEINFO	The AF or the FAMILY is incorrect.	Correct the AF or the FAMILY.
5	EIO	All	An I/O error occurred.	Check status and contents of source database if this occurred during a file access.
6	EAI_MEMORY	GETADDRINFO GETNAMEINFO	The resolver cannot obtain storage to process the host name.	Contact your system administrator.
6	ENXIO	All	The device or driver was not found.	Check status of the device attempting to access.
7	E2BIG	All	The argument list is too long.	Check the number of function parameters.
7	EAI_BADFLAGS	GETADDRINFO GETNAMEINFO	FLAGS has an incorrect value.	Correct the FLAGS.
8	EAI_SERVICE	GETADDRINFO	The SERVICE was not recognized for the specified socket type.	Correct the SERVICE.

Table 24. Sockets ERRNOs (continued)

Error number	Message name	Socket API type	Error description	Programmer's response
8	ENOEXEC	All	An EXEC format error occurred.	Check that the target module on an exec call is a valid executable module.
9	EAI_SOCKTYPE	GETADDRINFO	The SOCTYPE was not recognized.	Correct the SOCTYPE.
9	EBADF	All	An incorrect socket descriptor was specified.	Check socket descriptor value. It might be currently not in use or incorrect.
9	EBADF	Givesocket	The socket has already been given. The socket domain is not AF_INET or AF_INET6.	Check the validity of function parameters.
9	EBADF	Select	One of the specified descriptor sets is an incorrect socket descriptor.	Check the validity of function parameters.
9	EBADF	Takesocket	The socket has already been taken.	Check the validity of function parameters.
9	EAI_SOCKTYPE	GETADDRINFO	The SOCTYPE was not recognized.	Correct the SOCTYPE.
10	ECHILD	All	There are no children.	Check if created subtasks still exist.
11	EAGAIN	All	There are no more processes.	Retry the operation. Data or condition might not be available at this time.
11	EAGAIN	All	TCP/IP is not active at the time of the request.	Start TCP/IP, and retry the request.
11	EAGAIN	IOCTL (SIOCGPARTNERINFO)	The IOCTL was issued in no-suspend mode and the SIOCSPARTNERINFO IOCTL has not been issued.	Reissue the IOCTL with a timeout value to set the amount of time to wait while the partner security credentials are being retrieved. **Restriction:** You cannot use a select mask to determine when an IOCTL is complete, because an IOCTL is not affected by whether the socket is running in blocking or nonblocking mode. If the IOCTL times out, reissue the IOCTL to retrieve the partner security credentials.
12	ENOMEM	All	There is not enough storage.	Check the validity of function parameters.
13	EACCES	All	Permission denied, caller not authorized.	Check access authority of file.

Table 24. Sockets ERRNOs (continued)

Error number	Message name	Socket API type	Error description	Programmer's response
13	EACCES	IOCTL (SIOCGPARTNERINFO)	The application is not running in supervisor state, is not APF authorized, or is not permitted to the appropriate SERVAUTH profile.	Allow the application to issue this IOCTL, or provide the user ID with the proper SERVAUTH permission.
13	EACCES	IOCTL (SIOCTTLSCTL)	The IOCTL is requesting a function that requires that the socket be mapped to policy that specifies ApplicationControlled On.	Check policy and add ApplicationControlled On if the application should be permitted to issue the controlled SIOCTTLSCTL functions.
13	EACCES	Takesocket	The other application (listener) did not give the socket to your application. Permission denied, caller not authorized.	Check access authority of file.
14	EFAULT	All	An incorrect storage address or length was specified.	Check the validity of function parameters.
14	EFAULT	All EZASMI macros when using an asynchronous exit routine.	The exit routine has abnormally ended (ABEND condition).	Correct the error in the routine's code. Add an ESTAE routine to the exit.
14	EFAULT	IOCTL (SIOCSAPPLDATA)	An abend occurred while attempting to copy the SetADcontainer structure from the address provided in the SetAD_ptr field.	Check the validity of function parameters.
15	ENOTBLK	All	A block device is required.	Check device status and characteristics.
16	EBUSY	All	Listen has already been called for this socket. Device or file to be accessed is busy.	Check if the device or file is in use.
17	EEXIST	All	The data set exists.	Remove or rename existing file.
18	EXDEV	All	This is a cross-device link. A link to a file on another file system was attempted.	Check file permissions.
19	ENODEV	All	The specified device does not exist.	Check file name and if it exists.
20	ENOTDIR	All	The specified directory is not a directory.	Use a valid file that is a directory.
21	EISDIR	All	The specified directory is a directory.	Use a valid file that is not a directory.
22	EINVAL	All types	An incorrect argument was specified.	Check the validity of function parameters.
22	EINVAL	Multicast Source filter APIs	Mix of any-source, source-specific or full-state APIs	Specify the correct type of APIs.

Table 24. Sockets ERRNOs (continued)

Error number	Message name	Socket API type	Error description	Programmer's response
22	EINVAL	MCAST_JOIN_GROUP, MCAST_JOIN_SOURCE_ GROUP, MCAST_BLOCK_SOURCE, MCAST_LEAVE_GROUP, MCAST_LEAVE_SOURCE_ GROUP, MCAST_UNBLOCK_ SOURCE, SIOCGMSFILTER, SIOCSMSFILTER	The socket address family or the socket length of the input multicast group or the source IP address is not correct.	Specify the correct value.
22	EINVAL	SIOCSMSFILTER, SIOCSIPMSFILTER	The specified filter mode is not correct.	Specify the correct value.
23	ENFILE	All	Data set table overflow occurred.	Reduce the number of open files.
24	EMFILE	All	The socket descriptor table is full.	Check the maximum sockets specified in MAXDESC().
25	ENOTTY	All	An incorrect device call was specified.	Check specified IOCTL() values.
26	ETXTBSY	All	A text data set is busy.	Check the current use of the file.
27	EFBIG	All	The specified data set is too large.	Check size of accessed dataset.
28	ENOSPC	All	There is no space left on the device.	Increase the size of accessed file.
29	ESPIPE	All	An incorrect seek was attempted.	Check the offset parameter for seek operation.
30	EROFS	All	The data set system is Read only.	Access data set for read only operation.
31	EMLINK	All	There are too many links.	Reduce the number of links to the accessed file.
32	EPIPE	All	The connection is broken. For socket write/send, peer has shut down one or both directions.	Reconnect with the peer.
32	EPIPE	IOCTL (SIOCTTLSCTL requesting TTLS_INIT_ CONNECTION, TTLS_RESET_CIPHER, or TTLS_STOP_ CONNECTION)	The TCP connection is not in the established state.	Issue the SIOCTTLSCTL IOCTL when the socket is connected.
33	EDOM	All	The specified argument is too large.	Check and correct function parameters.
34	ERANGE	All	The result is too large.	Check function parameter values.
35	EWOULDBLOCK	Accept	The socket is in nonblocking mode and connections are not queued. This is not an error condition.	Reissue Accept().

Table 24. Sockets ERRNOs (continued)

Error number	Message name	Socket API type	Error description	Programmer's response
35	EWOULDBLOCK	IOCTL (SIOCTTLSCTL)	The handshake is in progress and the socket is a nonblocking socket.	For a nonblocking socket, you can wait for the handshake to complete by issuing Select or Poll for Socket Writable.
35	EWOULDBLOCK	Read Recvfrom	The socket is in nonblocking mode and read data is not available. This is not an error condition.	Issue a select on the socket to determine when data is available to be read or reissue the Read()/Recvfrom().
35	EWOULDBLOCK	All receive calls (RECV, RECVMSG, RECVFROM, READV, READ), when the socket is set with the SO_RCVTIMEO socket option	The socket is in blocking mode and the receive call has blocked for the time period that was specified in the SO_RCVTIMEO option. No data was received.	The application should reissue the receive call.
35	EWOULDBLOCK	Send Sendto Write	The socket is in nonblocking mode and buffers are not available.	Issue a select on the socket to determine when data is available to be written or reissue the Send(), Sendto(), or Write().
35	EWOULDBLOCK	All send calls (SEND, SENDMSG, SENDTO, WRITEV, WRITE), when the socket is set with the SO_SNDTIMEO socket option	The socket is in blocking mode and the send call has blocked for the time period that was specified in the SO_SNDTIMEO option. No data was sent.	The application should reissue the send call.
36	EINPROGRESS	Connect	The socket is marked nonblocking and the connection cannot be completed immediately. This is not an error condition.	See the Connect() description for possible responses.
36	EINPROGRESS	IOCTL (SIOCGPARTNERINFO)	The IOCTL was issued in no-suspend mode after the SIOCSPARTNERINFO IOCTL was issued, but the partner security credentials are not currently available.	Retry the IOCTL, or issue the IOCTL with a timeout value to set the amount of time to wait while the partner security credentials are being retrieved. **Restriction:** You cannot use a select mask to determine when an IOCTL is complete, because an IOCTL is not affected by whether the socket is running in blocking or nonblocking mode. If the IOCTL times out, reissue the IOCTL to retrieve the partner security credentials.

Table 24. Sockets ERRNOs (continued)

Error number	Message name	Socket API type	Error description	Programmer's response
36	EINPROGRESS	IOCTL (SIOCTTLSCTL requesting TTLS_INIT_ CONNECTION or TTLS_STOP_ CONNECTION)	The handshake is already in progress and the socket is a nonblocking socket.	For a nonblocking socket, you can wait for the handshake to complete by issuing Select or Poll for Socket Writable.
37	EALREADY	Connect	The socket is marked nonblocking and the previous connection has not been completed.	Reissue Connect().
37	EALREADY	IOCTL (SIOCGPARTNERINFO)	The request is already in progress. Only one IOCTL can be outstanding.	Check and modify the socket descriptor, if specified; otherwise, no action is needed.
37	EALREADY	IOCTL (SIOCTTLSCTL requesting TTLS_INIT_ CONNECTION or TTLS_STOP_ CONNECTION)	For TTLS_INIT_ CONNECTION, the socket is already secure. For TTLS_STOP_ CONNECTION, the socket is not secure.	Modify the application so that it issues the SIOCTTLSCTL IOCTL that requests TTLS_INIT_ CONNECTION only when the socket is not already secure and that requests TTLS_STOP_ CONNECTION only when the socket is secure.
37	EALREADY	Maxdesc	A socket has already been created calling Maxdesc() or multiple calls to Maxdesc().	Issue Getablesize() to query it.
37	EALREADY	Setibmopt	A connection already exists to a TCP/IP image. A call to SETIBMOPT (IBMTCP_IMAGE), has already been made.	Only call Setibmopt() once.
38	ENOTSOCK	All	A socket operation was requested on a nonsocket connection. The value for socket descriptor was not valid.	Correct the socket descriptor value and reissue the function call.
39	EDESTADDRREQ	All	A destination address is required.	Fill in the destination field in the correct parameter and reissue the function call.
40	EMSGSIZE	Sendto Sendmsg Send Write for Datagram (UDP) or RAW sockets	The message is too long. It exceeds the IP limit of 64K or the limit set by the setsockopt() call.	Either correct the length parameter, or send the message in smaller pieces.
41	EPROTOTYPE	All	The specified protocol type is incorrect for this socket.	Correct the protocol type parameter.
41	EPROTOTYPE	bind2addrsel	The referenced socket is not a stream (TCP) or datagram (UDP) socket.	Issue bind2addrsel() on TCP or UDP sockets only.

Table 24. Sockets ERRNOs (continued)

Error number	Message name	Socket API type	Error description	Programmer's response
41	EPROTOTYPE	IOCTL (SIOCGPARTNERINFO, SIOCSAPPLDATA, SIOCSPARTNERINFO, SIOCTTLSCTL)	Socket is not a TCP socket.	Issue the IOCTL on TCP sockets only.
42	ENOPROTOOPT	Getsockopt Setsockopt	The socket option specified is incorrect or the level is not SOL_SOCKET. Either the level or the specified optname is not supported.	Correct the level or optname.
42	ENOPROTOOPT	Getibmsockopt Setibmsockopt	Either the level or the specified optname is not supported.	Correct the level or optname.
43	EPROTONOSUPPORT	Socket	The specified protocol is not supported.	Correct the protocol parameter.
44	ESOCKTNOSUPPORT	All	The specified socket type is not supported.	Correct the socket type parameter.
45	EOPNOTSUPP	Accept Givesocket	The selected socket is not a stream socket.	Use a valid socket.
45	EOPNOTSUPP	bind2addrsel	The referenced socket is not a type that supports the requested function	Use a socket of the correct type.
45	EOPNOTSUPP	Getibmopt Setibmopt	The socket does not support this function call. This command is not supported for this function.	Correct the command parameter. See Getibmopt() for valid commands. Correct by ensuring a Listen() was not issued before the Connect().
45	EOPNOTSUPP	GETSOCKOPT	The specified GETSOCKOPT OPTNAME option is not supported by this socket API.	Correct the GETSOCKOPT OPTNAME option.
45	EOPNOTSUPP	IOCTL	The specified IOCTL command is not supported by this socket API.	Correct the IOCTL COMMAND.
45	EOPNOTSUPP	IOCTL (SIOCSPARTNERINFO)	The request must be issued before the listen call or the connect call.	Check and modify the socket descriptor, or close the connection and reissue the call.
45	EOPNOTSUPP	IOCTL (SIOCTTLSCTL requesting TTLS_INIT_ CONNECTION, TTLS_RESET_ SESSION, TTLS_RESET_ CIPHER or TTLS_STOP_ CONNECTION)	Mapped policy indicates that AT-TLS is not enabled for the connection.	Modify the policy to enable AT-TLS for the connection.
45	EOPNOTSUPP	Listen	The socket does not support the Listen call.	Change the type on the Socket() call when the socket was created. Listen() only supports a socket type of SOCK_STREAM.

Table 24. Sockets ERRNOs (continued)

Error number	Message name	Socket API type	Error description	Programmer's response
45	EOPNOTSUPP	RECV, RECVFROM, RECVMSG, SEND, SENDTO, SENDMSG	The specified flags are not supported on this socket type or protocol.	Correct the FLAG.
46	EPFNOSUPPORT	All	The specified protocol family is not supported or the specified domain for the client identifier is not AF_INET=2.	Correct the protocol family.
47	EAFNOSUPPORT	bind2addrsel inet6_is_srcaddr	You specified an IP address that is not an AF_INET6 IP address	Correct the IP address. If the IP address is an IPv4 address, you must specify it as an IPv4-mapped IPv6 address.
47	EAFNOSUPPORT	bind2addrsel inet6_is_srcaddr	You attempted an IPv6-only API for a stack that does not support the AF_INET6 domain.	Activate the AF_INET6 stack, and retry the request.
47	EAFNOSUPPORT	Bind Connect Socket	The specified address family is not supported by this protocol family.	For Socket(), set the domain parameter to AF_INET. For Bind() and Connect(), set Sin_Family in the socket address structure to AF_INET.
47	EAFNOSUPPORT	Getclient Givesocket	The socket specified by the socket descriptor parameter was not created in the AF_INET domain.	The Socket() call used to create the socket should be changed to use AF_INET for the domain parameter.
47	EAFNOSUPPORT	IOCTL	You attempted to use an IPv4-only ioctl on an AF_INET6 socket.	Use the correct socket type for the ioctl or use an ioctl that supports AF_INET6 sockets.
48	EADDRINUSE	Bind	The address is in a timed wait because a LINGER delay from a previous close or another process is using the address. This error can also occur if the port specified in the bind call has been configured as RESERVED on a port reservation statement in the TCP/IP profile.	If you want to reuse the same address, use Setsockopt() with SO_REUSEADDR. Refer to the section about Setsockopt() in *z/OS Communications Server: IP Sockets Application Programming Interface Guide and Reference* for more information. Otherwise, use a different address or port in the socket address structure.
48	EADDRINUSE	IP_ADD_MEMBERSHIP, IP_ADD_SOURCE_ MEMBERSHIP, IPV6_JOIN_GROUP, MCAST_JOIN_GROUP, MCAST_JOIN_SOURCE_ GROUP	The specified multicast address and interface address (or interface index) pair is already in use.	Correct the specified multicast address, interface address, or interface index.
49	EADDRNOTAVAIL	Bind	The specified address is incorrect for this host.	Correct the function address parameter.

Table 24. Sockets ERRNOs (continued)

Error number	Message name	Socket API type	Error description	Programmer's response
49	EADDRNOTAVAIL	Connect	The calling host cannot reach the specified destination.	Correct the function address parameter.
49	EADDRNOTAVAIL	bind2addrsel	For the specified destination address, there is no source address that the application can bind to. Possible reasons can be one of the following situations: • The socket is a stream socket, but the specified destination address is a multicast address. • No ephemeral ports are available to assign to the socket.	Correct the function address parameter or issue the request when ephemeral ports are available.
49	EADDRNOTAVAIL	inet6_is_srcaddr	The address specified is not correct for one of these reasons: • The address is not an address on this node. • The address was not active at the time of the request. • The scope ID specified for a link-local IPV6 address is incorrect.	Correct or activate the address
49	EADDRNOTAVAIL	IP_BLOCK_SOURCE, IP_ADD_SOURCE_ MEMBERSHIP, MCAST_BLOCK_SOURCE, MCAST_JOIN_SOURCE_ GROUP	A duplicate source IP address is specified on the multicast group and interface pair.	Correct the specified source IP address.
49	EADDRNOTAVAIL	IP_UNBLOCK_SOURCE, IP_DROP_SOURCE_ MEMBERSHIP, MCAST_UNBLOCK_ SOURCE, MCAST_LEAVE_SOURCE_ GROUP	A previously blocked source multicast group cannot be found.	Correct the specified address.
49	EADDRNOTAVAIL	Multicast APIs	The specified multicast address, interface address, or interface index is not correct.	Correct the specified address.
50	ENETDOWN	All	The network is down.	Retry when the connection path is up.
51	ENETUNREACH	Connect	The network cannot be reached.	Ensure that the target application is active.
52	ENETRESET	All	The network dropped a connection on a reset.	Reestablish the connection between the applications.
53	ECONNABORTED	All	The software caused a connection abend.	Reestablish the connection between the applications.

Table 24. Sockets ERRNOs (continued)

Error number	Message name	Socket API type	Error description	Programmer's response
54	ECONNRESET	All	The connection to the destination host is not available.	N/A
54	ECONNRESET	Send Write	The connection to the destination host is not available.	The socket is closing. Issue Send() or Write() before closing the socket.
55	ENOBUFS	All	No buffer space is available.	Check the application for massive storage allocation call.
55	ENOBUFS	Accept	Not enough buffer space is available to create the new socket.	Call your system administrator.
55	ENOBUFS	IOCTL (SIOCGPARTNERINFO)	The buffer size provided is too small.	Create a larger input buffer based on the value returned in the PI_Buflen field.
55	ENOBUFS	IOCTL (SIOCSAPPLDATA)	There is no storage available to store the associated data.	Call your system administrator.
55	ENOBUFS	IOCTL (SIOCTTLSCTL TTLS_Version1 requesting TTLS_RETURN_ CERTIFICATE or TTLS_Version2 query)	The buffer size provided is too small.	For TTLS_Version1 use the returned certificate length to allocate a larger buffer and reissue IOCTL with the larger buffer.
55	ENOBUFS	IP_BLOCK_SOURCE, IP_ADD_SOURCE_ MEMBERSHIP, MCAST_BLOCK_SOURCE, MCAST_JOIN_SOURCE_ GROUP, SIOCSIPMSFILTER, SIOCSMSFILTER, setipv4sourcefilter, setsourcefilter	A maximum of 64 source filters can be specified per multicast address, interface address pair.	Remove unneeded source IP addresses and reissue the command.
55	ENOBUFS	Send Sendto Write	Not enough buffer space is available to send the new message.	Call your system administrator.
55	ENOBUFS	Takesocket	Not enough buffer space is available to create the new socket.	Call your system administrator.
56	EISCONN	Connect	The socket is already connected.	Correct the socket descriptor on Connect() or do not issue a Connect() twice for the socket.
57	ENOTCONN	All	The socket is not connected.	Connect the socket before communicating.
57	ENOTCONN	IOCTL (SIOCGPARTNERINFO)	The requested socket is not connected.	Check and modify the socket descriptor, or reissue the IOCTL after the connect call from the client side or after the accept call from the server side.

Table 24. Sockets ERRNOs (continued)

Error number	Message name	Socket API type	Error description	Programmer's response
57	ENOTCONN	IOCTL (SIOCTTLSCTL)	The socket is not connected.	Issue the SIOCTTLSCTL IOCTL only after the socket is connected.
58	ESHUTDOWN	All	A Send cannot be processed after socket shutdown.	Issue read/receive before shutting down the read side of the socket.
59	ETOOMANYREFS	All	There are too many references. A splice cannot be completed.	Call your system administrator.
59	ETOOMANYREFS	IP_ADD_MEMBERSHIP, IP_ADD_SOURCE_ MEMBERSHIP, MCAST_JOIN_GROUP, MCAST_JOIN_SOURCE_ GROUP, IPV6_JOIN_GROUP	A maximum of 20 multicast groups per single UDP socket or a maximum of 256 multicast groups per single RAW socket can be specified.	Remove unneeded multicast groups and reissue the command.
60	ETIMEDOUT	Connect	The connection timed out before it was completed.	Ensure the server application is available.
61	ECONNREFUSED	Connect	The requested connection was refused.	Ensure server application is available and at specified port.
62	ELOOP	All	There are too many symbolic loop levels.	Reduce symbolic links to specified file.
63	ENAMETOOLONG	All	The file name is too long.	Reduce size of specified file name.
64	EHOSTDOWN	All	The host is down.	Restart specified host.
65	EHOSTUNREACH	All	There is no route to the host.	Set up network path to specified host and verify that host name is valid.
66	ENOTEMPTY	All	The directory is not empty.	Clear out specified directory and reissue call.
67	EPROCLIM	All	There are too many processes in the system.	Decrease the number of processes or increase the process limit.
68	EUSERS	All	There are too many users on the system.	Decrease the number of users or increase the user limit.
69	EDQUOT	All	The disk quota has been exceeded.	Call your system administrator.
70	ESTALE	All	An old NFS** data set handle was found.	Call your system administrator.
71	EREMOTE	All	There are too many levels of remote in the path.	Call your system administrator.
72	ENOSTR	All	The device is not a stream device.	Call your system administrator.
73	ETIME	All	The timer has expired.	Increase timer values or reissue function.

Table 24. Sockets ERRNOs (continued)

Error number	Message name	Socket API type	Error description	Programmer's response
73	ETIME	IOCTL (SIOCGPARTNERINFO)	The wait time for the request has expired, possibly as the result of network problems.	Retry the request. **Restriction:** You cannot use a select mask to determine when an IOCTL is complete, because an IOCTL is not affected by whether the socket is running in blocking or nonblocking mode. If the IOCTL times out, reissue the IOCTL to retrieve the partner security credentials.
74	ENOSR	All	There are no more stream resources.	Call your system administrator.
75	ENOMSG	All	There is no message of the desired type.	Call your system administrator.
76	EBADMSG	All	The system cannot read the message.	Verify that z/OS Communications Server installation was successful and that message files were properly loaded.
77	EIDRM	All	The identifier has been removed.	Call your system administrator.
78	EDEADLK	All	A deadlock condition has occurred.	Call your system administrator.
78	EDEADLK	Select Selectex	None of the sockets in the socket descriptor sets are either AF_INET or AF_IUCV sockets and there is no timeout value or no ECB specified. The select/selectex would never complete.	Correct the socket descriptor sets so that an AF_INET or AF_IUCV socket is specified. A timeout or ECB value can also be added to avoid the select/selectex from waiting indefinitely.
79	ENOLCK	All	No record locks are available.	Call your system administrator.
80	ENONET	All	The requested machine is not on the network.	Call your system administrator.
81	ERREMOTE	All	The object is remote.	Call your system administrator.
82	ENOLINK	All	The link has been severed.	Release the sockets and reinitialize the client-server connection.
83	EADV	All	An ADVERTISE error has occurred.	Call your system administrator.
84	ESRMNT	All	An SRMOUNT error has occurred.	Call your system administrator.
85	ECOMM	All	A communication error has occurred on a Send call.	Call your system administrator.
86	EPROTO	All	A protocol error has occurred.	Call your system administrator.

Table 24. Sockets ERRNOs (continued)

Error number	Message name	Socket API type	Error description	Programmer's response
86	EPROTO	IOCTL (SIOCTTLSCTL request in TTLS_RESET_SESSION TTLS_RESET_CIPHER TTLS_STOP_ CONNECTION or TTLS_ALLOW_ HSTIMEOUT)	One of the following errors occurred: • A TTLS_INIT_ CONNECTION request was not received for the connection • TTLS_RESET_ CIPHER or TTLS_STOP_ CIPHER was requested on a connection that is secured using SSL version 2 • TTLS_ALLOW_ HSTIMEOUT was requested but the policy has the HandshakeRole value **client** or the HandshakeTimeout value is 0.	• Request TTLS_INIT_ CONNECTION prior to requesting TTLS_RESET_ SESSION or TTLS_RESET_ CIPHER • Request TTLS_RESET_ CIPHER or TTLS_STOP_ CONNECTION only on connections secured using SSL version 3 or TLS version 1.0 or higher. • Request TTLS_ALLOW_ HSTIMEOUT only when the security type is TTLS_SEC_SERVER or higher and the HandshakeTimeout value is not 0.
87	EMULTIHOP	All	A multi-hop address link was attempted.	Call your system administrator.
88	EDOTDOT	All	A cross-mount point was detected. This is not an error.	Call your system administrator.
89	EREMCHG	All	The remote address has changed.	Call your system administrator.
90	ECONNCLOSED	All	The connection was closed by a peer.	Check that the peer is running.
113	EBADF	All	Socket descriptor is not in correct range. The maximum number of socket descriptors is set by MAXDESC(). The default range is 0–49.	Reissue function with corrected socket descriptor.
113	EBADF	Bind socket	The socket descriptor is already being used.	Correct the socket descriptor.
113	EBADF	Givesocket	The socket has already been given. The socket domain is not AF_INET.	Correct the socket descriptor.
113	EBADF	Select	One of the specified descriptor sets is an incorrect socket descriptor.	Correct the socket descriptor. Set on Select() or Selectex().
113	EBADF	Takesocket	The socket has already been taken.	Correct the socket descriptor.
113	EBADF	Accept	A Listen() has not been issued before the Accept().	Issue Listen() before Accept().
121	EINVAL	All	An incorrect argument was specified.	Check and correct all function parameters.

Table 24. Sockets ERRNOs (continued)

Error number	Message name	Socket API type	Error description	Programmer's response
121	EINVAL	IOCTL (SIOCSAPPLDATA)	The input parameter is not a correctly formatted SetApplData structure. • The SetAD_eye1 value is not valid. • The SetAD_ver value is not valid. • The storage pointed to by SetAD_ptr does not contain a correctly formatted SetADcontainer structure. • The SetAD_eye2 value is not valid. • The SetAD_len value contains an incorrect length for the SetAD_ver version of the SetADcontainer structure.	Check and correct all function parameters.
121	EINVAL	inet6_is_srcaddr	• One or more invalid IPV6_ADDR_ PREFERENCES flags were specified • A scope ID was omitted for a link local IP address • A scope ID was specified for an IP address that is not link-local • The socket address length was not valid	Correct the function parameters
122	ECLOSED			
126	ENMELONG			
134	ENOSYS	IOCTL	The function is not implemented	Either configure the system to support the **ioctl** command or remove the **ioctl** command from your program.
134	ENOSYS	IOCTL - siocgifnameindex	The TCP/IP stack processing the siocgifnameindex IOCTL is configured as a pure IPv4 TCP/IP stack. Additionally, UNIX System Services is configured to process as INET.	Either configure the system to support the **ioctl** command or remove the **ioctl** command from your program.
136	ENOTEMPT			
145	E2BIG	All	The argument list is too long.	Eliminate excessive number of arguments.

Table 24. Sockets ERRNOs (continued)

Error number	Message name	Socket API type	Error description	Programmer's response
156	EMVSINITIAL	All	Process initialization error. This indicates an z/OS UNIX process initialization failure. This is usually an indication that a proper OMVS RACF segment is not defined for the user ID associated with application. The RACF OMVS segment might not be defined or might contain errors such as an improper HOME() directory specification.	Attempt to initialize again. After ensuring that an OMVS Segment is defined, if the errno is still returned, call your MVS system programmer to have IBM service contacted.
157	EMISSED			
157	EMVSERR		An MVS environmental or internal error occurred.	
1002	EIBMSOCKOUTOFRANGE	Socket	A socket number assigned by the client interface code is out of range.	Check the socket descriptor parameter.
1003	EIBMSOCKINUSE	Socket	A socket number assigned by the client interface code is already in use.	Use a different socket descriptor.
1004	EIBMIUCVERR	All	The request failed because of an IUCV error. This error is generated by the client stub code.	Ensure IUCV/VMCF is functional.
1008	EIBMCONFLICT	All	This request conflicts with a request already queued on the same socket.	Cancel the existing call or wait for its completion before reissuing this call.
1009	EIBMCANCELLED	All	The request was canceled by the CANCEL call.	Informational, no action needed.
1011	EIBMBADTCPNAME	All	A TCP/IP name that is not valid was detected.	Correct the name specified in the IBM_TCPIMAGE structure.
1011	EIBMBADTCPNAME	Setibmopt	A TCP/IP name that is not valid was detected.	Correct the name specified in the IBM_TCPIMAGE structure.
1011	EIBMBADTCPNAME	INITAPI	A TCP/IP name that is not valid was detected.	Correct the name specified on the IDENT option TCPNAME field.
1012	EIBMBADREQUESTCODE	All	A request code that is not valid was detected.	Contact your system administrator.
1013	EIBMBADCONNECTIONSTATE	All	A connection token that is not valid was detected; bad state.	Verify TCP/IP is active.

Table 24. Sockets ERRNOs (continued)

Error number	Message name	Socket API type	Error description	Programmer's response
1014	EIBMUNAUTHORIZEDCALLER	All	An unauthorized caller specified an authorized keyword.	Ensure user ID has authority for the specified operation.
1015	EIBMBADCONNECTIONMATCH	All	A connection token that is not valid was detected. There is no such connection.	Verify TCP/IP is active.
1016	EIBMTCPABEND	All	An abend occurred when TCP/IP was processing this request.	Verify that TCP/IP has restarted.
1023	EIBMTERMERROR	All	Encountered a terminating error while processing.	Call your system administrator.
1026	EIBMINVDELETE	All	Delete requestor did not create the connection.	Delete the request from the process that created it.
1027	EIBMINVSOCKET	All	A connection token that is not valid was detected. No such socket exists.	Call your system programmer.
1028	EIBMINVTCPCONNECTION	All	Connection terminated by TCP/IP. The token was invalidated by TCP/IP.	Reestablish the connection to TCP/IP.
1032	EIBMCALLINPROGRESS	All	Another call was already in progress.	Reissue after previous call has completed.
1036	EIBMNOACTIVETCP	All	TCP/IP is not installed or not active.	Correct TCP/IP name used.
1036	EIBMNOACTIVETCP	Select	EIBMNOACTIVETCP	Ensure TCP/IP is active.
1036	EIBMNOACTIVETCP	Getibmopt	No TCP/IP image was found.	Ensure TCP/IP is active.
1037	EIBMINVTSRBUSERDATA	All	The request control block contained data that is not valid.	Call your system programmer.
1038	EIBMINVUSERDATA	All	The request control block contained user data that is not valid.	Check your function parameters and call your system programmer.
1040	EIBMSELECTEXPOST	SELECTEX	SELECTEX passed an ECB that was already posted.	Check whether the user's ECB was already posted.
1112	ECANCEL			
1162	ENOPARTNERINFO	IOCTL (SIOCGPARTNERINFO)	The partner resides in a TCP/IP stack running a release that is earlier than V1R12, or the partner is not in the same sysplex.	Ensure that both endpoints reside in TCP/IP stacks that are running V1R12 or any later release, or check and modify the socket descriptor. If the partner is not in the same sysplex, security credentials will not be returned.
2001	EINVALIDRXSOCKETCALL	REXX	A syntax error occurred in the RXSOCKET parameter list.	Correct the parameter list passed to the REXX socket call.

Table 24. Sockets ERRNOs (continued)

Error number	Message name	Socket API type	Error description	Programmer's response
2002	ECONSOLEINTERRUPT	REXX	A console interrupt occurred.	Retry the task.
2003	ESUBTASKINVALID	REXX	The subtask ID is incorrect.	Correct the subtask ID on the INITIALIZE call.
2004	ESUBTASKALREADYACTIVE	REXX	The subtask is already active.	Only issue the INITIALIZE call once in your program.
2005	ESUBTASKNOTACTIVE	REXX	The subtask is not active.	Issue the INITIALIZE call before any other socket call.
2006	ESOCKETNOTALLOCATED	REXX	The specified socket or needed control block could not be allocated.	Increase the user storage allocation for this job.
2007	EMAXSOCKETSREACHED	REXX	The maximum number of sockets has been reached.	Increase the number of allocate sockets, or decrease the number of sockets used by your program.
2009	ESOCKETNOTDEFINED	REXX	The socket is not defined.	Issue the SOCKET call before the call that fails.
2011	EDOMAINSERVERFAILURE	REXX	A Domain Name Server failure occurred.	Call your MVS system programmer.
2012	EINVALIDNAME	REXX	An incorrect *name* was received from the TCP/IP server.	Call your MVS system programmer.
2013	EINVALIDCLIENTID	REXX	An incorrect *clientid* was received from the TCP/IP server.	Call your MVS system programmer.
2014	ENIVALIDFILENAME	REXX	An error occurred during NUCEXT processing.	Specify the correct translation table file name, or verify that the translation table is valid.
2016	EHOSTNOTFOUND	REXX	The host is not found.	Call your MVS system programmer.
2017	EIPADDRNOTFOUND	REXX	Address not found.	Call your MVS system programmer.
2019	ENORECOVERY	REXX	A non-recoverable failure occurred during the Resolver's processing of the GETHOSTBYADDR or GETHOSTBYNAME call.	Contact the IBM support center.
2020	EINVALIDCOMBINATION	REXX	An invalid combination of IPV6_ADDR_ PREFERENCES flags was received from the caller.	Correct the specified flags
2021	EOPTNAMEMISMATCH	REXX	The caller specified an OPTNAME that is invalid for the LEVEL that it specified.	Correct either the OPTNAME or the LEVEL.

Table 24. Sockets ERRNOs (continued)

Error number	Message name	Socket API type	Error description	Programmer's response
2022	EFLAGSMISMATCH	REXX	The caller issued a GETADDRINFO with conflicting FLAGS and EFLAGS parameters: either AI_EXT_FLAGS was specified with a null EFLAGS, or AI_EXT_FLAGS was not specified but EFLAGS was not null.	Correct either the FLAGS parameter or the EFLAGS parameter. A non-null EFLAGS should be specified if and only if AI_EXT_FLAGS is specified in the FLAGS.
2051	EFORMATERROR	REXX	The name server was unable to interpret the query	Contact the IBM support center.
3412	ENODATA		Message does not exist.	
3416	ELINKED		Stream is linked.	
3419	ERECURSE		Recursive attempt rejected.	
3420	EASYNC		Asynchronous I/O scheduled. This is a normal, internal event that is NOT returned to the user.	
3448	EUNATCH		The protocol required to support the specified address family is not available.	
3464	ETERM		Operation terminated.	
3474	EUNKNOWN		Unknown system state.	
3495	EBADOBJ		You attempted to reference a object that does not exist.	
3513	EOUTOFSTATE		Protocol engine has received a command that is not acceptable in its current state.	

z/OS UNIX return codes

All return codes not listed in either "Sockets return codes (ERRNOs)" on page 885 or "Sockets extended ERRNOs" on page 905 are z/OS UNIX error condition codes that are not translated to a TCP/IP errno. This is an errno that is received from z/OS UNIX. These errnos are found in the SYS1.MACLIB(BPXYERNO) and are defined in *z/OS UNIX System Services Messages and Codes*.

For more information about z/OS UNIX error codes, see *z/OS UNIX System Services Messages and Codes*.

Additional return codes

The following table contains the error condition codes that are returned in the ERRNO field by the API when you use the sockets extended interfaces. The RETCODE field contains a –1 when an error condition is returned.

Sockets extended ERRNOs

Table 25. Sockets extended ERRNOs

Error code	Problem description	System action	Programmer's response
10100	An ESTAE macro did not complete normally.	End the call.	Call your MVS system programmer.
10101	A STORAGE OBTAIN failed.	End the call.	Increase MVS storage in the application's address space.
10108	The first call issued was not a valid first call.	End the call.	For a list of valid first calls, refer to the section on special considerations in the general programming information.
10110	LOAD of EZBSOH03 (alias EZASOH03) failed.	End the call.	Call the IBM Software Support Center.
10154	Errors were found in the parameter list for an IOCTL call.	Disable the subtask for interrupts. Return an error code to the caller.	Correct the IOCTL call. You might have incorrect sequencing of socket calls.
10155	The length parameter for an IOCTL call is less than or equal to 0.	Disable the subtask for interrupts. Return an error code to the caller.	Correct the IOCTL call. You might have incorrect sequencing of socket calls.
10156	The length parameter for an IOCTL call is 3200 (32 x 100).	Disable the subtask for interrupts. Return an error code to the caller.	Correct the IOCTL call. You might have incorrect sequencing of socket calls.
10159	A 0 or negative data length was specified for a READ or READV call.	Disable the subtask for interrupts. Return an error code to the caller.	Correct the length in the READ call.
10161	The REQARG parameter in the IOCTL parameter list is 0.	End the call.	Correct the program.
10163	A 0 or negative data length was found for a RECV, RECVFROM, or RECVMSG call.	Disable the subtask for interrupts. Sever the DLC path. Return an error code to the caller.	Correct the data length.
10167	The descriptor set size for a SELECT or SELECTEX call is less than or equal to 0.	Disable the subtask for interrupts. Return an error code to the caller.	Correct the SELECT or SELECTEX call. You might have incorrect sequencing of socket calls.
10168	The descriptor set size *in bytes* for a SELECT or SELECTEX call is greater than 8192. A number greater than the maximum number of allowed sockets (65534 is the maximum) has been specified.	Disable the subtask for interrupts. Return an error code to the caller.	Correct the descriptor set size.
10170	A 0 or negative data length was found for a SEND or SENDMSG call.	Disable the subtask for interrupts. Return an error code to the caller.	Correct the data length in the SEND call.

Table 25. Sockets extended ERRNOs (continued)

Error code	Problem description	System action	Programmer's response
10174	A 0 or negative data length was found for a SENDTO call.	Disable the subtask for interrupts. Return an error code to the caller.	Correct the data length in the SENDTO call.
10178	The SETSOCKOPT option length is less than the minimum length.	Disable the subtask for interrupts. Return an error code to the caller.	Correct the OPTLEN parameter.
10179	The SETSOCKOPT option length is greater than the maximum length.	Disable the subtask for interrupts. Return an error code to the caller.	Correct the OPTLEN parameter.
10184	A data length of 0 was specified for a WRITE call.	Disable the subtask for interrupts. Return an error code to the caller.	Correct the data length in the WRITE call.
10186	A negative data length was specified for a WRITE or WRITEV call.	Disable the subtask for interrupts. Return an error code to the caller.	Correct the data length in the WRITE call.
10190	The GETHOSTNAME option length is not in the range of 1–255.	Disable the subtask for interrupts. Return an error code to the caller.	Correct the length parameter.
10193	The SETSOCKOPT or GETSOCKOPT option length is shorter than the minimum length or longer than the maximum length.	End the call.	Correct the length parameter.
10197	The application issued an INITAPI call after the connection was already established.	Bypass the call.	Correct the logic that produces the INITAPI call that is not valid.
10198	The maximum number of sockets specified for an INITAPI exceeds 65535.	Return to the user.	Correct the INITAPI call.
10200	The first call issued was not a valid first call.	End the call.	For a list of valid first calls, refer to the section on special considerations in the general programming information.
10202	The RETARG parameter in the IOCTL call is 0.	End the call.	Correct the parameter list. You might have incorrect sequencing of socket calls.
10203	The requested socket number is a negative value.	End the call.	Correct the requested socket number.
10205	The requested socket number is a duplicate.	End the call.	Correct the requested socket number.
10208	The NAMELEN parameter for a GETHOSTBYNAME call was not specified.	End the call.	Correct the NAMELEN parameter. You might have incorrect sequencing of socket calls.
10209	The NAME parameter on a GETHOSTBYNAME call was not specified.	End the call.	Correct the NAME parameter. You might have incorrect sequencing of socket calls.

Table 25. Sockets extended ERRNOs (continued)

Error code	Problem description	System action	Programmer's response
10210	The HOSTENT parameter on a GETHOSTBYNAME or GETHOSTBYADDR call was not specified.	End the call.	Correct the HOSTENT parameter. You might have incorrect sequencing of socket calls.
10211	The HOSTADDR parameter on a GETHOSTBYNAME or GETHOSTBYADDR call is incorrect.	End the call.	Correct the HOSTADDR parameter. You might have incorrect sequencing of socket calls.
10212	The resolver program failed to load correctly for a GETHOSTBYNAME or GETHOSTBYADDR call.	End the call.	Check the JOBLIB, STEPLIB, and linklib datasets and rerun the program.
10213	Not enough storage is available to allocate the HOSTENT structure.	End the call.	Increase the user storage allocation for this job.
10214	The HOSTENT structure was not returned by the resolver program.	End the call.	Ensure that the domain name server is available. This can be a nonerror condition indicating that the name or address specified in a GETHOSTBYADDR or GETHOSTBYNAME call could not be matched.
10215	The APITYPE parameter on an INITAPI call instruction was not 2 or 3.	End the call.	Correct the APITYPE parameter.
10218	The application programming interface (API) cannot locate the specified TCP/IP.	End the call.	Ensure that an API that supports the performance improvements related to CPU conservation is installed on the system and verify that a valid TCP/IP name was specified on the INITAPI call. This error call might also mean that EZASOKIN could not be loaded.
10219	The NS parameter is greater than the maximum socket for this connection.	End the call.	Correct the NS parameter on the ACCEPT, SOCKET or TAKESOCKET call.
10221	The AF parameter of a SOCKET call is not AF_INET.	End the call.	Set the AF parameter equal to AF_INET.
10222	The SOCTYPE parameter of a SOCKET call must be stream, datagram, or raw (1, 2, or 3).	End the call.	Correct the SOCTYPE parameter.
10223	No ASYNC parameter specified for INITAPI with APITYPE=3 call.	End the call.	Add the ASYNC parameter to the INITAPI call.
10224	The IOVCNT parameter is less than or equal to 0, for a READV, RECVMSG, SENDMSG, or WRITEV call.	End the call.	Correct the IOVCNT parameter.
10225	The IOVCNT parameter is greater than 120, for a READV, RECVMSG, SENDMSG, or WRITEV call.	End the call.	Correct the IOVCNT parameter.

Table 25. Sockets extended ERRNOs (continued)

Error code	Problem description	System action	Programmer's response
10226	Not valid COMMAND parameter specified for a GETIBMOPT call.	End the call.	Correct the COMMAND parameter of the GETIBMOPT call.
10229	A call was issued on an APITYPE=3 connection without an ECB or REQAREA parameter.	End the call.	Add an ECB or REQAREA parameter to the call.
10300	Termination is in progress for either the CICS transaction or the socket interface.	End the call.	None.
10330	A SELECT call was issued without a MAXSOC value and a TIMEOUT parameter.	End the call.	Correct the call by adding a TIMEOUT parameter.
10331	A call that is not valid was issued while in SRB mode.	End the call.	Get out of SRB mode and reissue the call.
10332	A SELECT call is invoked with a MAXSOC value greater than that which was returned in the INITAPI function (MAXSNO field).	End the call.	Correct the MAXSOC parameter and reissue the call.
10334	An error was detected in creating the data areas required to process the socket call.	End the call.	Call the IBM Software Support Center.
10999	An abend has occurred in the subtask.	Write message EZY1282E to the system console. End the subtask and post the TRUE ECB.	If the call is correct, call your system programmer.
20000	An unknown function code was found in the call.	End the call.	Correct the SOC-FUNCTION parameter.
20001	The call passed an incorrect number of parameters.	End the call.	Correct the parameter list.
20002	The user ID associated with the program linking EZACIC25 does not have the proper authority to execute a CICS EXTRACT EXIT.	End the call.	Start the CICS socket interface before executing this call.
20003	The CICS socket interface is not in operation.	End the call.	Contact the CICS system programmer. Ensure that the user ID being used is permitted to have at least UPDATE access to the EXITPROGRAM resource.
20004	The CICS socket TRUE failed to suspend the task.	End the call.	Call the IBM Software Support Center.
20005	The socket task was purged by CICS while the task was being suspended by the CICS socket TRUE.	End the call.	None.

User abend U4093

An abend U4093 indicates that a sockets extended call that is not valid has been detected. It is issued by EZASOKET following a call to EZASOKFN if EZASOKFN has detected an error in the socket call parameter list. The registers at the time of the abend are:

- R2 contains the address of the save area containing the calling program registers.
- R11 contains the error code passed to EZASOKET by EZASOKFN.

  Code Description

  X'4E20' (20000)
  Indicates EZASOKFN could not find the requested CALL function name.

  X'4E21' (20001)
  Indicates that EZASOKFN found an incorrect number of parameters in the parameter list for the requested function.
- R12 contains the address of the incorrect parameter list.

Figure 232 is an example of abend U4093:

```
USER COMPLETION CODE=4093
TIME=15.01.58  SEQ=00074  CPU=0000  ASID=000E
PSW AT TIME OF ERROR  078D1000   80018F14  ILC 2  INTC 0D
ACTIVE LOAD MODULE=DLSV2AS2  ADDRESS=00018670  OFFSET=000008A4
DATA AT PSW  00018F0E - 00181610  0A0D4100  35185000
GPR  0-3  80000000  80000FFD  000189E4  00018DC0
GPR  4-7  00019DC0  00018CE0  00018AA6  00018D18
GPR  8-11 00013780  00019378  00019088  00004E21
GPR 12-15 000187D4  0001902C  80018EF4  00004E21
```

Figure 232. Example of abend U4093

Appendix C. Address family cross reference

This information contains AF_INET, AF_INET6, and AF_IUCV address family cross reference information for the following APIs:

- TCP/IP C socket API
- X/Open Transport Interface
- Macro API for IPv4 or IPv6 that is written in z/OS assembler language
- Call instruction API for IPv4 or IPv6 socket applications
- z/OS Communications Server socket API for REXX
- Pascal language for IPv4 socket API

Address families define different styles of addressing. All hosts in the same addressing family understand and use the same method for addressing socket endpoints. TCP/IP supports the following addressing families:

- AF_INET
- AF_INET6
- AF_IUCV

The AF_INET and AF_INET6 families both define addressing in the internet domain. The AF_IUCV family defines addressing in the IUCV domain. In the IUCV domain, address spaces can use the socket interface to communicate with other address spaces on the same host.

The INET, INET6, and IUCV column entries are:

yes The call applies to this address family.

no If you use this call with this address family, an error is returned.

n/a If you use this call with this address family, no error is returned and the call is not processed.

blank The call does not apply to this API.

Notes:

1. Pascal API supports only AF_INET address family.
2. XTI API supports only AF_INET address family.
3. INET6 is not supported.

Table 26. C socket address families cross reference

Application Programming Interface (API)		
Function	**C SOCKETS**	
	INET	**IUCV**
accept()	yes	yes
bind()	yes	yes
close()	yes	yes
connect()	yes	yes
endhostent()	yes	n/a
endnetent()	yes	n/a

© Copyright IBM Corp. 1989, 2010

Table 26. C socket address families cross reference (continued)

Application Programming Interface (API)		
Function	**C SOCKETS**	
	INET	**IUCV**
endprotoent()	yes	n/a
endservent()	yes	n/a
fcntl()	yes	no
getclientid()	yes	no
getdtablesize()	yes	yes
gethostbyaddr()	yes	no
gethostbyname()	yes	n/a
gethostent()	yes	n/a
gethostid()	yes	no
gethostname()	yes	no
getibmopt()	yes	no
getibmsockopt()	yes	no
getnetbyaddr()	yes	n/a
getnetbyname()	yes	n/a
getnetent()	yes	n/a
getpeername()	yes	yes
getprotobyname()	yes	n/a
getprotobynumber()	yes	n/a
getprotoent()	yes	n/a
getservbyname()	yes	n/a
getservbyport()	yes	n/a
getservent()	yes	n/a
getsockname()	yes	yes
getsockopt()	yes	no
givesocket()	yes	no
htonl()	yes	n/a
htons()	yes	n/a
inet_addr()	yes	n/a
inet_inaof()	yes	n/a
inet_makeaddr()	yes	n/a
inet_netof()	yes	n/a
inet_network()	yes	n/a
inet_ntoa()	yes	n/a
ioctl()	yes	no
listen()	yes	yes
maxdesc()	yes	yes
ntohl()	yes	n/a
ntohs()	yes	n/a

Table 26. C socket address families cross reference (continued)

Application Programming Interface (API)		
Function	**C SOCKETS**	
	INET	**IUCV**
read()	yes	yes
readv()	yes	yes
recv()	yes	yes
recvfrom()	yes	yes
recvmsg()	yes	yes
select()	yes	yes
selectex()	yes	yes
send()	yes	yes
sendmsg()	yes	no
sendto()	yes	no
setibmopt()	yes	no
setibmsockopt()	yes	no
sethostent()	yes	n/a
setnetent()	yes	n/a
setprotoent()	yes	n/a
setservent()	yes	n/a
setsockopt()	yes	no
shutdown()	yes	yes
sock_debug()	yes	yes
sock_do_teststor()	yes	yes
socket()	yes	yes
takesocket()	yes	no
tcperror()	yes	yes
write()	yes	yes
writev()	yes	yes

Note: In the following table, IUCV is not supported.

Table 27. MACRO, CALL, REXX, socket address families cross reference

Application Programming Interface (API)						
COMMAND	**MACRO**		**CALL**		**REXX**	
	INET	**INET6**	**INET**	**INET6**	**INET**	**INET6**
ACCEPT	yes	yes	yes	yes	yes	yes
BIND	yes	yes	yes	yes	yes	yes
BIND2ADDRSEL	no	yes	no	yes	no	yes
CANCEL	yes	yes				
CLOSE	yes	yes	yes	yes	yes	yes
CONNECT	yes	yes	yes	yes	yes	yes

Table 27. MACRO, CALL, REXX, socket address families cross reference (continued)

Application Programming Interface (API)						
COMMAND	**MACRO**		**CALL**		**REXX**	
	INET	**INET6**	**INET**	**INET6**	**INET**	**INET6**
FCNTL	yes	yes	yes	yes	yes	yes
FREEADDRINFO	yes	yes	yes	yes		
GETADDRINFO	yes	yes	yes	yes	yes	yes
GETCLIENTID	yes	yes	yes	yes	yes	yes
GETDOMAINNAME					yes	yes
GETHOSTBYADDR	yes	yes	yes	yes	yes	yes
GETHOSTBYNAME	yes	yes	yes	yes	yes	yes
GETHOSTID	yes	yes	yes	yes	yes	yes
GETHOSTNAME	yes	yes	yes	yes	yes	yes
GETIBMOPT	yes	yes	yes	yes		
GETNAMEINFO	yes	yes	yes	yes	yes	yes
GETPEERNAME	yes	yes	yes	yes	yes	yes
GETPROTOBYNAME					n/a	n/a
GETPROTOBYNUMBER					yes	yes
GETSERVBYNAME					yes	yes
GETSERVBYPORT					yes	yes
GETSOCKNAME	yes	yes	yes	yes	yes	yes
GETSOCKOPT see Table 28 on page 916 for exceptions.	yes	yes	yes	yes	yes	yes
GIVESOCKET	yes	yes	yes	yes	yes	yes
GLOBAL	yes	yes	yes	yes		
INET6_IS_SRCADDR	no	yes	no	yes	no	yes
INITAPI	yes	yes	yes	yes		
IOCTL see Table 28 on page 916 for exceptions.	yes	yes	yes	yes	yes	yes
LISTEN	yes	yes	yes	yes	yes	yes
NTOP	yes	yes	yes	yes		
PTON	yes	yes	yes	yes		
READ	yes	yes	yes	yes	yes	yes
READV	yes	yes	yes	yes		
RECV	yes	yes	yes	yes	yes	yes
RECVFROM	yes	yes	yes	yes	yes	yes
RECVMSG	yes	yes	yes	yes		
RESOLVE					yes	yes
SELECT	yes	yes	yes	yes	yes	yes
SELECTEX	yes	yes	yes	yes		
SEND	yes	yes	yes	yes	yes	yes
SENDMSG	yes	yes	yes	yes		

Table 27. MACRO, CALL, REXX, socket address families cross reference (continued)

Application Programming Interface (API)						
COMMAND	**MACRO**		**CALL**		**REXX**	
	INET	**INET6**	**INET**	**INET6**	**INET**	**INET6**
SENDTO	yes	yes	yes	yes	yes	yes
SETSOCKOPT see Table 28 on page 916 for exceptions.	yes	yes	yes	yes	yes	yes
SHUTDOWN	yes	yes	yes	yes	yes	yes
SOCKET	yes	yes	yes	yes	yes	yes
TAKESOCKET	yes	yes	yes	yes	yes	yes
TASK	yes	yes	yes	yes		
TERMAPI	yes	yes	yes	yes		
VERSION					yes	yes
WRITE	yes	yes	yes	yes	yes	yes
WRITEV	yes	yes	yes	yes		

Table 28. MACRO, CALL, REXX, exceptions

Application Programming Interface (API)						
COMMAND	**MACRO**		**CALL**		**REXX**	
	INET	**INET6**	**INET**	**INET6**	**INET**	**INET6**
GETSOCKOPT exceptions						
IP_MULTICAST_IF	yes	no	yes	no	yes	no
IP_MULTICAST_LOOP	yes	no	yes	no	yes	no
IP_MULTICAST_TTL	yes	no	yes	no	yes	no
IPV6_ADDR_PREFERENCES	no	yes	no	yes	no	yes
IPV6_MULTICAST_HOPS	no	yes	no	yes	no	yes
IPV6_MULTICAST_IF	no	yes	no	yes	no	yes
IPV6_MULTICAST_LOOP	no	yes	no	yes	no	yes
IPV6_UNICAST_HOPS	no	yes	no	yes	no	yes
IPV6_V6ONLY	no	yes	no	yes	no	yes
SETSOCKOPT exceptions						
IP_ADD_MEMBERSHIP	yes	no	yes	no	yes	no
IP_ADD_SOURCE_MEMBERSHIP	yes	no	yes	no	yes	no
IP_BLOCK_SOURCE	yes	no	yes	no	yes	no
IP_DROP_MEMBERSHIP	yes	no	yes	no	yes	no
IP_DROP_SOURCE_MEMBERSHIP	yes	no	yes	no	yes	no
IP_MULTICAST_IF	yes	no	yes	no	yes	no
IP_MULTICAST_LOOP	yes	no	yes	no	yes	no
IP_MULTICAST_TTL	yes	no	yes	no	yes	no
IP_UNBLOCK_SOURCE	yes	no	yes	no	yes	no
IPV6_ADDR_PREFERENCES	no	yes	no	yes	no	yes
IPV6_JOIN_GROUP	no	yes	no	yes	no	yes
IPV6_LEAVE_GROUP	no	yes	no	yes	no	yes
IPV6_MULTICAST_HOPS	no	yes	no	yes	no	yes
IPV6_MULTICAST_IF	no	yes	no	yes	no	yes
IPV6_MULTICAST_LOOP	no	yes	no	yes	no	yes
IPV6_UNICAST_HOPS	no	yes	no	yes	no	yes
IPV6_V6ONLY	no	yes	no	yes	no	yes
IOCTL exceptions						
SIOCGHOMEIF6	no	yes	no	yes		
SIOCGIPMSFILTER	yes	no	yes	no	yes	no
SIOCSIPMSFILTER	yes	no	yes	no	yes	no

Appendix D. GETSOCKOPT/SETSOCKOPT command values

You can use the following table to determine the decimal or hexadecimal value associated with the GETSOCKOPT/SETSOCKOPT OPTNAMES supported by the APIs discussed in this document.

The command names are shown with underscores for the assembler language. The underscores should be changed to dashes if using the COBOL programming language.

Languages that cannot easily handle binary values, such as COBOL, should use the decimal value associated with the command where necessary.

The hexadecimal value can be used in Macro, Assembler and PL/I programs.

Table 29. GETSOCKOPT/SETSOCKOPT command values for Macro, Assembler, COBOL and PL/I

Command name	Decimal value	Hex value
IP_ADD_MEMBERSHIP	1048581	X'00100005'
IP_ADD_SOURCE_MEMBERSHIP	1048588	X'0010000C'
IP_BLOCK_SOURCE	1048586	X'0010000A'
IP_DROP_MEMBERSHIP	1048582	X'00100006'
IP_DROP_SOURCE_MEMBERSHIP	1048589	X'0010000D'
IP_MULTICAST_IF	1048583	X'00100007'
IP_MULTICAST_LOOP	1048580	X'00100004'
IP_MULTICAST_TTL	1048579	X'00100003'
IP_UNBLOCK_SOURCE	1048587	X'0010000B'
IPV6_ADDR_PREFERENCES	65568	X'00010020'
IPV6_JOIN_GROUP	65541	X'00010005'
IPV6_LEAVE_GROUP	65542	X'00010006'
IPV6_MULTICAST_HOPS	65545	X'00010009'
IPV6_MULTICAST_IF	65543	X'00010007'
IPV6_MULTICAST_LOOP	65540	X'00010004'
IPV6_UNICAST_HOPS	65539	X'00010003'
IPV6_V6ONLY	65546	X'0001000A'
MCAST_BLOCK_SOURCE	1048620	X'0010002C'
MCAST_JOIN_GROUP	1048616	X'00100028'
MCAST_JOIN_SOURCE_GROUP	1048618	X'0010002A'
MCAST_LEAVE_GROUP	1048617	X'00100029'
MCAST_LEAVE_SOURCE_GROUP	1048619	X'0010002B'
MCAST_UNBLOCK_SOURCE	1048621	X'0010002D'
SO_BROADCAST	32	X'00000020'
SO_ERROR	4103	X'00001007'
SO_LINGER	128	X'00000080'

© Copyright IBM Corp. 1989, 2010

Table 29. GETSOCKOPT/SETSOCKOPT command values for Macro, Assembler, COBOL and PL/I (continued)

Command name	Decimal value	Hex value
SO_KEEPALIVE	8	X'00000008'
SO_OOBINLINE	256	X'00000100'
SO_RCVBUF	4098	X'00001002'
SO_RCVTIMEO	4102	X'00001006'
SO_REUSEADDR	4	X'00000004'
SO_SNDBUF	4097	X'00001001'
SO_SNDTIMEO	4101	X'00001005'
SO_TYPE	4104	X'00001008'
TCP_KEEPALIVE	2147483654	X'80000008'
TCP_NODELAY	2147483649	X'80000001'

Table 30. GETSOCKOPT/SETSOCKOPT optname value for C programs

Option name	Decimal value
IP_ADD_MEMBERSHIP	5
IP_ADD_SOURCE_MEMBERSHIP	12
IP_BLOCK_SOURCE	10
IP_DROP_MEMBERSHIP	6
IP_DROP_SOURCE_MEMBERSHIP	13
IP_MULTICAST_IF	7
IP_MULTICAST_LOOP	4
IP_MULTICAST_TTL	3
IP_UNBLOCK_SOURCE	11
MCAST_BLOCK_SOURCE	44
MCAST_JOIN_GROUP	40
MCAST_JOIN_SOURCE_GROUP	42
MCAST_LEAVE_GROUP	41
MCAST_LEAVE_SOURCE_GROUP	43
MCAST_UNBLOCK_SOURCE	45
SO_ACCEPTCONN	2
SO_BROADCAST	32
SO_CLUSTERCONNTYPE	16385
SO_DEBUG	1
SO_ERROR	4103
SO_KEEPALIVE	8
SO_LINGER	128
SO_OOBINLINE	256
SO_RCVBUF	4098
SO_REUSEADDR	4
SO_SNDBUF	4097

Table 30. GETSOCKOPT/SETSOCKOPT optname value for C programs (continued)

Option name	Decimal value
SO_TYPE	4104
TCP_KEEPALIVE	8
TCP_NODELAY	1

Appendix E. Abbreviations and acronyms

AIX® Advanced Interactive Executive

ANSI American National Standards Institute

API Application program interface

APPC Advanced Program-to-Program Communications

APPN Advanced Peer-to-Peer Networking

ARP Address Resolution Protocol

ASCII American National Standard Code for Information Interchange

ASN.1 Abstract Syntax Notation One

AT-TLS
Application Transparent Transport Layer Security

AUI Attachment Unit Interface

BIOS Basic Input/Output System

BNC Bayonet Neill-Concelman

CCITT
Comite Consultatif International Telegraphique et Telephonique. The International Telegraph and Telephone Consultative Committee

CETI Continuously Executing Transfer Interface

CLAW Common Link Access to Workstation

CLIST Command List

CMS Conversational Monitor System

CP Control Program

CPI Common Programming Interface

CREN Corporation for Research and Education Networking

CSD Corrective Service Diskette

CTC Channel-to-Channel

CU Control Unit

CUA Common User Access

DASD
Direct Access Storage Device

DBCS Double Byte Character Set

DLL Dynamic Link Library

DNS Domain Name System

DOS Disk Operating System

DPI Distributed Program Interface

EBCDIC
Extended Binary-Coded Decimal Interchange Code

© Copyright IBM Corp. 1989, 2010

EISA Enhanced Industry Standard Adapter

ELANS
IBM Ethernet LAN Subsystem

ESCON®
Enterprise Systems Connection

FAT File Allocation Table

FDDI Fiber Distributed Data Interface

FTAM File Transfer Access Management

FTP File Transfer Protocol

FTP API
File Transfer Protocol Applications Programming Interface

GCS Group Control System

GDDM®
Graphical Data Display Manager

GDF Graphics Data File

HCH** HYPERchannel device**

HIPPI High Performance Parallel Interface

HPFS High Performance File System

ICAT Installation Configuration Automation Tool

ICMP Internet Control Message Protocol

IEEE Institute of Electrical and Electronic Engineers

IETF Internet Engineering Task Force

ILANS
IBM Token-Ring LAN Subsystem

IP Internet Protocol

IPL Initial Program Load

ISA Industry Standard Adapter

ISDN Integrated Services Digital Network

ISO International Organization for Standardization

IUCV Inter-User Communication Vehicle

JES Job Entry Subsystem

JIS Japanese Institute of Standards

JCL Job Control Language

LAN Local Area Network

LAPS LAN Adapter Protocol Support

LCS IBM LAN Channel Station

LPD Line Printer Daemon

LPQ Line Printer Query

LPR Line Printer Client

LPRM Line Printer Remove

LPRMON
Line Printer Monitor

LU Logical Unit

MAC Media Access Control

Mbps Megabits per second

MBps Megabytes per second

MCA Micro Channel Adapter

MHS Message Handling System

MIB Management Information Base

MIH Missing Interrupt Handler

MILNET
Military Network

MTU Maximum Transmission Unit

MVS Multiple Virtual Storage

MX Mail Exchange

NCP Network Control Program

NCS Network Computing System

NDIS Network Driver Interface Specification

NFS** Network File System**

NIC Network Information Center

NLS multicultural support

NSFNET
National Science Foundation Network

OS/2 Operating System/2

OSF** Open Software Foundation**, Inc.

OSI Open Systems Interconnection

OSIMF/6000
Open Systems Interconnection Messaging and Filing/6000

OV/MVS
OfficeVision®/MVS

OV/VM
OfficeVision/VM

PAD Packet Assembly/Disassembly

PC program call

PCA Parallel Channel Adapter

PDN Public Data Network

PDU Protocol Data Units

PING Packet Internet Groper

PIOAM
Parallel I/O Access Method

POP Post Office Protocol

PROFS™
Professional Office Systems

PSCA Personal System Channel Attach

PSDN Packet Switching Data Network

PU Physical Unit

PVM Passthrough Virtual Machine

RACF Resource Access Control Facility

RARP Reverse Address Resolution Protocol

REXEC
Remote Execution

REXX Restructured Extended Executor Language

RFC Request For Comments

RIP Routing Information Protocol

RISC Reduced Instruction Set Computer

RPC Remote procedure call

RSCS Remote Spooling Communications Subsystem

SAA System Application Architecture

SBCS Single Byte Character Set

SDLC Synchronous Data Link Control

SLIP Serial Line Internet Protocol

SMI Structure for Management Information

SMTP Simple Mail Transfer Protocol

SNA Systems Network Architecture

SNMP
Simple Network Management Protocol

SOA Start of Authority

SPOOL
Simultaneous Peripheral Operations Online

SQL IBM Structured Query Language

TCP Transmission Control Protocol

TCP/IP
Transmission Control Protocol/Internet Protocol

TFTP Trivial File Transfer Protocol

TSO Time Sharing Option

TTL Time-to-Live

UDP User Datagram Protocol

VGA Video Graphic Array

VM Virtual Machine

VMCF
Virtual machine communication facility

VM/SP
Virtual Machine/System Product

VM/XA
Virtual Machine/Extended Architecture

VTAM
Virtual Telecommunications Access Method

WAN Wide Area Network

XDR eXternal Data Representation

Appendix F. Related protocol specifications

This appendix lists the related protocol specifications (RFCs) for TCP/IP. The Internet Protocol suite is still evolving through requests for comments (RFC). New protocols are being designed and implemented by researchers and are brought to the attention of the Internet community in the form of RFCs. Some of these protocols are so useful that they become recommended protocols. That is, all future implementations for TCP/IP are recommended to implement these particular functions or protocols. These become the *de facto* standards, on which the TCP/IP protocol suite is built.

You can request RFCs through electronic mail, from the automated Network Information Center (NIC) mail server, by sending a message to `service@nic.ddn.mil` with a subject line of `RFC` *`nnnn`* for text versions or a subject line of `RFC` *`nnnn`*`.PS` for PostScript versions. To request a copy of the RFC index, send a message with a subject line of `RFC INDEX`.

For more information, contact `nic@nic.ddn.mil` or at:

Government Systems, Inc.
Attn: Network Information Center
14200 Park Meadow Drive
Suite 200
Chantilly, VA 22021

Hard copies of all RFCs are available from the NIC, either individually or by subscription. Online copies are available at the following Web address: http://www.rfc-editor.org/rfc.html.

See "Internet drafts" on page 943 for draft RFCs implemented in this and previous Communications Server releases.

Many features of TCP/IP Services are based on the following RFCs:

RFC	Title and Author
RFC 652	*Telnet output carriage-return disposition option* D. Crocker
RFC 653	*Telnet output horizontal tabstops option* D. Crocker
RFC 654	*Telnet output horizontal tab disposition option* D. Crocker
RFC 655	*Telnet output formfeed disposition option* D. Crocker
RFC 657	*Telnet output vertical tab disposition option* D. Crocker
RFC 658	*Telnet output linefeed disposition* D. Crocker
RFC 698	*Telnet extended ASCII option* T. Mock
RFC 726	*Remote Controlled Transmission and Echoing Telnet option* J. Postel, D. Crocker
RFC 727	*Telnet logout option* M.R. Crispin
RFC 732	*Telnet Data Entry Terminal option* J.D. Day
RFC 733	*Standard for the format of ARPA network text messages* D. Crocker, J. Vittal, K.T. Pogran, D.A. Henderson

© Copyright IBM Corp. 1989, 2010

RFC 734 *SUPDUP Protocol* M.R. Crispin

RFC 735 *Revised Telnet byte macro option* D. Crocker, R.H. Gumpertz

RFC 736 *Telnet SUPDUP option* M.R. Crispin

RFC 749 *Telnet SUPDUP—Output option* B. Greenberg

RFC 765 *File Transfer Protocol specification* J. Postel

RFC 768 *User Datagram Protocol* J. Postel

RFC 779 *Telnet send-location option* E. Killian

RFC 783 *TFTP Protocol (revision 2)* K.R. Sollins

RFC 791 *Internet Protocol* J. Postel

RFC 792 *Internet Control Message Protocol* J. Postel

RFC 793 *Transmission Control Protocol* J. Postel

RFC 820 *Assigned numbers* J. Postel

RFC 821 *Simple Mail Transfer Protocol* J. Postel

RFC 822 *Standard for the format of ARPA Internet text messages* D. Crocker

RFC 823 *DARPA Internet gateway* R. Hinden, A. Sheltzer

RFC 826 *Ethernet Address Resolution Protocol: Or converting network protocol addresses to 48.bit Ethernet address for transmission on Ethernet hardware* D. Plummer

RFC 854 *Telnet Protocol Specification* J. Postel, J. Reynolds

RFC 855 *Telnet Option Specification* J. Postel, J. Reynolds

RFC 856 *Telnet Binary Transmission* J. Postel, J. Reynolds

RFC 857 *Telnet Echo Option* J. Postel, J. Reynolds

RFC 858 *Telnet Suppress Go Ahead Option* J. Postel, J. Reynolds

RFC 859 *Telnet Status Option* J. Postel, J. Reynolds

RFC 860 *Telnet Timing Mark Option* J. Postel, J. Reynolds

RFC 861 *Telnet Extended Options: List Option* J. Postel, J. Reynolds

RFC 862 *Echo Protocol* J. Postel

RFC 863 *Discard Protocol* J. Postel

RFC 864 *Character Generator Protocol* J. Postel

RFC 865 *Quote of the Day Protocol* J. Postel

RFC 868 *Time Protocol* J. Postel, K. Harrenstien

RFC 877 *Standard for the transmission of IP datagrams over public data networks* J.T. Korb

RFC 883 *Domain names: Implementation specification* P.V. Mockapetris

RFC 884 *Telnet terminal type option* M. Solomon, E. Wimmers

RFC 885 *Telnet end of record option* J. Postel

RFC 894 *Standard for the transmission of IP datagrams over Ethernet networks* C. Hornig

RFC 896 *Congestion control in IP/TCP internetworks* J. Nagle

RFC 903 *Reverse Address Resolution Protocol* R. Finlayson, T. Mann, J. Mogul, M. Theimer

RFC 904 *Exterior Gateway Protocol formal specification* D. Mills

RFC 919 *Broadcasting Internet Datagrams* J. Mogul

RFC 922 *Broadcasting Internet datagrams in the presence of subnets* J. Mogul

RFC 927 *TACACS user identification Telnet option* B.A. Anderson

RFC 933 *Output marking Telnet option* S. Silverman

RFC 946 *Telnet terminal location number option* R. Nedved

RFC 950 *Internet Standard Subnetting Procedure* J. Mogul, J. Postel

RFC 952 *DoD Internet host table specification* K. Harrenstien, M. Stahl, E. Feinler

RFC 959 *File Transfer Protocol* J. Postel, J.K. Reynolds

RFC 961 *Official ARPA-Internet protocols* J.K. Reynolds, J. Postel

RFC 974 *Mail routing and the domain system* C. Partridge

RFC 1001 *Protocol standard for a NetBIOS service on a TCP/UDP transport: Concepts and methods* NetBios Working Group in the Defense Advanced Research Projects Agency, Internet Activities Board, End-to-End Services Task Force

RFC 1002 *Protocol Standard for a NetBIOS service on a TCP/UDP transport: Detailed specifications* NetBios Working Group in the Defense Advanced Research Projects Agency, Internet Activities Board, End-to-End Services Task Force

RFC 1006 *ISO transport services on top of the TCP: Version 3* M.T. Rose, D.E. Cass

RFC 1009 *Requirements for Internet gateways* R. Braden, J. Postel

RFC 1011 *Official Internet protocols* J. Reynolds, J. Postel

RFC 1013 *X Window System Protocol, version 11: Alpha update April 1987* R. Scheifler

RFC 1014 *XDR: External Data Representation standard* Sun Microsystems

RFC 1027 *Using ARP to implement transparent subnet gateways* S. Carl-Mitchell, J. Quarterman

RFC 1032 *Domain administrators guide* M. Stahl

RFC 1033 *Domain administrators operations guide* M. Lottor

RFC 1034 *Domain names—concepts and facilities* P.V. Mockapetris

RFC 1035 *Domain names—implementation and specification* P.V. Mockapetris

RFC 1038 *Draft revised IP security option* M. St. Johns

RFC 1041 *Telnet 3270 regime option* Y. Rekhter

RFC 1042 *Standard for the transmission of IP datagrams over IEEE 802 networks* J. Postel, J. Reynolds

RFC 1043 *Telnet Data Entry Terminal option: DODIIS implementation* A. Yasuda, T. Thompson

RFC 1044 *Internet Protocol on Network System's HYPERchannel: Protocol specification* K. Hardwick, J. Lekashman

RFC 1053 *Telnet X.3 PAD option* S. Levy, T. Jacobson

RFC 1055 *Nonstandard for transmission of IP datagrams over serial lines: SLIP* J. Romkey

RFC 1057 *RPC: Remote Procedure Call Protocol Specification: Version 2* Sun Microsystems

RFC 1058 *Routing Information Protocol* C. Hedrick

RFC 1060 *Assigned numbers* J. Reynolds, J. Postel

RFC 1067 *Simple Network Management Protocol* J.D. Case, M. Fedor, M.L. Schoffstall, J. Davin

RFC 1071 *Computing the Internet checksum* R.T. Braden, D.A. Borman, C. Partridge

RFC 1072 *TCP extensions for long-delay paths* V. Jacobson, R.T. Braden

RFC 1073 *Telnet window size option* D. Waitzman

RFC 1079 *Telnet terminal speed option* C. Hedrick

RFC 1085 *ISO presentation services on top of TCP/IP based internets* M.T. Rose

RFC 1091 *Telnet terminal-type option* J. VanBokkelen

RFC 1094 *NFS: Network File System Protocol specification* Sun Microsystems

RFC 1096 *Telnet X display location option* G. Marcy

RFC 1101 *DNS encoding of network names and other types* P. Mockapetris

RFC 1112 *Host extensions for IP multicasting* S.E. Deering

RFC 1113 *Privacy enhancement for Internet electronic mail: Part I — message encipherment and authentication procedures* J. Linn

RFC 1118 *Hitchhikers Guide to the Internet* E. Krol

RFC 1122 *Requirements for Internet Hosts—Communication Layers* R. Braden, Ed.

RFC 1123 *Requirements for Internet Hosts—Application and Support* R. Braden, Ed.

RFC 1146 *TCP alternate checksum options* J. Zweig, C. Partridge

RFC 1155 *Structure and identification of management information for TCP/IP-based internets* M. Rose, K. McCloghrie

RFC 1156 *Management Information Base for network management of TCP/IP-based internets* K. McCloghrie, M. Rose

RFC 1157 *Simple Network Management Protocol (SNMP)* J. Case, M. Fedor, M. Schoffstall, J. Davin

RFC 1158 *Management Information Base for network management of TCP/IP-based internets: MIB-II* M. Rose

RFC 1166 *Internet numbers* S. Kirkpatrick, M.K. Stahl, M. Recker

RFC 1179 *Line printer daemon protocol* L. McLaughlin

RFC 1180 *TCP/IP tutorial* T. Socolofsky, C. Kale

RFC 1183 *New DNS RR Definitions* C.F. Everhart, L.A. Mamakos, R. Ullmann, P.V. Mockapetris

RFC 1184 *Telnet Linemode Option* D. Borman

RFC 1186 *MD4 Message Digest Algorithm* R.L. Rivest

RFC 1187 *Bulk Table Retrieval with the SNMP* M. Rose, K. McCloghrie, J. Davin

RFC 1188 *Proposed Standard for the Transmission of IP Datagrams over FDDI Networks* D. Katz

RFC 1190 *Experimental Internet Stream Protocol: Version 2 (ST-II)* C. Topolcic

RFC 1191 *Path MTU discovery* J. Mogul, S. Deering

RFC 1198 *FYI on the X window system* R. Scheifler

RFC 1207 *FYI on Questions and Answers: Answers to commonly asked "experienced Internet user" questions* G. Malkin, A. Marine, J. Reynolds

RFC 1208 *Glossary of networking terms* O. Jacobsen, D. Lynch

RFC 1213 *Management Information Base for Network Management of TCP/IP-based internets: MIB-II* K. McCloghrie, M.T. Rose

RFC 1215 *Convention for defining traps for use with the SNMP* M. Rose

RFC 1227 *SNMP MUX protocol and MIB* M.T. Rose

RFC 1228 *SNMP-DPI: Simple Network Management Protocol Distributed Program Interface* G. Carpenter, B. Wijnen

RFC 1229 *Extensions to the generic-interface MIB* K. McCloghrie

RFC 1230 *IEEE 802.4 Token Bus MIB* K. McCloghrie, R. Fox

RFC 1231 *IEEE 802.5 Token Ring MIB* K. McCloghrie, R. Fox, E. Decker

RFC 1236 *IP to X.121 address mapping for DDN* L. Morales, P. Hasse

RFC 1256 *ICMP Router Discovery Messages* S. Deering, Ed.

RFC 1267 *Border Gateway Protocol 3 (BGP-3)* K. Lougheed, Y. Rekhter

RFC 1268 *Application of the Border Gateway Protocol in the Internet* Y. Rekhter, P. Gross

RFC 1269 *Definitions of Managed Objects for the Border Gateway Protocol: Version 3* S. Willis, J. Burruss

RFC 1270 *SNMP Communications Services* F. Kastenholz, ed.

RFC 1285 *FDDI Management Information Base* J. Case

RFC 1315 *Management Information Base for Frame Relay DTEs* C. Brown, F. Baker, C. Carvalho

RFC 1321 *The MD5 Message-Digest Algorithm* R. Rivest

RFC 1323 *TCP Extensions for High Performance* V. Jacobson, R. Braden, D. Borman

RFC 1325 *FYI on Questions and Answers: Answers to Commonly Asked "New Internet User" Questions* G. Malkin, A. Marine

RFC 1327 *Mapping between X.400 (1988)/ISO 10021 and RFC 822* S. Hardcastle-Kille

RFC 1340 *Assigned Numbers* J. Reynolds, J. Postel

RFC 1344 *Implications of MIME for Internet Mail Gateways* N. Bornstein

RFC 1349 *Type of Service in the Internet Protocol Suite* P. Almquist

RFC 1350 *The TFTP Protocol (Revision 2)* K.R. Sollins

RFC 1351 *SNMP Administrative Model* J. Davin, J. Galvin, K. McCloghrie

RFC 1352 *SNMP Security Protocols* J. Galvin, K. McCloghrie, J. Davin

RFC 1353 *Definitions of Managed Objects for Administration of SNMP Parties* K. McCloghrie, J. Davin, J. Galvin

RFC 1354 *IP Forwarding Table MIB* F. Baker

RFC 1356 *Multiprotocol Interconnect on X.25 and ISDN in the Packet Mode* A. Malis, D. Robinson, R. Ullmann

RFC 1358 *Charter of the Internet Architecture Board (IAB)* L. Chapin

RFC 1363 *A Proposed Flow Specification* C. Partridge

RFC 1368 *Definition of Managed Objects for IEEE 802.3 Repeater Devices* D. McMaster, K. McCloghrie

RFC 1372 *Telnet Remote Flow Control Option* C. L. Hedrick, D. Borman

RFC 1374 *IP and ARP on HIPPI* J. Renwick, A. Nicholson

RFC 1381 *SNMP MIB Extension for X.25 LAPB* D. Throop, F. Baker

RFC 1382 *SNMP MIB Extension for the X.25 Packet Layer* D. Throop

RFC 1387 *RIP Version 2 Protocol Analysis* G. Malkin

RFC 1388 *RIP Version 2 Carrying Additional Information* G. Malkin

RFC 1389 *RIP Version 2 MIB Extensions* G. Malkin, F. Baker

RFC 1390 *Transmission of IP and ARP over FDDI Networks* D. Katz

RFC 1393 *Traceroute Using an IP Option* G. Malkin

RFC 1398 *Definitions of Managed Objects for the Ethernet-Like Interface Types* F. Kastenholz

RFC 1408 *Telnet Environment Option* D. Borman, Ed.

RFC 1413 *Identification Protocol* M. St. Johns

RFC 1416 *Telnet Authentication Option* D. Borman, ed.

RFC 1420 *SNMP over IPX* S. Bostock

RFC 1428 *Transition of Internet Mail from Just-Send-8 to 8bit-SMTP/MIME* G. Vaudreuil

RFC 1442 *Structure of Management Information for version 2 of the Simple Network Management Protocol (SNMPv2)* J. Case, K. McCloghrie, M. Rose, S. Waldbusser

RFC 1443 *Textual Conventions for version 2 of the Simple Network Management Protocol (SNMPv2)* J. Case, K. McCloghrie, M. Rose, S. Waldbusser

RFC 1445 *Administrative Model for version 2 of the Simple Network Management Protocol (SNMPv2)* J. Galvin, K. McCloghrie

RFC 1447 *Party MIB for version 2 of the Simple Network Management Protocol (SNMPv2)* K. McCloghrie, J. Galvin

RFC 1448 *Protocol Operations for version 2 of the Simple Network Management Protocol (SNMPv2)* J. Case, K. McCloghrie, M. Rose, S. Waldbusser

RFC 1464 *Using the Domain Name System to Store Arbitrary String Attributes* R. Rosenbaum

RFC 1469 *IP Multicast over Token-Ring Local Area Networks* T. Pusateri

RFC 1483 *Multiprotocol Encapsulation over ATM Adaptation Layer 5* Juha Heinanen

RFC 1514 *Host Resources MIB* P. Grillo, S. Waldbusser

RFC 1516 *Definitions of Managed Objects for IEEE 802.3 Repeater Devices* D. McMaster, K. McCloghrie

RFC 1521 *MIME (Multipurpose Internet Mail Extensions) Part One: Mechanisms for Specifying and Describing the Format of Internet Message Bodies* N. Borenstein, N. Freed

RFC 1535 *A Security Problem and Proposed Correction With Widely Deployed DNS Software* E. Gavron

RFC 1536 *Common DNS Implementation Errors and Suggested Fixes* A. Kumar, J. Postel, C. Neuman, P. Danzig, S. Miller

RFC 1537 *Common DNS Data File Configuration Errors* P. Beertema

RFC 1540 *Internet Official Protocol Standards* J. Postel

RFC 1571 *Telnet Environment Option Interoperability Issues* D. Borman

RFC 1572 *Telnet Environment Option* S. Alexander

RFC 1573 *Evolution of the Interfaces Group of MIB-II* K. McCloghrie, F. Kastenholz

RFC 1577 *Classical IP and ARP over ATM* M. Laubach

RFC 1583 *OSPF Version 2* J. Moy

RFC 1591 *Domain Name System Structure and Delegation* J. Postel

RFC 1592 *Simple Network Management Protocol Distributed Protocol Interface Version 2.0* B. Wijnen, G. Carpenter, K. Curran, A. Sehgal, G. Waters

RFC 1594 *FYI on Questions and Answers— Answers to Commonly Asked "New Internet User" Questions* A. Marine, J. Reynolds, G. Malkin

RFC 1644 *T/TCP — TCP Extensions for Transactions Functional Specification* R. Braden

RFC 1646 *TN3270 Extensions for LUname and Printer Selection* C. Graves, T. Butts, M. Angel

RFC 1647 *TN3270 Enhancements* B. Kelly

RFC 1652 *SMTP Service Extension for 8bit-MIMEtransport* J. Klensin, N. Freed, M. Rose, E. Stefferud, D. Crocker

RFC 1664 *Using the Internet DNS to Distribute RFC1327 Mail Address Mapping Tables* C. Allochio, A. Bonito, B. Cole, S. Giordano, R. Hagens

RFC 1693 *An Extension to TCP: Partial Order Service* T. Connolly, P. Amer, P. Conrad

RFC 1695 *Definitions of Managed Objects for ATM Management Version 8.0 using SMIv2* M. Ahmed, K. Tesink

RFC 1701 *Generic Routing Encapsulation (GRE)* S. Hanks, T. Li, D. Farinacci, P. Traina

RFC 1702 *Generic Routing Encapsulation over IPv4 networks* S. Hanks, T. Li, D. Farinacci, P. Traina

RFC 1706 *DNS NSAP Resource Records* B. Manning, R. Colella

RFC 1712 *DNS Encoding of Geographical Location* C. Farrell, M. Schulze, S. Pleitner D. Baldoni

RFC 1713 *Tools for DNS debugging* A. Romao

RFC 1723 *RIP Version 2—Carrying Additional Information* G. Malkin

RFC 1752 *The Recommendation for the IP Next Generation Protocol* S. Bradner, A. Mankin

RFC 1766 *Tags for the Identification of Languages* H. Alvestrand

RFC 1771 *A Border Gateway Protocol 4 (BGP-4)* Y. Rekhter, T. Li

RFC 1794 *DNS Support for Load Balancing* T. Brisco

RFC 1819 *Internet Stream Protocol Version 2 (ST2) Protocol Specification—Version ST2+* L. Delgrossi, L. Berger Eds.

RFC 1826 *IP Authentication Header* R. Atkinson

RFC 1828 *IP Authentication using Keyed MD5* P. Metzger, W. Simpson

RFC 1829 *The ESP DES-CBC Transform* P. Karn, P. Metzger, W. Simpson

RFC 1830 *SMTP Service Extensions for Transmission of Large and Binary MIME Messages* G. Vaudreuil

RFC 1831 *RPC: Remote Procedure Call Protocol Specification Version 2* R. Srinivasan

RFC 1832 *XDR: External Data Representation Standard* R. Srinivasan

RFC 1833 *Binding Protocols for ONC RPC Version 2* R. Srinivasan

RFC 1850 *OSPF Version 2 Management Information Base* F. Baker, R. Coltun

RFC 1854 *SMTP Service Extension for Command Pipelining* N. Freed

RFC 1869 *SMTP Service Extensions* J. Klensin, N. Freed, M. Rose, E. Stefferud, D. Crocker

RFC 1870 *SMTP Service Extension for Message Size Declaration* J. Klensin, N. Freed, K. Moore

RFC 1876 *A Means for Expressing Location Information in the Domain Name System* C. Davis, P. Vixie, T. Goodwin, I. Dickinson

RFC 1883 *Internet Protocol, Version 6 (IPv6) Specification* S. Deering, R. Hinden

RFC 1884 *IP Version 6 Addressing Architecture* R. Hinden, S. Deering, Eds.

RFC 1886 *DNS Extensions to support IP version 6* S. Thomson, C. Huitema

RFC 1888 *OSI NSAPs and IPv6* J. Bound, B. Carpenter, D. Harrington, J. Houldsworth, A. Lloyd

RFC 1891 *SMTP Service Extension for Delivery Status Notifications* K. Moore

RFC 1892 *The Multipart/Report Content Type for the Reporting of Mail System Administrative Messages* G. Vaudreuil

RFC 1894 *An Extensible Message Format for Delivery Status Notifications*K. Moore, G. Vaudreuil

RFC 1901 *Introduction to Community-based SNMPv2* J. Case, K. McCloghrie, M. Rose, S. Waldbusser

RFC 1902 *Structure of Management Information for Version 2 of the Simple Network Management Protocol (SNMPv2)* J. Case, K. McCloghrie, M. Rose, S. Waldbusser

RFC 1903 *Textual Conventions for Version 2 of the Simple Network Management Protocol (SNMPv2)* J. Case, K. McCloghrie, M. Rose, S. Waldbusser

RFC 1904 *Conformance Statements for Version 2 of the Simple Network Management Protocol (SNMPv2)* J. Case, K. McCloghrie, M. Rose, S. Waldbusser

RFC 1905 *Protocol Operations for Version 2 of the Simple Network Management Protocol (SNMPv2)* J. Case, K. McCloghrie, M. Rose, S. Waldbusser

RFC 1906 *Transport Mappings for Version 2 of the Simple Network Management Protocol (SNMPv2)* J. Case, K. McCloghrie, M. Rose, S. Waldbusser

RFC 1907 *Management Information Base for Version 2 of the Simple Network Management Protocol (SNMPv2)* J. Case, K. McCloghrie, M. Rose, S. Waldbusser

RFC 1908 *Coexistence between Version 1 and Version 2 of the Internet-standard Network Management Framework* J. Case, K. McCloghrie, M. Rose, S. Waldbusser

RFC 1912 *Common DNS Operational and Configuration Errors* D. Barr

RFC 1918 *Address Allocation for Private Internets* Y. Rekhter, B. Moskowitz, D. Karrenberg, G.J. de Groot, E. Lear

RFC 1928 *SOCKS Protocol Version 5* M. Leech, M. Ganis, Y. Lee, R. Kuris, D. Koblas, L. Jones

RFC 1930 *Guidelines for creation, selection, and registration of an Autonomous System (AS)* J. Hawkinson, T. Bates

RFC 1939 *Post Office Protocol-Version 3* J. Myers, M. Rose

RFC 1981 *Path MTU Discovery for IP version 6* J. McCann, S. Deering, J. Mogul

RFC 1982 *Serial Number Arithmetic* R. Elz, R. Bush

RFC 1985 *SMTP Service Extension for Remote Message Queue Starting* J. De Winter

RFC 1995 *Incremental Zone Transfer in DNS* M. Ohta

RFC 1996 *A Mechanism for Prompt Notification of Zone Changes (DNS NOTIFY)* P. Vixie

RFC 2010 *Operational Criteria for Root Name Servers* B. Manning, P. Vixie

RFC 2011 *SNMPv2 Management Information Base for the Internet Protocol using SMIv2* K. McCloghrie, Ed.

RFC 2012 *SNMPv2 Management Information Base for the Transmission Control Protocol using SMIv2* K. McCloghrie, Ed.

RFC 2013 *SNMPv2 Management Information Base for the User Datagram Protocol using SMIv2* K. McCloghrie, Ed.

RFC 2018 *TCP Selective Acknowledgement Options* M. Mathis, J. Mahdavi, S. Floyd, A. Romanow

RFC 2026 *The Internet Standards Process — Revision 3* S. Bradner

RFC 2030 *Simple Network Time Protocol (SNTP) Version 4 for IPv4, IPv6 and OSI* D. Mills

RFC 2033 *Local Mail Transfer Protocol* J. Myers

RFC 2034 *SMTP Service Extension for Returning Enhanced Error Codes*N. Freed

RFC 2040 *The RC5, RC5–CBC, RC-5–CBC-Pad, and RC5–CTS Algorithms*R. Baldwin, R. Rivest

RFC 2045 *Multipurpose Internet Mail Extensions (MIME) Part One: Format of Internet Message Bodies* N. Freed, N. Borenstein

RFC 2052 *A DNS RR for specifying the location of services (DNS SRV)* A. Gulbrandsen, P. Vixie

RFC 2065 *Domain Name System Security Extensions* D. Eastlake 3rd, C. Kaufman

RFC 2066 *TELNET CHARSET Option* R. Gellens

RFC 2080 *RIPng for IPv6* G. Malkin, R. Minnear

RFC 2096 *IP Forwarding Table MIB* F. Baker

RFC 2104 *HMAC: Keyed-Hashing for Message Authentication* H. Krawczyk, M. Bellare, R. Canetti

RFC 2119 *Keywords for use in RFCs to Indicate Requirement Levels* S. Bradner

RFC 2133 *Basic Socket Interface Extensions for IPv6* R. Gilligan, S. Thomson, J. Bound, W. Stevens

RFC 2136 *Dynamic Updates in the Domain Name System (DNS UPDATE)* P. Vixie, Ed., S. Thomson, Y. Rekhter, J. Bound

RFC 2137 *Secure Domain Name System Dynamic Update* D. Eastlake 3rd

RFC 2163 *Using the Internet DNS to Distribute MIXER Conformant Global Address Mapping (MCGAM)* C. Allocchio

RFC 2168 *Resolution of Uniform Resource Identifiers using the Domain Name System* R. Daniel, M. Mealling

RFC 2178 *OSPF Version 2* J. Moy

RFC 2181 *Clarifications to the DNS Specification* R. Elz, R. Bush

RFC 2205 *Resource ReSerVation Protocol (RSVP)—Version 1 Functional Specification* R. Braden, Ed., L. Zhang, S. Berson, S. Herzog, S. Jamin

RFC 2210 *The Use of RSVP with IETF Integrated Services* J. Wroclawski

RFC 2211 *Specification of the Controlled-Load Network Element Service* J. Wroclawski

RFC 2212 *Specification of Guaranteed Quality of Service* S. Shenker, C. Partridge, R. Guerin

RFC 2215 *General Characterization Parameters for Integrated Service Network Elements* S. Shenker, J. Wroclawski

RFC 2217 *Telnet Com Port Control Option* G. Clarke

RFC 2219 *Use of DNS Aliases for Network Services* M. Hamilton, R. Wright

RFC 2228 *FTP Security Extensions* M. Horowitz, S. Lunt

RFC 2230 *Key Exchange Delegation Record for the DNS* R. Atkinson

RFC 2233 *The Interfaces Group MIB using SMIv2* K. McCloghrie, F. Kastenholz

RFC 2240 *A Legal Basis for Domain Name Allocation* O. Vaughn

RFC 2246 *The TLS Protocol Version 1.0* T. Dierks, C. Allen

RFC 2251 *Lightweight Directory Access Protocol (v3)* M. Wahl, T. Howes, S. Kille

RFC 2253 *Lightweight Directory Access Protocol (v3): UTF-8 String Representation of Distinguished Names* M. Wahl, S. Kille, T. Howes

RFC 2254 *The String Representation of LDAP Search Filters* T. Howes

RFC 2261 *An Architecture for Describing SNMP Management Frameworks* D. Harrington, R. Presuhn, B. Wijnen

RFC 2262 *Message Processing and Dispatching for the Simple Network Management Protocol (SNMP)* J. Case, D. Harrington, R. Presuhn, B. Wijnen

RFC 2271 *An Architecture for Describing SNMP Management Frameworks* D. Harrington, R. Presuhn, B. Wijnen

RFC 2273 *SNMPv3 Applications* D. Levi, P. Meyer, B. Stewartz

RFC 2274 *User-based Security Model (USM) for version 3 of the Simple Network Management Protocol (SNMPv3)* U. Blumenthal, B. Wijnen

RFC 2275 *View-based Access Control Model (VACM) for the Simple Network Management Protocol (SNMP)* B. Wijnen, R. Presuhn, K. McCloghrie

RFC 2279 *UTF-8, a transformation format of ISO 10646* F. Yergeau

RFC 2292 *Advanced Sockets API for IPv6* W. Stevens, M. Thomas

RFC 2308 *Negative Caching of DNS Queries (DNS NCACHE)* M. Andrews

RFC 2317 *Classless IN-ADDR.ARPA delegation* H. Eidnes, G. de Groot, P. Vixie

RFC 2320 *Definitions of Managed Objects for Classical IP and ARP Over ATM Using SMIv2 (IPOA-MIB)* M. Greene, J. Luciani, K. White, T. Kuo

RFC 2328 *OSPF Version 2* J. Moy

RFC 2345 *Domain Names and Company Name Retrieval* J. Klensin, T. Wolf, G. Oglesby

RFC 2352 *A Convention for Using Legal Names as Domain Names* O. Vaughn

RFC 2355 *TN3270 Enhancements* B. Kelly

RFC 2358 *Definitions of Managed Objects for the Ethernet-like Interface Types* J. Flick, J. Johnson

RFC 2373 *IP Version 6 Addressing Architecture* R. Hinden, S. Deering

RFC 2374 *An IPv6 Aggregatable Global Unicast Address Format* R. Hinden, M. O'Dell, S. Deering

RFC 2375 *IPv6 Multicast Address Assignments* R. Hinden, S. Deering

RFC 2385 *Protection of BGP Sessions via the TCP MD5 Signature Option*A. Hefferman

RFC 2389 *Feature negotiation mechanism for the File Transfer Protocol* P. Hethmon, R. Elz

RFC 2401 *Security Architecture for Internet Protocol* S. Kent, R. Atkinson

RFC 2402 *IP Authentication Header* S. Kent, R. Atkinson

RFC 2403 *The Use of HMAC-MD5–96 within ESP and AH* C. Madson, R. Glenn

RFC 2404 *The Use of HMAC-SHA–1–96 within ESP and AH* C. Madson, R. Glenn

RFC 2405 *The ESP DES-CBC Cipher Algorithm With Explicit IV* C. Madson, N. Doraswamy

RFC 2406 *IP Encapsulating Security Payload (ESP)* S. Kent, R. Atkinson

RFC 2407 *The Internet IP Security Domain of Interpretation for ISAKMP*D. Piper

RFC 2408 *Internet Security Association and Key Management Protocol (ISAKMP)* D. Maughan, M. Schertler, M. Schneider, J. Turner

RFC 2409 *The Internet Key Exchange (IKE)* D. Harkins, D. Carrel

RFC 2410 *The NULL Encryption Algorithm and Its Use With IPsec* R. Glenn, S. Kent,

RFC 2428 *FTP Extensions for IPv6 and NATs* M. Allman, S. Ostermann, C. Metz

RFC 2445 *Internet Calendaring and Scheduling Core Object Specification (iCalendar)* F. Dawson, D. Stenerson

RFC 2459 *Internet X.509 Public Key Infrastructure Certificate and CRL Profile* R. Housley, W. Ford, W. Polk, D. Solo

RFC 2460 *Internet Protocol, Version 6 (IPv6) Specification* S. Deering, R. Hinden

RFC 2461 *Neighbor Discovery for IP Version 6 (IPv6)* T. Narten, E. Nordmark, W. Simpson

RFC 2462 *IPv6 Stateless Address Autoconfiguration* S. Thomson, T. Narten

RFC 2463 *Internet Control Message Protocol (ICMPv6) for the Internet Protocol Version 6 (IPv6) Specification* A. Conta, S. Deering

RFC 2464 *Transmission of IPv6 Packets over Ethernet Networks* M. Crawford

RFC 2466 *Management Information Base for IP Version 6: ICMPv6 Group* D. Haskin, S. Onishi

RFC 2476 *Message Submission* R. Gellens, J. Klensin

RFC 2487 *SMTP Service Extension for Secure SMTP over TLS* P. Hoffman

RFC 2505 *Anti-Spam Recommendations for SMTP MTAs* G. Lindberg

RFC 2523 *Photuris: Extended Schemes and Attributes* P. Karn, W. Simpson

RFC 2535 *Domain Name System Security Extensions* D. Eastlake 3rd

RFC 2538 *Storing Certificates in the Domain Name System (DNS)* D. Eastlake 3rd, O. Gudmundsson

RFC 2539 *Storage of Diffie-Hellman Keys in the Domain Name System (DNS)* D. Eastlake 3rd

RFC 2540 *Detached Domain Name System (DNS) Information* D. Eastlake 3rd

RFC 2554 *SMTP Service Extension for Authentication* J. Myers

RFC 2570 *Introduction to Version 3 of the Internet-standard Network Management Framework* J. Case, R. Mundy, D. Partain, B. Stewart

RFC 2571 *An Architecture for Describing SNMP Management Frameworks* B. Wijnen, D. Harrington, R. Presuhn

RFC 2572 *Message Processing and Dispatching for the Simple Network Management Protocol (SNMP)* J. Case, D. Harrington, R. Presuhn, B. Wijnen

RFC 2573 *SNMP Applications* D. Levi, P. Meyer, B. Stewart

RFC 2574 *User-based Security Model (USM) for version 3 of the Simple Network Management Protocol (SNMPv3)* U. Blumenthal, B. Wijnen

RFC 2575 *View-based Access Control Model (VACM) for the Simple Network Management Protocol (SNMP)* B. Wijnen, R. Presuhn, K. McCloghrie

RFC 2576 *Co-Existence between Version 1, Version 2, and Version 3 of the Internet-standard Network Management Framework* R. Frye, D. Levi, S. Routhier, B. Wijnen

RFC 2578 *Structure of Management Information Version 2 (SMIv2)* K. McCloghrie, D. Perkins, J. Schoenwaelder

RFC 2579 *Textual Conventions for SMIv2* K. McCloghrie, D. Perkins, J. Schoenwaelder

RFC 2580 *Conformance Statements for SMIv2* K. McCloghrie, D. Perkins, J. Schoenwaelder

RFC 2581 *TCP Congestion Control* M. Allman, V. Paxson, W. Stevens

RFC 2583 *Guidelines for Next Hop Client (NHC) Developers* R. Carlson, L. Winkler

RFC 2591 *Definitions of Managed Objects for Scheduling Management Operations* D. Levi, J. Schoenwaelder

RFC 2625 *IP and ARP over Fibre Channel* M. Rajagopal, R. Bhagwat, W. Rickard

RFC 2635 *Don't SPEW A Set of Guidelines for Mass Unsolicited Mailings and Postings (spam*)* S. Hambridge, A. Lunde

RFC 2637 *Point-to-Point Tunneling Protocol* K. Hamzeh, G. Pall, W. Verthein, J. Taarud, W. Little, G. Zorn

RFC 2640 *Internationalization of the File Transfer Protocol* B. Curtin

RFC 2665 *Definitions of Managed Objects for the Ethernet-like Interface Types* J. Flick, J. Johnson

RFC 2671 *Extension Mechanisms for DNS (EDNS0)* P. Vixie

RFC 2672 *Non-Terminal DNS Name Redirection* M. Crawford

RFC 2675 *IPv6 Jumbograms* D. Borman, S. Deering, R. Hinden

RFC 2710 *Multicast Listener Discovery (MLD) for IPv6* S. Deering, W. Fenner, B. Haberman

RFC 2711 *IPv6 Router Alert Option* C. Partridge, A. Jackson

RFC 2740 *OSPF for IPv6* R. Coltun, D. Ferguson, J. Moy

RFC 2753 *A Framework for Policy-based Admission Control* R. Yavatkar, D. Pendarakis, R. Guerin

RFC 2782 *A DNS RR for specifying the location of services (DNS SRV)* A. Gubrandsen, P. Vixix, L. Esibov

RFC 2821 *Simple Mail Transfer Protocol* J. Klensin, Ed.

RFC 2822 *Internet Message Format* P. Resnick, Ed.

RFC 2840 *TELNET KERMIT OPTION* J. Altman, F. da Cruz

RFC 2845 *Secret Key Transaction Authentication for DNS (TSIG)* P. Vixie, O. Gudmundsson, D. Eastlake 3rd, B. Wellington

RFC 2851 *Textual Conventions for Internet Network Addresses* M. Daniele, B. Haberman, S. Routhier, J. Schoenwaelder

RFC 2852 *Deliver By SMTP Service Extension* D. Newman

RFC 2874 *DNS Extensions to Support IPv6 Address Aggregation and Renumbering* M. Crawford, C. Huitema

RFC 2915 *The Naming Authority Pointer (NAPTR) DNS Resource Record* M. Mealling, R. Daniel

RFC 2920 *SMTP Service Extension for Command Pipelining* N. Freed

RFC 2930 *Secret Key Establishment for DNS (TKEY RR)* D. Eastlake, 3rd

RFC 2941 *Telnet Authentication Option* T. Ts'o, ed., J. Altman

RFC 2942 *Telnet Authentication: Kerberos Version 5* T. Ts'o

RFC 2946 *Telnet Data Encryption Option* T. Ts'o

RFC 2952 *Telnet Encryption: DES 64 bit Cipher Feedback* T. Ts'o

RFC 2953 *Telnet Encryption: DES 64 bit Output Feedback* T. Ts'o

RFC 2992 *Analysis of an Equal-Cost Multi-Path Algorithm* C. Hopps

RFC 3019 *IP Version 6 Management Information Base for The Multicast Listener Discovery Protocol* B. Haberman, R. Worzella

RFC 3060 *Policy Core Information Model—Version 1 Specification* B. Moore, E. Ellesson, J. Strassner, A. Westerinen

RFC 3152 *Delegation of IP6.ARPA* R. Bush

RFC 3164 *The BSD Syslog Protocol* C. Lonvick

RFC 3207 *SMTP Service Extension for Secure SMTP over Transport Layer Security* P. Hoffman

RFC 3226 *DNSSEC and IPv6 A6 aware server/resolver message size requirements* O. Gudmundsson

RFC 3291 *Textual Conventions for Internet Network Addresses* M. Daniele, B. Haberman, S. Routhier, J. Schoenwaelder

RFC 3363 *Representing Internet Protocol version 6 (IPv6) Addresses in the Domain Name System* R. Bush, A. Durand, B. Fink, O. Gudmundsson, T. Hain

RFC 3376 *Internet Group Management Protocol, Version 3* B. Cain, S. Deering, I. Kouvelas, B. Fenner, A. Thyagarajan

RFC 3390 *Increasing TCP's Initial Window* M. Allman, S. Floyd, C. Partridge

RFC 3410 *Introduction and Applicability Statements for Internet-Standard Management Framework* J. Case, R. Mundy, D. Partain, B. Stewart

RFC 3411 *An Architecture for Describing Simple Network Management Protocol (SNMP) Management Frameworks* D. Harrington, R. Presuhn, B. Wijnen

RFC 3412 *Message Processing and Dispatching for the Simple Network Management Protocol (SNMP)* J. Case, D. Harrington, R. Presuhn, B. Wijnen

RFC 3413 *Simple Network Management Protocol (SNMP) Applications* D. Levi, P. Meyer, B. Stewart

RFC 3414 *User-based Security Model (USM) for version 3 of the Simple Network Management Protocol (SNMPv3)* U. Blumenthal, B. Wijnen

RFC 3415 *View-based Access Control Model (VACM) for the Simple Network Management Protocol (SNMP)* B. Wijnen, R. Presuhn, K. McCloghrie

RFC 3416 *Version 2 of the Protocol Operations for the Simple Network Management Protocol (SNMP)* R. Presuhn, J. Case, K. McCloghrie, M. Rose, S. Waldbusser

RFC 3417 *Transport Mappings for the Simple Network Management Protocol (SNMP)* R. Presuhn, J. Case, K. McCloghrie, M. Rose, S. Waldbusser

RFC 3418 *Management Information Base (MIB) for the Simple Network Management Protocol (SNMP)* R. Presuhn, J. Case, K. McCloghrie, M. Rose, S. Waldbusser

RFC 3419 *Textual Conventions for Transport Addresses* M. Daniele, J. Schoenwaelder

RFC 3484 *Default Address Selection for Internet Protocol version 6 (IPv6)* R. Draves

RFC 3493 *Basic Socket Interface Extensions for IPv6* R. Gilligan, S. Thomson, J. Bound, J. McCann, W. Stevens

RFC 3513 *Internet Protocol Version 6 (IPv6) Addressing Architecture* R. Hinden, S. Deering

RFC 3526 *More Modular Exponential (MODP) Diffie-Hellman groups for Internet Key Exchange (IKE)* T. Kivinen, M. Kojo

RFC 3542 *Advanced Sockets Application Programming Interface (API) for IPv6* W. Richard Stevens, M. Thomas, E. Nordmark, T. Jinmei

RFC 3566 *The AES-XCBC-MAC-96 Algorithm and Its Use With IPsec* S. Frankel, H. Herbert

RFC 3569 *An Overview of Source-Specific Multicast (SSM)* S. Bhattacharyya, Ed.

RFC 3584 *Coexistence between Version 1, Version 2, and Version 3 of the Internet-standard Network Management Framework* R. Frye, D. Levi, S. Routhier, B. Wijnen

RFC 3602 *The AES-CBC Cipher Algorithm and Its Use with IPsec* S. Frankel, R. Glenn, S. Kelly

RFC 3629 *UTF-8, a transformation format of ISO 10646* R. Kermode, C. Vicisano

RFC 3658 *Delegation Signer (DS) Resource Record (RR)* O. Gudmundsson

RFC 3678 *Socket Interface Extensions for Multicast Source Filters* D. Thaler, B. Fenner, B. Quinn

RFC 3715 *IPsec-Network Address Translation (NAT) Compatibility Requirements* B. Aboba, W. Dixon

RFC 3810 *Multicast Listener Discovery Version 2 (MLDv2) for IPv6* R. Vida, Ed., L. Costa, Ed.

RFC 3947 *Negotiation of NAT-Traversal in the IKE* T. Kivinen, B. Swander, A. Huttunen, V. Volpe

RFC 3948 *UDP Encapsulation of IPsec ESP Packets* A. Huttunen, B. Swander, V. Volpe, L. DiBurro, M. Stenberg

RFC 4001 *Textual Conventions for Internet Network Addresses* M. Daniele, B. Haberman, S. Routhier, J. Schoenwaelder

RFC 4007 *IPv6 Scoped Address Architecture* S. Deering, B. Haberman, T. Jinmei, E. Nordmark, B. Zill

RFC 4022 *Management Information Base for the Transmission Control Protocol (TCP)* R. Raghunarayan

RFC 4106 *The Use of Galois/Counter Mode (GCM) in IPsec Encapsulating Security Payload (ESP)* J. Viega, D. McGrew

RFC 4109 *Algorithms for Internet Key Exchange version 1 (IKEv1)* P. Hoffman

RFC 4113 *Management Information Base for the User Datagram Protocol (UDP)* B. Fenner, J. Flick

RFC 4191 *Default Router Preferences and More-Specific Routes* R. Draves, D. Thaler

RFC 4217 *Securing FTP with TLS* P. Ford-Hutchinson

RFC 4292 *IP Forwarding Table MIB* B. Haberman

RFC 4293 *Management Information Base for the Internet Protocol (IP)* S. Routhier

RFC 4301 *Security Architecture for the Internet Protocol* S. Kent, K. Seo

RFC 4302 *IP Authentication Header* S. Kent

RFC 4303 *IP Encapsulating Security Payload (ESP)* S. Kent

RFC 4304 *Extended Sequence Number (ESN) Addendum to IPsec Domain of Interpretation (DOI) for Internet Security Association and Key Management Protocol (ISAKMP)* S. Kent

RFC 4306 *Internet Key Exchange (IKEv2) Protocol* C. Kaufman, Ed.

RFC 4307 *Cryptographic Algorithms for Use in the Internet Key Exchange Version 2 (IKEv2)* J. Schiller

RFC 4308 *Cryptographic Suites for IPsec* P. Hoffman

RFC 4434 *The AES-XCBC-PRF-128 Algorithm for the Internet Key Exchange Protocol* P. Hoffman

RFC 4552 *Authentication/Confidentiality for OSPFv3* M. Gupta, N. Melam

RFC 4678 *Server/Application State Protocol v1* A. Bivens

RFC 4718 *IKEv2 Clarifications and Implementation Guidelines* P. Eronen, P. Hoffman

RFC 4753 *ECP Groups for IKE and IKEv2* D. Fu, J. Solinas

RFC 4754 *IKE and IKEv2 Authentication Using the Elliptic Curve Digital Signature Algorithm (ECDSA)* D. Fu, J. Solinas

RFC 4809	*Requirements for an IPsec Certificate Management Profile* C. Bonatti, Ed., S. Turner, Ed., G. Lebovitz, Ed.
RFC 4835	*Cryptographic Algorithm Implementation Requirements for Encapsulating Security Payload (ESP) and Authentication Header* V. Manral
RFC 4862	*IPv6 Stateless Address Autoconfiguration* S. Thomson, T. Narten, T. Jinmei
RFC 4868	*Using HMAC-SHA-256, HMAC-SHA-384, and HMAC-SHA-512 with IPsec* S. Kelly, S. Frankel
RFC 4869	*Suite B Cryptographic Suites for IPsec* L. Law, J. Solinas
RFC 4941	*Privacy Extensions for Stateless Address Autoconfiguration in IPv6* T. Narten, R. Draves, S. Krishnan
RFC 4945	*The Internet IP Security PKI Profile of IKEv1/ISAKMP, IKEv2, and PKIX* B. Korver
RFC 5014	*IPv6 Socket API for Source Address Selection* E. Nordmark, S. Chakrabarti, J. Laganier
RFC 5095	*Deprecation of Type 0 Routing Headers in IPv6* J. Abley, P. Savola, G. Neville-Neil
RFC 5175	*IPv6 Router Advertisement Flags Option* B. Haberman, Ed., R. Hinden
RFC 5282	*Using Authenticated Encryption Algorithms with the Encrypted Payload of the Internet Key Exchange version 2 (IKEv2) Protocol* D. Black, D. McGrew

Internet drafts

Internet drafts are working documents of the Internet Engineering Task Force (IETF), its areas, and its working groups. Other groups may also distribute working documents as Internet drafts. You can see Internet drafts at http://www.ietf.org/ID.html.

Several areas of IPv6 implementation include elements of the following Internet drafts and are subject to change during the RFC review process.

Draft Title and Author

draft-ietf-ipngwg-icmp-v3-07
Internet Control Message Protocol (ICMPv6) for the Internet Protocol Version 6 (IPv6) Specification A. Conta, S. Deering

Appendix G. Accessibility

Publications for this product are offered in Adobe® Portable Document Format (PDF) and should be compliant with accessibility standards. If you experience difficulties when using PDF files, you may view the information through the z/OS Internet Library Web site or the z/OS Information Center. If you continue to experience problems, send an e-mail to mhvrcfs@us.ibm.com or write to:

IBM Corporation
Attention: MHVRCFS Reader Comments
Department H6MA, Mail Station P181
2455 South Road
Poughkeepsie, NY 12601-5400
U.S.A.

Accessibility features help a user who has a physical disability, such as restricted mobility or limited vision, to use software products successfully. The major accessibility features in z/OS enable users to:

- Use assistive technologies such as screen readers and screen magnifier software
- Operate specific or equivalent features using only the keyboard
- Customize display attributes such as color, contrast, and font size

Using assistive technologies

Assistive technology products, such as screen readers, function with the user interfaces found in z/OS. Consult the assistive technology documentation for specific information when using such products to access z/OS interfaces.

Keyboard navigation of the user interface

Users can access z/OS user interfaces using TSO/E or ISPF. Refer to *z/OS TSO/E Primer*, *z/OS TSO/E User's Guide*, and *z/OS ISPF User's Guide Vol I* for information about accessing TSO/E and ISPF interfaces. These guides describe how to use TSO/E and ISPF, including the use of keyboard shortcuts or function keys (PF keys). Each guide includes the default settings for the PF keys and explains how to modify their functions.

z/OS information

z/OS information is accessible using screen readers with the BookServer/Library Server versions of z/OS books in the Internet library at www.ibm.com/systems/z/os/zos/bkserv/.

© Copyright IBM Corp. 1989, 2010

Notices

This information was developed for products and services offered in the USA.

IBM may not offer all of the products, services, or features discussed in this document in other countries. Consult your local IBM representative for information on the products and services currently available in your area. Any reference to an IBM product, program, or service is not intended to state or imply that only that IBM product, program, or service may be used. Any functionally equivalent product, program, or service that does not infringe any IBM intellectual property right may be used instead. However, it is the user's responsibility to evaluate and verify the operation of any non-IBM product, program, or service.

IBM may have patents or pending patent applications covering subject matter described in this document. The furnishing of this document does not give you any license to these patents. You can send license inquiries, in writing, to:

IBM Director of Licensing
IBM Corporation
North Castle Drive
Armonk, NY 10504-1785
U.S.A.

For license inquiries regarding double-byte (DBCS) information, contact the IBM Intellectual Property Department in your country or send inquiries, in writing, to:

Intellectual Property Licensing
Legal and Intellectual Property Law
IBM Japan Ltd.
1623-14 Shimotsuruma,, Yamato-Shi
Kanagawa 242-8502 Japan

The following paragraph does not apply to the United Kingdom or any other country where such provisions are inconsistent with local law:
INTERNATIONAL BUSINESS MACHINES CORPORATION PROVIDES THIS PUBLICATION "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF NON-INFRINGEMENT, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Some states do not allow disclaimer of express or implied warranties in certain transactions, therefore, this statement may not apply to you.

This information could include technical inaccuracies or typographical errors. Changes are periodically made to the information herein; these changes will be incorporated in new editions of the publication. IBM may make improvements and/or changes in the product(s) and/or the program(s) described in this publication at any time without notice.

Any references in this information to non-IBM Web sites are provided for convenience only and do not in any manner serve as an endorsement of those Web sites. The materials at those Web sites are not part of the materials for this IBM product and use of those Web sites is at your own risk.

© Copyright IBM Corp. 1989, 2010

IBM may use or distribute any of the information you supply in any way it believes appropriate without incurring any obligation to you.

Licensees of this program who wish to have information about it for the purpose of enabling: (i) the exchange of information between independently created programs and other programs (including this one) and (ii) the mutual use of the information which has been exchanged, should contact:

Site Counsel
IBM Corporation
P.O. Box 12195
3039 Cornwallis Road
Research Triangle Park, North Carolina 27709-2195
U.S.A

Such information may be available, subject to appropriate terms and conditions, including in some cases, payment of a fee.

The licensed program described in this information and all licensed material available for it are provided by IBM under terms of the IBM Customer Agreement, IBM International Program License Agreement, or any equivalent agreement between us.

Any performance data contained herein was determined in a controlled environment. Therefore, the results obtained in other operating environments may vary significantly. Some measurements may have been made on development-level systems and there is no guarantee that these measurements will be the same on generally available systems. Furthermore, some measurement may have been estimated through extrapolation. Actual results may vary. Users of this document should verify the applicable data for their specific environment.

Information concerning non-IBM products was obtained from the suppliers of those products, their published announcements or other publicly available sources. IBM has not tested those products and cannot confirm the accuracy of performance, compatibility or any other claims related to non-IBM products. Questions on the capabilities of non-IBM products should be addressed to the suppliers of those products.

All statements regarding IBM's future direction or intent are subject to change or withdrawal without notice, and represent goals and objectives only.

This information contains examples of data and reports used in daily business operations. To illustrate them as completely as possible, the examples include the names of individuals, companies, brands, and products. All of these names are fictitious and any similarity to the names and addresses used by an actual business enterprise is entirely coincidental.

COPYRIGHT LICENSE:

This information contains sample application programs in source language, which illustrates programming techniques on various operating platforms. You may copy, modify, and distribute these sample programs in any form without payment to IBM, for the purposes of developing, using, marketing or distributing application programs conforming to the application programming interface for the operating platform for which the sample programs are written. These examples have not been thoroughly tested under all conditions. IBM, therefore, cannot guarantee or

imply reliability, serviceability, or function of these programs. The sample programs are provided "AS IS", without warranty of any kind. IBM shall not be liable for any damages arising out of your use of the sample programs.

Each copy or any portion of these sample programs or any derivative work must include a copyright notice as follows:

© (your company name) (year). Portions of this code are derived from IBM Corp. Sample Programs. © Copyright IBM Corp. _enter the year or years_.

IBM is required to include the following statements in order to distribute portions of this document and the software described herein to which contributions have been made by The University of California. Portions herein © Copyright 1979, 1980, 1983, 1986, Regents of the University of California. Reproduced by permission. Portions herein were developed at the Electrical Engineering and Computer Sciences Department at the Berkeley campus of the University of California under the auspices of the Regents of the University of California.

Portions of this publication relating to RPC are Copyright © Sun Microsystems, Inc., 1988, 1989.

Some portions of this publication relating to X Window System** are Copyright © 1987, 1988 by Digital Equipment Corporation, Maynard, Massachusetts, and the Massachusetts Institute Of Technology, Cambridge, Massachusetts. All Rights Reserved.

Some portions of this publication relating to X Window System are Copyright © 1986, 1987, 1988 by Hewlett-Packard Corporation.

Permission to use, copy, modify, and distribute the M.I.T., Digital Equipment Corporation, and Hewlett-Packard Corporation portions of this software and its documentation for any purpose without fee is hereby granted, provided that the above copyright notice appears in all copies and that both that copyright notice and this permission notice appear in supporting documentation, and that the names of M.I.T., Digital, and Hewlett-Packard not be used in advertising or publicity pertaining to distribution of the software without specific, written prior permission. M.I.T., Digital, and Hewlett-Packard make no representation about the suitability of this software for any purpose. It is provided ″as is″ without express or implied warranty.

Copyright © 1983, 1995-1997 Eric P. Allman

Copyright © 1988, 1993 The Regents of the University of California. All rights reserved.

Redistribution and use in source and binary forms, with or without modification, are permitted provided that the following conditions are met:

1. Redistributions of source code must retain the above copyright notice, this list of conditions and the following disclaimer.
2. Redistributions in binary form must reproduce the above copyright notice, this list of conditions and the following disclaimer in the documentation and/or other materials provided with the distribution.
3. All advertising materials mentioning features or use of this software must display the following acknowledgement:

```
This product includes software developed by the University of
California, Berkeley and its contributors.
```

4. Neither the name of the University nor the names of its contributors may be used to endorse or promote products derived from this software without specific prior written permission.

THIS SOFTWARE IS PROVIDED BY THE REGENTS AND CONTRIBUTORS ``AS IS'' AND ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE DISCLAIMED. IN NO EVENT SHALL THE REGENTS OR CONTRIBUTORS BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

This software program contains code, and/or derivatives or modifications of code originating from the software program "Popper." Popper is Copyright ©1989-1991 The Regents of the University of California, All Rights Reserved. Popper was created by Austin Shelton, Information Systems and Technology, University of California, Berkeley.

Permission from the Regents of the University of California to use, copy, modify, and distribute the "Popper" software contained herein for any purpose, without fee, and without a written agreement is hereby granted, provided that the above copyright notice and this paragraph and the following two paragraphs appear in all copies. HOWEVER, ADDITIONAL PERMISSIONS MAY BE NECESSARY FROM OTHER PERSONS OR ENTITIES, TO USE DERIVATIVES OR MODIFICATIONS OF POPPER.

IN NO EVENT SHALL THE UNIVERSITY OF CALIFORNIA BE LIABLE TO ANY PARTY FOR DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, INCLUDING LOST PROFITS, ARISING OUT OF THE USE OF THE POPPER SOFTWARE, OR ITS DERIVATIVES OR MODIFICATIONS, AND ITS DOCUMENTATION, EVEN IF THE UNIVERSITY OF CALIFORNIA HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

THE UNIVERSITY OF CALIFORNIA SPECIFICALLY DISCLAIMS ANY WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THE POPPER SOFTWARE PROVIDED HEREUNDER IS ON AN "AS IS" BASIS, AND THE UNIVERSITY OF CALIFORNIA HAS NO OBLIGATIONS TO PROVIDE MAINTENANCE, SUPPORT, UPDATES, ENHANCEMENTS, OR MODIFICATIONS.

Copyright © 1983 The Regents of the University of California. All rights reserved.

Redistribution and use in source and binary forms are permitted provided that the above copyright notice and this paragraph are duplicated in all such forms and that any documentation, advertising materials, and other materials related to such distribution and use acknowledge that the software was developed by the University of California, Berkeley. The name of the University may not be used to

endorse or promote products derived from this software without specific prior written permission. THIS SOFTWARE IS PROVIDED ``AS IS'' AND WITHOUT ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, WITHOUT LIMITATION, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

Copyright © 1991, 1993 The Regents of the University of California. All rights reserved.

Redistribution and use in source and binary forms, with or without modification, are permitted provided that the following conditions are met:

1. Redistributions of source code must retain the above copyright notice, this list of conditions and the following disclaimer.
2. Redistributions in binary form must reproduce the above copyright notice, this list of conditions and the following disclaimer in the documentation and/or other materials provided with the distribution.
3. All advertising materials mentioning features or use of this software must display the following acknowledgement:

   `This product includes software developed by the University of California, Berkeley and its contributors.`
4. Neither the name of the University nor the names of its contributors may be used to endorse or promote products derived from this software without specific prior written permission.

THIS SOFTWARE IS PROVIDED BY THE REGENTS AND CONTRIBUTORS ``AS IS'' AND ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE DISCLAIMED. IN NO EVENT SHALL THE REGENTS OR CONTRIBUTORS BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

Copyright © 1990 by the Massachusetts Institute of Technology

Export of this software from the United States of America may require a specific license from the United States Government. It is the responsibility of any person or organization contemplating export to obtain such a license before exporting.

WITHIN THAT CONSTRAINT, permission to use, copy, modify, and distribute this software and its documentation for any purpose and without fee is hereby granted, provided that the above copyright notice appear in all copies and that both that copyright notice and this permission notice appear in supporting documentation, and that the name of M.I.T. not be used in advertising or publicity pertaining to distribution of the software without specific, written prior permission. Furthermore if you modify this software you must label your software as modified software and not distribute it in such a fashion that it might be confused with the original M.I.T. software. M.I.T. makes no representations about the suitability of this software for any purpose. It is provided ″as is″ without express or implied warranty.

Copyright © 1998 by the FundsXpress, INC. All rights reserved.

Export of this software from the United States of America may require a specific license from the United States Government. It is the responsibility of any person or organization contemplating export to obtain such a license before exporting.

WITHIN THAT CONSTRAINT, permission to use, copy, modify, and distribute this software and its documentation for any purpose and without fee is hereby granted, provided that the above copyright notice appear in all copies and that both that copyright notice and this permission notice appear in supporting documentation, and that the name of FundsXpress not be used in advertising or publicity pertaining to distribution of the software without specific, written prior permission. FundsXpress makes no representations about the suitability of this software for any purpose. It is provided ″as is″ without express or implied warranty.

THIS SOFTWARE IS PROVIDED ``AS IS'' AND WITHOUT ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, WITHOUT LIMITATION, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

Copyright © 1999, 2000 Internet Software Consortium.

Permission to use, copy, modify, and distribute this software for any purpose with or without fee is hereby granted, provided that the above copyright notice and this permission notice appear in all copies.

THE SOFTWARE IS PROVIDED ″AS IS″ AND INTERNET SOFTWARE CONSORTIUM DISCLAIMS ALL WARRANTIES WITH REGARD TO THIS SOFTWARE INCLUDING ALL IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS. IN NO EVENT SHALL INTERNET SOFTWARE CONSORTIUM BE LIABLE FOR ANY SPECIAL, DIRECT, INDIRECT, OR CONSEQUENTIAL DAMAGES OR ANY DAMAGES WHATSOEVER RESULTING FROM LOSS OF USE, DATA OR PROFITS, WHETHER IN AN ACTION OF CONTRACT, NEGLIGENCE OR OTHER TORTIOUS ACTION, ARISING OUT OF OR IN CONNECTION WITH THE USE OR PERFORMANCE OF THIS SOFTWARE.

Copyright © 1995-1998 Eric Young (eay@cryptsoft.com) All rights reserved.

This package is an SSL implementation written by Eric Young (eay@cryptsoft.com). The implementation was written so as to conform with Netscape's SSL.

This library is free for commercial and non-commercial use as long as the following conditions are adhered to. The following conditions apply to all code found in this distribution, be it the RC4, RSA, lhash, DES, etc., code; not just the SSL code. The SSL documentation included with this distribution is covered by the same copyright terms except that the holder is Tim Hudson (tjh@cryptsoft.com).

Copyright remains Eric Young's, and as such any Copyright notices in the code are not to be removed. If this package is used in a product, Eric Young should be given attribution as the author of the parts of the library used. This can be in the form of a textual message at program startup or in documentation (online or textual) provided with the package.

Redistribution and use in source and binary forms, with or without modification, are permitted provided that the following conditions are met:

1. Redistributions of source code must retain the copyright notice, this list of conditions and the following disclaimer.
2. Redistributions in binary form must reproduce the above copyright notice, this list of conditions and the following disclaimer in the documentation and/or other materials provided with the distribution.
3. All advertising materials mentioning features or use of this software must display the following acknowledgement: "This product includes cryptographic software written by Eric Young (eay@cryptsoft.com)". The word 'cryptographic' can be left out if the routines from the library being used are not cryptographic related.
4. If you include any Windows specific code (or a derivative thereof) from the apps directory (application code) you must include acknowledgement:

   "This product includes software written by Tim Hudson (tjh@cryptsoft.com)"

THIS SOFTWARE IS PROVIDED BY ERIC YOUNG ``AS IS'' AND ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE DISCLAIMED. IN NO EVENT SHALL THE AUTHOR OR CONTRIBUTORS BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

The license and distribution terms for any publicly available version or derivative of this code cannot be changed. i.e. this code cannot simply be copied and put under another distribution license [including the GNU Public License.]

This product includes cryptographic software written by Eric Young.

Copyright © 1999, 2000 Internet Software Consortium.

Permission to use, copy, modify, and distribute this software for any purpose with or without fee is hereby granted, provided that the above copyright notice and this permission notice appear in all copies.

THE SOFTWARE IS PROVIDED "AS IS" AND INTERNET SOFTWARE CONSORTIUM DISCLAIMS ALL WARRANTIES WITH REGARD TO THIS SOFTWARE INCLUDING ALL IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS. IN NO EVENT SHALL INTERNET SOFTWARE CONSORTIUM BE LIABLE FOR ANY SPECIAL, DIRECT, INDIRECT, OR CONSEQUENTIAL DAMAGES OR ANY DAMAGES WHATSOEVER RESULTING FROM LOSS OF USE, DATA OR PROFITS, WHETHER IN AN ACTION OF CONTRACT, NEGLIGENCE OR OTHER TORTIOUS ACTION, ARISING OUT OF OR IN CONNECTION WITH THE USE OR PERFORMANCE OF THIS SOFTWARE.

The IBM implementation of the Resource Reservation Setup Protocol API (RAPI) described in this document is derived from the Resource Reservation Setup Protocol API (RAPI) specification, The Open Group Document Number C809, ISBN 185912264, published by The Open Group, December 1998.

The specification document is copyrighted by The Open Group. See The Open Group Web site at http://www.opengroup.org/publications/catalog/c809.htm for the source of the specification. See *z/OS Communications Server: IP Programmer's Guide and Reference* for details about IBM use of this information.

Copyright © 2004 IBM Corporation and its licensors, including Sendmail, Inc., and the Regents of the University of California. All rights reserved.

Copyright © 1999,2000,2001 Compaq Computer Corporation

Copyright © 1999,2000,2001 Hewlett-Packard Company

Copyright © 1999,2000,2001 IBM Corporation

Copyright © 1999,2000,2001 Hummingbird Communications Ltd.

Copyright © 1999,2000,2001 Silicon Graphics, Inc.

Copyright © 1999,2000,2001 Sun Microsystems, Inc.

Copyright © 1999,2000,2001 The Open Group

All rights reserved.

Permission is hereby granted, free of charge, to any person obtaining a copy of this software and associated documentation files (the "Software"), to deal in the Software without restriction, including without limitation the rights to use, copy, modify, merge, publish, distribute, and/or sell copies of the Software, and to permit persons to whom the Software is furnished to do so, provided that the above copyright notice(s) and this permission notice appear in all copies of the Software and that both the above copyright notice(s) and this permission notice appear in supporting documentation.

THE SOFTWARE IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT OF THIRD PARTY RIGHTS. IN NO EVENT SHALL THE COPYRIGHT HOLDER OR HOLDERS INCLUDED IN THIS NOTICE BE LIABLE FOR ANY CLAIM, OR ANY SPECIAL INDIRECT OR CONSEQUENTIAL DAMAGES, OR ANY DAMAGES WHATSOEVER RESULTING FROM LOSS OF USE, DATA OR PROFITS, WHETHER IN AN ACTION OF CONTRACT, NEGLIGENCE OR OTHER TORTIOUS ACTION, ARISING OUT OF OR IN CONNECTION WITH THE USE OR PERFORMANCE OF THIS SOFTWARE.

Except as contained in this notice, the name of a copyright holder shall not be used in advertising or otherwise to promote the sale, use or other dealings in this Software without prior written authorization of the copyright holder.

X Window System is a trademark of The Open Group.

If you are viewing this information softcopy, the photographs and color illustrations may not appear.

You can obtain softcopy from the z/OS Collection (SK3T-4269), which contains BookManager and PDF formats.

Programming interface information

This publication documents intended Programming Interfaces that allow the customer to write programs to obtain the services of z/OS Communications Server.

Policy for unsupported hardware

Various z/OS elements, such as DFSMS, HCD, JES2, JES3, and MVS, contain code that supports specific hardware servers or devices. In some cases, this device-related element support remains in the product even after the hardware devices pass their announced End of Service date. z/OS may continue to service element code; however, it will not provide service related to unsupported hardware devices. Software problems related to these devices will not be accepted for service, and current service activity will cease if a problem is determined to be associated with out-of-support devices. In such cases, fixes will not be issued.

Trademarks

IBM, the IBM logo, and ibm.com are trademarks or registered trademarks of International Business Machines Corp., registered in many jurisdictions worldwide. Other product and service names might be trademarks of IBM or other companies. A current list of IBM trademarks is available on the Web at Copyright and trademark information at www.ibm.com/legal/copytrade.shtml.

Adobe and PostScript are registered trademarks of Adobe Systems Incorporated in the United States, and/or other countries.

Intel is a registered trademark of Intel Corporation or its subsidiaries in the United States and other countries.

Java and all Java-based trademarks and logos are trademarks of Sun Microsystems, Inc. in the United States, other countries, or both.

Linux is a registered trademark of Linus Torvalds in the United States, other countries, or both.

Microsoft and Windows are trademarks of Microsoft Corporation in the United States, other countries, or both.

UNIX is a registered trademark of The Open Group in the United States and other countries.

Other product and service names might be trademarks of IBM or other companies.

Bibliography

This bibliography contains descriptions of the documents in the z/OS Communications Server library.

z/OS Communications Server documentation is available in the following forms:

- Online at the z/OS Internet Library web page at www.ibm.com/systems/z/os/zos/bkserv/
- In softcopy on CD-ROM collections. See "Softcopy information" on page xxv.

z/OS Communications Server library updates

An index to z/OS Communications Server book updates is at http://www.ibm.com/support/docview.wss?uid=swg21178966. Updates to documents are also available on RETAIN® and in information APARs (info APARs). Go to http://www.ibm.com/software/network/commserver/zos/support to view information APARs. In addition, Info APARs for z/OS documents are in *z/OS and z/OS.e DOC APAR and PTF ++HOLD Documentation*, which can be found at http://publibz.boulder.ibm.com/cgi-bin/bookmgr_OS390/ BOOKS/ZIDOCMST/CCONTENTS.

z/OS Communications Server information

z/OS Communications Server product information is grouped by task in the following tables.

Planning

Title	Number	Description
z/OS Communications Server: New Function Summary	GC31-8771	This document is intended to help you plan for new IP for SNA function, whether you are migrating from a previous version or installing z/OS for the first time. It summarizes what is new in the release and identifies the suggested and required modifications needed to use the enhanced functions.
z/OS Communications Server: IPv6 Network and Application Design Guide	SC31-8885	This document is a high-level introduction to IPv6. It describes concepts of z/OS Communications Server's support of IPv6, coexistence with IPv4, and migration issues.

Resource definition, configuration, and tuning

Title	Number	Description
z/OS Communications Server: IP Configuration Guide	SC31-8775	This document describes the major concepts involved in understanding and configuring an IP network. Familiarity with the z/OS operating system, IP protocols, z/OS UNIX System Services, and IBM Time Sharing Option (TSO) is recommended. Use this document in conjunction with the *z/OS Communications Server: IP Configuration Reference*.

© Copyright IBM Corp. 1989, 2010

Title	Number	Description
z/OS Communications Server: IP Configuration Reference	SC31-8776	This document presents information for people who want to administer and maintain IP. Use this document in conjunction with the *z/OS Communications Server: IP Configuration Guide*. The information in this document includes: • TCP/IP configuration data sets • Configuration statements • Translation tables • Protocol number and port assignments
z/OS Communications Server: SNA Network Implementation Guide	SC31-8777	This document presents the major concepts involved in implementing an SNA network. Use this document in conjunction with the *z/OS Communications Server: SNA Resource Definition Reference*.
z/OS Communications Server: SNA Resource Definition Reference	SC31-8778	This document describes each SNA definition statement, start option, and macroinstruction for user tables. It also describes NCP definition statements that affect SNA. Use this document in conjunction with the *z/OS Communications Server: SNA Network Implementation Guide*.
z/OS Communications Server: SNA Resource Definition Samples	SC31-8836	This document contains sample definitions to help you implement SNA functions in your networks, and includes sample major node definitions.
z/OS Communications Server: IP Network Print Facility	SC31-8833	This document is for system programmers and network administrators who need to prepare their network to route SNA, JES2, or JES3 printer output to remote printers using TCP/IP Services.

Operation

Title	Number	Description
z/OS Communications Server: IP User's Guide and Commands	SC31-8780	This document describes how to use TCP/IP applications. It contains requests that allow a user to log on to a remote host using Telnet, transfer data sets using FTP, send and receive electronic mail, print on remote printers, and authenticate network users.
z/OS Communications Server: IP System Administrator's Commands	SC31-8781	This document describes the functions and commands helpful in configuring or monitoring your system. It contains system administrator's commands, such as TSO NETSTAT, PING, TRACERTE and their UNIX counterparts. It also includes TSO and MVS commands commonly used during the IP configuration process.
z/OS Communications Server: SNA Operation	SC31-8779	This document serves as a reference for programmers and operators requiring detailed information about specific operator commands.
z/OS Communications Server: Quick Reference	SX75-0124	This document contains essential information about SNA and IP commands.

Customization

Title	Number	Description
z/OS Communications Server: SNA Customization	SC31-6854	This document enables you to customize SNA, and includes the following: • Communication network management (CNM) routing table • Logon-interpret routine requirements • Logon manager installation-wide exit routine for the CLU search exit • TSO/SNA installation-wide exit routines • SNA installation-wide exit routines

Writing application programs

Title	Number	Description
z/OS Communications Server: IP Sockets Application Programming Interface Guide and Reference	SC31-8788	This document describes the syntax and semantics of program source code necessary to write your own application programming interface (API) into TCP/IP. You can use this interface as the communication base for writing your own client or server application. You can also use this document to adapt your existing applications to communicate with each other using sockets over TCP/IP.
z/OS Communications Server: IP CICS Sockets Guide	SC31-8807	This document is for programmers who want to set up, write application programs for, and diagnose problems with the socket interface for CICS using z/OS TCP/IP.
z/OS Communications Server: IP IMS Sockets Guide	SC31-8830	This document is for programmers who want application programs that use the IMS TCP/IP application development services provided by the TCP/IP Services of IBM.
z/OS Communications Server: IP Programmer's Guide and Reference	SC31-8787	This document describes the syntax and semantics of a set of high-level application functions that you can use to program your own applications in a TCP/IP environment. These functions provide support for application facilities, such as user authentication, distributed databases, distributed processing, network management, and device sharing. Familiarity with the z/OS operating system, TCP/IP protocols, and IBM Time Sharing Option (TSO) is recommended.
z/OS Communications Server: SNA Programming	SC31-8829	This document describes how to use SNA macroinstructions to send data to and receive data from (1) a terminal in either the same or a different domain, or (2) another application program in either the same or a different domain.
z/OS Communications Server: SNA Programmer's LU 6.2 Guide	SC31-8811	This document describes how to use the SNA LU 6.2 application programming interface for host application programs. This document applies to programs that use only LU 6.2 sessions or that use LU 6.2 sessions along with other session types. (Only LU 6.2 sessions are covered in this document.)
z/OS Communications Server: SNA Programmer's LU 6.2 Reference	SC31-8810	This document provides reference material for the SNA LU 6.2 programming interface for host application programs.
z/OS Communications Server: CSM Guide	SC31-8808	This document describes how applications use the communications storage manager.

Title	Number	Description
z/OS Communications Server: CMIP Services and Topology Agent Guide	SC31-8828	This document describes the Common Management Information Protocol (CMIP) programming interface for application programmers to use in coding CMIP application programs. The document provides guide and reference information about CMIP services and the SNA topology agent.

Diagnosis

Title	Number	Description
z/OS Communications Server: IP Diagnosis Guide	GC31-8782	This document explains how to diagnose TCP/IP problems and how to determine whether a specific problem is in the TCP/IP product code. It explains how to gather information for and describe problems to the IBM Software Support Center.
z/OS Communications Server: ACF/TAP Trace Analysis Handbook	GC23-8588-00	This document explains how to gather the trace data that is collected and stored in the host processor. It also explains how to use the Advanced Communications Function/Trace Analysis Program (ACF/TAP) service aid to produce reports for analyzing the trace data information.
z/OS Communications Server: SNA Diagnosis Vol 1, Techniques and Procedures and *z/OS Communications Server: SNA Diagnosis Vol 2, FFST Dumps and the VIT*	GC31-6850 GC31-6851	These documents help you identify an SNA problem, classify it, and collect information about it before you call the IBM Support Center. The information collected includes traces, dumps, and other problem documentation.
z/OS Communications Server: SNA Data Areas Volume 1 and *z/OS Communications Server: SNA Data Areas Volume 2*	GC31-6852 GC31-6853	These documents describe SNA data areas and can be used to read an SNA dump. They are intended for IBM programming service representatives and customer personnel who are diagnosing problems with SNA.

Messages and codes

Title	Number	Description
z/OS Communications Server: SNA Messages	SC31-8790	This document describes the ELM, IKT, IST, IUT, IVT, and USS messages. Other information in this document includes: • Command and RU types in SNA messages • Node and ID types in SNA messages • Supplemental message-related information
z/OS Communications Server: IP Messages Volume 1 (EZA)	SC31-8783	This volume contains TCP/IP messages beginning with EZA.
z/OS Communications Server: IP Messages Volume 2 (EZB, EZD)	SC31-8784	This volume contains TCP/IP messages beginning with EZB or EZD.
z/OS Communications Server: IP Messages Volume 3 (EZY)	SC31-8785	This volume contains TCP/IP messages beginning with EZY.
z/OS Communications Server: IP Messages Volume 4 (EZZ, SNM)	SC31-8786	This volume contains TCP/IP messages beginning with EZZ and SNM.
z/OS Communications Server: IP and SNA Codes	SC31-8791	This document describes codes and other information that appear in z/OS Communications Server messages.

Index

A

abbreviations and acronyms 921
abend U4093, user 909
abends
  C program 113
  errno value dependency 113
  return values 113
  RTL functions 113
  SCEERUN 113
  uninitialized storage 114
ACCEPT (call) 473
ACCEPT (macro) 271
accept() 117
accessibility 945
addr parameter on C socket calls
  on accept() 117
  on gethostbyaddr() 135
address families 8
address parameter on TCP/UDP/IP (pascal), on gethoststring 834
address, loopback 22
addressing sockets in internet domain 9
addressing within sockets, network byte order 11
addrlen parameter on C socket calls
  on accept() 117
  on gethostbyaddr() 135
AddUserNote 831
AF parameter on call interface, on SOCKET 607
AF parameter on macro interface, on socket 414
AF_INET 27
AF_INET address family 9, 12, 911
AF_IUCV 27
AF_IUCV address family 911
ALET parameter on macro socket interface
  on RECV 367
  on RECVFROM 371
  on SEND 386
  on SENDTO 392
  on WRITE 420
allocate, socket call 27
AmountOfTime parameter on TCP/UDP/IP (Pascal) , on SetTimer 846
APITYPE parameter on macro interface, INITAPI call 345
application program, organizing 15
applications program interface (API)
  C language API 105
  Pascal language API 817
arg parameter on C socket calls
  on fcntl() 131
  on ioctl() 170
Assembler Callable Services, z/OS UNIX, general description 8
assembler calls 828
assembler programs, macro instructions 271
asynchronous communication, (Pascal API) 817
asynchronous ECB routine 267
asynchronous exit routine 267
asynchronous macro, coding example 269
asynchronous select 50
AtoETable parameter on TCP/UDP/IP (Pascal), on ReadXlateTable 843
ATTACH supervisor call instruction 39, 52

B

backlog parameter on C socket call, listen() 172
BACKLOG parameter on call interface, LISTEN call 552
BACKLOG parameter on macro interface, LISTEN call 357
BeginTcpIp (Pascal) 831
Berkeley socket implementation 114
bind () 119
BIND (call) 475
BIND (macro) 274
BIND2ADDRSEL (call) 478
BIND2ADDRSEL (macro) 278
bit set macros on C socket calls
  FD_CLR 187
  FD_ISSET 187
  FD_SET 187
  FD_ZERO 187
bit-mask on call interface, on EZACIC06 call 619
bit-mask-length on call interface, on EZACIC06 call 620
buf parameter on C socket calls
  on read() 177
  on recv() 180
  on recvfrom() 182
  on write() 218
BUF parameter on call socket interface
  on GETIBMOPT 507
  on READ 557
  on RECV 561
  on RECVFROM 564
  on SEND 581
  on SENDTO 588
  on WRITE 612
BUF parameter on macro socket interface
  on GETIBMOPT 309
  on RECV 367
  on RECVFROM 369
  on SEND 386
  on SENDTO 392
  on WRITE 420
Buffer parameter on TCP/UDP/IP (Pascal) procedure
  on MonQuery 838
  on RawIpReceive 841
  on RawIpSend 842
  on TcpFReceive, TcpReceive, TcpWaitReceive 848
  on TcpFSend, TcpSend, TcpWaitSend 850
bufferaddress parameter on TCP/UDP/IP (Pascal) procedure
  on UdpNReceive 857
  on UdpSend 859
BufferLength parameter on TCP/UDP/IP (Pascal) interface
  on RawIpReceive 841
  on TcpFSend, TcpSend, TcpWaitSend 851
  on UdpNReceive 857
BUFFERspaceAVAILABLE (Pascal) 824
bufSize parameter on TCP/UDP/IP (Pascal), on MonQuery 838
byte order parameter on C socket calls
  on htonl() 162
  on htons() 163
  on ntohl() 175

© Copyright IBM Corp. 1989, 2010

byte order parameter on C socket calls *(continued)*
on ntohs() 176
byte ordering convention
big endian 11
little endian 11
BytesRead parameter on TCP&slr;UDP&slr;IP (Pascal)
procedure, on TcpFReceive, TcpReceive,
TcpWaitReceive</idxterm> 848
BytesToRead 821
BytesToRead parameter on TCP/UDP/IP (Pascal)
procedure 848

C

C applications
compiling and link-editing non-reentrant modules 106
compiling and link-editing reentrant modules 109
C socket application programming interface 105
C socket call syntax 115
C socket calls
accept()
description 117
example 118
return values 118
use example 117
bind()
AF_INET domain example 121
AF_IUCV domain example 122
created in the AF_INET domain 119
created in the AF_IUCV domain 120
description 119
return values 120
use example 30
close()
description 123
example 123
return values 123
connect()
description 124
Examples 126
return values 125
Servers, AF_INET domain 124
Servers, AF_IUCV domain 125
endhostent() 127
endnetent() 128
endprotoent() 129
endservent() 130
fcntl()
call example 131
description 131
return values 131
getclientid()
call example 133
description 133
return values 133
getdtablesize() 134
gethostbyaddr()
call example 135
description 135
return values 135
gethostbyname()
call example 136
description 136
return values 136
gethostent()
call example 137
description 138
C socket calls *(continued)*
gethostent() *(continued)*
return values 137
gethostid()
description 138
return values 138
gethostname()
description 139
return values 139
getibmopt()
description 140
return values 141
getibmsockopt()
call example 142
description 142
return values 142
getnetbyaddr()
description 143
return values 143
getnetbyname()
description 144
return values 144
getnetent()
description 145
return values 145
getpeername()
description 146
return values 146
getprotobyname()
description 147
return values 147
getprotobynumber()
description 148
return values 148
getprotoent()
description 149
return values 149
getservbyname()
description 150
return values 150
getservbyport()
description 151
return values 151
getservent()
description 152
return values 152
getsockname()
description 153
return values 153
getsockopt()
call example 158
description 154
options 155, 158, 207
return values 158
givesocket()
description 160
return values 161
htonl()
description 162
return values 162
htons()
description 163
return values 163
inet_addr()
description 164
return values 164

C socket calls *(continued)*
inet_lnaof()
description 165
return values 165
inet_makeaddr()
description 166
return values 166
inet_netof()
description 167
return values 167
inet_network()
description 168
return values 168
inet_ntoa()
description 169
return values 169
ioctl()
call example 170, 171
command 170
description 170
return values 171
listen()
call example 172
description 117, 172
return values 172
maxdesc()
description 173
examples 174
return values 173
ntohl()
description 175
return values 175
ntohs()
description 176
return values 176
read()
description 177
return values 177
readv()
description 178
return values 178
use example 69
recv()
call example 180
description 180
return values 180
use example 69
recvfrom()
call example 182
description 182
return values 183
use example 72
recvmsg()
description 184
return values 185
select()
bit set macros 187
call example 186, 188
description 186
return values 188
use example 50, 117
selectex()
description 190
return values 190
send()
call example 192
description 69, 192
C socket calls *(continued)*
send() *(continued)*
return values 192
use example 69
sendmsg()
description 194
return values 195
sendto()
call example 196
description 196
return values 196
use example 72
sethostent()
description 198
return values 198
setibmopt()
description 199
return values 199
structure elements 199
setibmsockopt()
call example 201
return values 201
setnetent()
description 203
return values 203
setprotoent()
description 204
return values 204
setservent()
description 205
return values 205
setsockopt()
call example 209
description 206
options 207
return values 209
shutdown()
description 210
return values 210
sock_debug() 211
sock_do_teststor() 212
socket()
call examples 215
description 213
limitations 215
return values 215
takesocket()
description 216
return values 216
tcperror()
call example 217
description 217
write()
description 218
return values 218
use example 69
writev()
description 219
return values 219
use examples 69
C socket header files
bsdtypes.h 114, 173, 187
fcntl.h 114
if.h 114
in.h 114
inet.h 114, 119
ioctl.h 114

C socket header files *(continued)*
manifest.h 114
netdb.h 114
rtrouteh.h 114
saiucv.h 114, 120
socket.h 184, 194
uio.h 114, 178, 219
C socket programming concepts 5
C sockets, general description 8
C structures 115
C/C++ Sockets, general description 8
CALAREA parameter on CANCEL 281
CALL Instruction Interface for Assembler, PL/I, and COBOL 469
Call Instructions for Assembler, PL/1, and COBOL Programs
ACCEPT 473
BIND 475
BIND2ADDRSEL 478
CLOSE 481
CONNECT 482
EZACIC04 615
EZACIC05 617
EZACIC06 619
EZACIC08 621
FCNTL 485
GETCLIENTID 498
GETHOSTBYADDR 499
GETHOSTBYNAME 502
GETHOSTID 504
GETHOSTNAME 505
GETIBMOPT 506
GETPEERNAME 513
GETSOCKNAME 515
GETSOCKOPT 517
GIVESOCKET 533
INET6_IS_SRCADDR 535
INITAPI 538
IOCTL 540
LISTEN 551
READ 556
READV 558
RECV 559
RECVFROM 561
RECVMSG 565
SELECT 569
SELECTEX 574
SENDMSG 581
SENDTO 585
SETSOCKOPT 589
SHUTDOWN 605
SOCKET 607
TAKESOCKET 608
TERMAPI 610
WRITE 611
WRITEV 612
Call Instructions for Assembler, PL/I, and COBOL Programs
EZACIC14 629
EZACIC15 631
call interface sample PL/I programs 633
call sequence 17
call syntax, C sockets 115
CallReturn parameter on TCP/UDP/IP (Pascal), on SayCalRe 843
CANCEL (macro) 281
CHAR-MASK parameter on call interface, on EZACIC06 619
Character Generator 21
CICS (customer information control system) sockets
general description 8
CICS, not using tcperror() 106
Class parameter on TCP/UDP/IP (pascal), on IsLocalHost 837
ClearTimer 832
client and server socket programs 15
CLIENT parameter on call socket interface
on GETCLIENTID 499
on GIVESOCKET 534
on TAKESOCKET 610
CLIENT parameter on macro socket interface
on GETCLIENTID 299
on GIVESOCKET 337
on TAKESOCKET 417
client program, designing 57
client, socket calls, general
givesocket() and takesocket() 39
send() and recv() 68
clientid parameter on C socket call
on getclientid() 133
on givesocket() 160
on takesocket() 216
CLOSE (macro) 282
cmd parameter on C socket calls
on fcntl() 131
on inet_addr() 164
on inet_network() 168
on ioctl() 170
COMMAND parameter on call interface, IOCTL call 542
COMMAND parameter on call socket interface
on EZACIC06 620
on FCNTL 486
on GETIBMOPT 507
COMMAND parameter on macro interface
on FCNTL 288
on IOCTL 347
COMMAND parameter on macro socket interface
on GETIBMOPT 308
Communications Server for z/OS, online information xxvii
compiling and linking, C sockets
compiling and link-editing non-reentrant modules 106
compiling and link-editing reentrant modules 109
concepts, TCP/IP 3
concurrent server program, designing 39
concurrent server socket programs 17
CONNECT (macro) 284
connect() 124
Connection (Pascal) 820
connection information record (Pascal) 820
Connection parameter on TCP/UDP/IP (Pascal) procedure
on TcpAbort 846
on TcpClose 847
on TcpFReceive, TcpReceive, TcpWaitReceive 848
on TcpFSend, TcpSend, TcpWaitSend 850
on TcpOption 854
Connection States (Pascal) 819, 821
CONNECTIONclosing (Pascal) 819
ConnectionInfo parameter on TCP/UDP/IP (Pascal) procedure
on TcpOpen, TcpWaitOpen 852
on TcpStatus 855
CONNECTIONstateCHANGED (Pascal) 824
ConnIndex parameter on TCP/UDP/IP (Pascal) procedure
on UdpClose 856
on UdpNReceive 857
on UdpOpen 858
on UdpReceive 859

ConnIndex parameter on TCP/UDP/IP (Pascal) procedure *(continued)*
on UdpSend 859
CreateTimer 832
customer information control system sockets, general description, see also CICS 8

D

Data parameter on TCP/UDP/IP (Pascal), on SetTimer 846
data sets
hlq.AEZAMAC4 828
hlq.ETC.PROTO 129, 147, 148, 204
hlq.ETC.SERVICES 9, 130, 150, 151, 205
hlq.HOSTS.ADDRINFO 127
hlq.HOSTS.SITEINFO 127
MANIFEST.H 115
NETDB.H 135, 136, 137, 143, 151
SEZACMAC 233
SEZACMTX 233
SEZAINST 53, 233
SEZALOAD 233
TCPIP.DATA 212
user_id.TCPIP.DATA 834, 851
data sets for TCP/IP programming libraries 22
data structures, Pascal 819
data transfer between sockets 63
data transfer, sockets 6
data translation, socket interface 614
ASCII to EBCDIC 617
bit-mask to character 619
character to bit-mask 619
EBCDIC to ASCII 615, 629
DATAdelivered (Pascal) 824
datagram sockets 5
datagram sockets, program design 61
DatagramAddress parameter on TCP/UDP/IP (Pascal), on UdpReceive 859
DataLength parameter on TCP/UDP/IP (Pascal), on RawIpSend 842
debug and measurement tools
Character Generator 21
Discard 21
Echo 21
designing an iterative server program 27
DestroyTimer 832
disability 945
Discard 21
DNS, online information xxviii
domain name system (DNS) 852
domain parameter on C socket calls
on getclientid() 133
on gethostbyaddr() 135
on socket() 213
DomainName parameter on TCP/UDP/IP (Pascal) , on GetIdentity 835
dotted decimal notation 168

E

ECB parameter on EZASMI 50
ECB parameter on macro interface
on ACCEPT 274
on BIND 277
on BIND2ADDRSEL 280
on CANCEL 281
ECB parameter on macro interface *(continued)*
on CLOSE 283
on CONNECT 287
on FCNTL 289
on GETCLIENTID 300
on GETHOSTBYNAME 302
on GETHOSTID 305
on GETHOSTNAME 307
on GETPEERNAME 316
on GETSOCKNAME 319
on GETSOCKOPT 321
on GIVESOCKET 338
on INET6_IS_SRCADDR 342
on IOCTL 356
on LISTEN 358
on READ 363
on READV 365
on RECV 367
on RECVFROM 371
on RECVMSG 375
on SELECT 380
on SEND 386
on SENDMSG 390
on SENDTO 393
on SETSOCKOPT 396
on SHUTDOWN 412
on SOCKET 415
on TAKESOCKET 418
on WRITE 421
on WRITEV 423
ECBPTR parameter on C socket call, shutdown () 190
Echo 21
endhostent() 127
endnetent() 128
endprotoent() 129
endservent() 130
EndTcpIp (Pascal) 832
ERETMSK parameter on call interface, on SELECT 573
ERRNO parameter on call socket interface
on ACCEPT 475
on BIND 478
on BIND2ADDRSEL 481
on CLOSE 482
on CONNECT 485
on FCNTL 487
on GETCLIENTID 499
on GETHOSTNMAE 506
on GETIBMOPT 509
on GETPEERNAME 515
on GETSOCKNAME 517
on GETSOCKOPT 519
on GIVESOCKET 535
on INET6_IS_SRCADDR 538
on INITAPI 540
on IOCTL 550
on LISTEN 552
on READ 557
on READV 559
on RECV 561
on RECVFROM 565
on RECVMSG 569
on SELECT 573
on SELECTEX 578
on SEND 581
on SENDMSG 585
on SENDTO 588
on SETSOCKOPT 590

ERRNO parameter on call socket interface *(continued)*
on SHUTDOWN 606
on SOCKET 608
on TAKESOCKET 610
on WRITE 612
on WRITEV 614
ERRNO parameter on macro socket interface
on ACCEPT 274
on BIND 277
on BIND2ADDRSEL 280
on CANCEL 282
on CLOSE 283
on CONNECT 286
on FCNTL 289, 290, 298, 488, 498
on GETIBMOPT 310
on GETSOCLOPT 321, 396
on GETSPCKNAME 319
on GIVESOCKET 338
on GRTCLIENTID 300
on GRTHOSTNAME 307
on GRTPEERNAME 316
on INET6_IS_SRCADDR 342
on INITAPI 345
on IOCTL 356
on LISTEN 358
on READV 365
on RECV 367
on RECVFROM 371
on RECVMSG 375
on SELECT 378
on SELECTEX 383
on SEND 386
on SENDMSG 390
on SENDTO 393
on SHUTDOWN 412
on SOCKET 414
on TAKESOCKET 417
on WRITE 421
on WRITEV 423
errno values, code dependency 113
errno values, printing 113
ERRNO.H message file 114
ERROR parameter on macro interface
on ACCEPT 274
on BIND 277
on BIND2ADDRSEL 281
on CLOSE 284
on CONNECT 287
on FCNTL 289, 290, 298, 314
on GETCLIENTID 300
on GETHOSTBYADDR 301
on GETHOSTBYNAME 304
on GETHOSTID 306
on GETHOSTNAME 308
on GETPEERNAME 317
on GETSOCKNAME 319
on GETSOCKOPT 322, 396
on GIVESOCKET 338
on INET6_IS_SRCADDR 342
on INITAPI 345
on IOCTL 356
on LISTEN 358
on RECV 368
on RECVFROM 372
on SELECT 380
on SEND 387
on SENDTO 394
ERROR parameter on macro interface *(continued)*
on SHUTDOWN 413
on SOCKET 415
on TAKESOCKET 418
on WRITE 421
ERROR parameter on macro socket interface
on CANCEL 282
on GETIBMOPT 310
on RECVMSG 375
on SELECTEX 384
on SENDMSG 390
on WRITEV 423
ESDNMASK parameter on call interface, on SELECT 573
EtoATable parameter on TCP/UDP/IP (Pascal), on ReadXlateTable 843
EWOULDBLOCK error return, call interface calls
RECV 560
RECVFROM 562
EWOULDBLOCK error return, macro interface calls 288, 368, 421
exceptfds parameter on C socket calls
on select() 186
on selectex() 190
EZACIC04, call interface, EBCDIC to ASCII translation 615
EZACIC05, call interface, ASCII to EBCDIC translation 617
EZACIC06 47
EZACIC06, call interface, bit-mask translation 619
EZACIC08, HOSTENT structure interpreter utility 621
EZACIC09, RES structure interpreter utility 624
EZACIC14, call interface, EBCDIC to ASCII translation 629
EZACIC15, call interface, ASCII to EBCDIC translation 631
EZASOKET
Assembler language call format 471
COBOL language call format 471
PL/I language call format 471

F

FCNTL (call) 485
fcntl() 131
FD_SETSIZE on send() 187
file specification record (Pascal) 826
FLAGS parameter on call socket interface
on RECV 561
on RECVFROM 563
on RECVMSG 568
on SEND 580
on SENDMSG 585
on SENDTO 587
FLAGS parameter on macro socket interface
on INET6_IS_SRCADDR 341
on RECV 367
on RECVFROM 371
on RECVMSG 375
on SEND 386
on SENDMSG 390
on SENDTO 393
flags, parameter on C socket calls
on recv() 180
on recvfrom() 182
on recvmsg() 184
on send() 192
on sendmsg() 194
on sendto() 196
FNDELAY flag on call interface, on FCNTL 486
ForeignAddress parameter on TCP/UDP/IP (Pascal), on PingRequest 839

ForeignSocket 821
ForeignSocket parameter on TCP/UDP/IP (Pascal), on
UdpSend 859
FSENDresponse (Pascal) 825

G

GETCLIENTID (call) 498
GETCLIENTID (macro) 298
getclientid() 133
getdtablesize() 134
GETHOSTBYADDR (call) 499
gethostbyaddr() 135
GETHOSTBYNAME (call) 502
GETHOSTBYNAME (macro) 136, 302
gethostent() 137
GETHOSTID (call) 504
GETHOSTID (macro) 305
gethostid() 138
GETHOSTNAME (call) 505
GETHOSTNAME (macro) 306
gethostname() 139
GetHostNumber 833
GetHostResol 833
GetHostString 834
GetIBMopt 140
GETIBMOPT (call) 506
GETIBMOPT (macro) 308
GetIBMSockopt 142
GetIdentity 834
getnetbyaddr() 143
getnetbyname() 144
getnetent() 145
GetNextNote 835
GETPEERNAME (call) 513
GETPEERNAME (macro) 314
getpeername() 146
getprotobyname() 147
getprotobynumber() 148
getprotoent() 149
getservbyname() 150
getservbyport() 151
getservent() 152
GetSmsg 836
GETSOCKNAME (call) 515
GETSOCKNAME (macro) 317
getsockname() 153
GETSOCKOPT (call) 517
GETSOCKOPT (macro) 320
getsockopt() 154
GIVESOCKET (call) 533
GIVESOCKET (macro) 336
givesocket() 160
GLOBAL (macro) 338
guidelines for using socket types 6

H

Handle (Pascal) 836
header files
C sockets
in.h 12, 117, 119
saiucv.h 120, 125
general, tcperrno.h 217
Pascal 818, 819
HiperSockets Accelerator 156
hisdesc parameter on C socket call, takesocket() 216
host lookup routines 828
HOSTADDR parameter on call interface, on
GETHOSTBYADDR 500
HostAddress parameter on TCP/UDP/IP (Pascal), on
Handle 837
HOSTADR parameter on macro socket interface, on
GETHOSTBYADDR 301
HOSTENT parameter on call socket interface
on GETHOSTBYADDR 500
on GETHOSTBYNAME 503
HOSTENT parameter on macro socket interface
on GETHOSTBYADDR 301
on GETHOSTBYNAME 303
HOSTENT structure interpreter parameters, on
EZACIC08 622
hostname parameter on TCP/UDP/IP (Pascal), on
GetIdentity 835
hostnumber parameter on TCP/UDP/IP (Pascal)
on GetHostNumber 833
on GetHostResol 834, 835
how parameter on C socket call, on shutdown() 210
HOW parameter on call interface, on SHUTDOWN 606
HOW parameter on macro interface, on SHUTDOWN 412
htonl() 162
htons() 163

I

IBM Software Support Center, contacting xxi
IDENT parameter on call interface, INITAPI call 539
IDENT parameter on macro interface, INITAPI call 344
IMS (information management system) sockets
general description 7
in parameter on C socket calls
on inet_lnaof() 165
on inet_netof() 167
on inet_ntoa() 169
IN-BUFFER parameter on call interface, EZACIC05 call 617
inet_addr() 164
inet_lnaof() 165
inet_makeaddr() 166
inet_netof() 167
inet_network() 168
inet_ntoa() 169
INET6_IS_SRCADDR (call) 535
INET6_IS_SRCADDR(macro) 339
inetdesc parameter on maxdesc(), C socket call 173
Information APARs xxv
information management system socket interface, general
description, see also IMS 7
INITAPI(call) 538
INITAPI(macro) 342
initialization procedures, TCP/UDP/IP (Pascal) 827
interface, C socket 5
internet control message protocol (ICMP) 6
internet domain, addressing sockets 9
Internet, finding z/OS information online xxvii
InternetAddress parameter on TCP/UDP/IP (Pascal)
procedure
on SayInAd 844
on SayIntNum 844
internetwork, protocol layer 5
IOCTL (call) 540
IOCTL (macro) 345
ioctl() 170

iov parameter on C socket calls
on readv() 178
on writev() 219
IOV parameter on call socket interface
on READV 559
on WRITEV 613
IOV parameter on macro socket interface
on RECVMSG 374
on SENDMSG 389
on WRITEV 422
iovcnt parameter on C socket calls
on readv() 178
on writev() 219
IOVCNT parameter on call socket interface
on READV 559
on RECVMSG 568
on SENDMSG 585
on WRITEV 613
IOVCNT parameter on macro socket interface
on READV 365
on RECVMSG 374
on SENDMSG 389
on WRITEV 423
IPv6 programs 73
iQDIO 156
IsLocalAddress 836
IsLocalHost 837
iterative server socket programs 16

J

JCL
non-reentrant modules
compiling 107
linking 108
running 109
reentrant modules
compiling 110
prelinking and linking 111
running 113

K

keyboard 945

L

language syntax, C socket call 115
len parameter on C socket calls
on read() 177
on recv() 180
on recvfrom() 182
on send() 192
on sendto() 196
on write() 218
LENGTH parameter on call socket interface
on EZACIC04 616
on EZACIC05 618
on EZACIC14 629
on EZACIC15 631
length parameter on TCP/UDP/IP (Pascal) procedure
on MonQuery 838
on PingRequest 839
on UdpSend 859
level parameter on C socket calls
on getibmsockopt() 142
level parameter on C socket calls *(continued)*
on getsockopt() 154
on setibmsockopt() 201
on setsockopt() 206
libraries
Data Set 22
sockets and pascal API 114
license, patent, and copyright information 947
listen () 172
LISTEN (call) 551
LISTEN (macro) 356
Listening (Pascal) 819
lna parameter on inet_makeaddr(), C socket call 166
LocalSocket 821
LocalSocket parameter on TCP/UDP/IP (Pascal), on UdpOpen 858
LookAt xxv
loopback, test address 22

M

macro instruction interface for assembler programs 261
macro instructions for assembler programs
ACCEPT 271
BIND 274
BIND2ADDRSEL 278
CANCEL 281
CLOSE 282
CONNECT 284
GETCLIENTID 298
GETDHOSTBYNAME 302
GETHOSTID 305
GETHOSTNAME 306
GETIBMOPT 308
GETPEERNAME 314
GETSOCKNAME 317
GETSOCKOPT 320
GIVESOCKET 336
GLOBAL 338
INET6_IS_SRCADDR 339
INITAPI 342
IOCTL 345
LISTEN 356
READV 363
RECV 365
RECVFROM 368
RECVMSG 372
SELECT 376
SELECTEX 380
SEND 384
SENDMSG 387
SENDTO 390
SETSOCKOPT 394
SHUTDOWN 411
SOCKET 413
TAKESOCKET 416
TASK 418
TERMAPI 419
WRITE 419
WRITEV 421
macro interface sample Assembler language programs 423
mainframe
education xxv
MANIFEST.H header file 115
maxdesc() 173
maximum number of sockets 11
MAXSNO parameter on call interface, INITAPI call 540

MAXSNO parameter on macro interface, INITAPI call 344
MAXSOC parameter on call socket interface
on INITAPI 539
on SELECT 572
on SELECTEX 578
MAXSOC parameter on macro socket interface
on INITAPI 344
on SELECT 378
on SELECTEX 383
MISCSERV (miscellaneous server) 21
monitor procedures 828
MonQuery 838
Motorola-style byte ordering 11
msg parameter on C socket calls
on recvmsg() 184
on send() 192
on sendmsg() 194
on sendto() 196
MSG parameter on call socket interface
on RECVMSG 567
on SENDMSG 583
MSG parameter on macro call interface
on RECVMSG 373, 388
multicast programs 75

N

name parameter on C socket calls
on bind() 119
on connect() 124
on gethostbyname() 136
on gethostname() 139
on getnetbyname() 144
on getpeername() 146
on getprotobyname() 147
on getservbyname() 150
on getsockname() 153
on recvfrom() 183
NAME parameter on call socket interface
on ACCEPT 474
on BIND 477
on BIND2ADDRSEL 480
on CONNECT 484
on GETHOSTBYNAME 503
on GETHOSTNAME 506
on GETPEERNAME 514
on GETSOCKNAME 516
on INET6_IS_SRCADDR 536
on RECVFROM 564
NAME parameter on macro interface
on ACCEPT 272
on BIND 276
on BIND2ADDRSEL 279
on CONNECT 285
on GETHOSTBYNAME 303
on GETHOSTNAME 307
on GETPEERNAME 315
on GETSOCKNAME 318
on INET6_IS_SRCADDR 340
on RECVFROM 369
on SENDTO 392
Name parameter on TCP/UDP/IP (Pascal) procedure
on GetHostNumber 833
on GetHostResol 834
on GetHostString 834
on IsLocalHost 837
namelen parameter on C socket calls
on bind() 119
on connect() 124
on gethostname() 139
on getpeername() 146
on recvfrom() 183
NAMELEN parameter on call socket interface
on GETHOSTBYNAME 503
on GETHOSTNAME 506
NAMELEN parameter on macro socket interface
on GETHOSTBYNAME 303
on GETHOSTNAME 307
NBYTE parameter on call socket interface
on READ 557
on RECV 561
on RECVFROM 564
on SEND 581
on SENDTO 587
on WRITE 612
NBYTE parameter on macro socket interface
on RECV 367
on RECVFROM 369
on SEND 386
on SENDTO 392
on WRITE 420
net parameter on C socket call
on getnetbyaddr() 143
on inet_makeaddr() 166
NETSTAT command 820
network concentrator function 156
NewNameOfTCP parameter on TCP/UDP/IP (Pascal), on TcpNameChange 852
nfds parameter on C socket calls
on select() 186
on selectex() 190
non-reentrant modules, compiling and link-editing 106
NONEXISTENT (Pascal) 819
Note parameter on TCP/UDP/IP (Pascal), on GetNextNote 835
Notification parameter on TCP/UDP/IP (Pascal), on SayNoeEn 845
notification record (Pascal) 821
Notifications parameter on TCP/UDP/IP (Pascal)
on Handle 836
on Unhandle 860
NotificationTag (Pascal) 823
NS parameter on macro interface
on ACCEPT 274
on SOCKET 415
on TAKESOCKET 417
ntohl() 175
ntohs() 176
number of sockets, maximum 11
NumPackets parameter on TCP/UDP/IP (Pascal), on RawIpSend 842

O

obey file 6
onoff parameter on C socket calls
on sock_debug() 211
on sock_do_teststor() 212
OPEN (Pascal) 819
OpenAttemptTimeout 821
OptionName parameter on TCP/UDP/IP (Pascal), on TcpOption 854
options, getsockopt(), C socket call 155, 158, 207

OptionValue parameter on TCP/UDP/IP (Pascal), on
TcpOption 855
optlen parameter on C socket calls
on getibmsockopt() 142
on getsockopt() 154
on setibmsockopt() 201
on setsockopt() 206
optname parameter on C socket calls
on getibmsockopt() 142
on getsockopt() 154
on setibmsockopt() 201
on setsockopt() 206
optval parameter on C socket calls
on getibmsockopt() 142
on getsockopt() 154
on setibmsockopt() 201
on setsockopt() 206
organizing TCP/IP application program 15
OUT-BUFFER parameter on call interface, on EZACIC04 615
OUT-BUFFER parameter on call interface, on EZACIC14 629
OUT-BUFFER parameter on call interface, on EZACIC15 631

P

parameters common, macro interface
'value' 265
(reg) 265
*indaddr 265
address 265
Pascal
assembler calls 828
asynchronous communication 817
Compiler, IBM VS Pascal and Library 818
connection information record 820
connection state type 819
data structures 819
file specification record 826
include files
tcperrno.h 114
notification record 821
notifications 827
procedure call usage 827
return codes 829
software requirements 818
TCP/UDP/IP 817
Pascal procedure calls
AddUserNote 831
BeginTcpIp 831
ClearTimer 832
CreateTimer 832
DestroyTimer 832
EndTcpIp 832
GetHostNumber 833
GetHostResol 833
GetHostString 834
GetIdentity 834
GetNextNote 835
GetSmsg 836
Handle 836
IsLocalAddress 836
IsLocalHost 837
MonQuery 838
PingRequest 839
RawIpClose 839
RawIpOpen 840
RawIpReceive 841
RawIpSend 841
Pascal procedure calls *(continued)*
ReadXlateTable 842
SayCalRe 843
SayConSt 843
SayIntAd 844
SayIntNum 844
SayNotEn 844
SayPorTy 845
SayProTy 845
SetTimer 845
TcpAbort 846
TcpClose 847
TcpFReceive, TcpReceive, TcpWaitReceive 847
TcpFSend, TcpSend, TcpWaitSend 849
TcpNameChange 851
TcpOpen, TcpWaitOpen 852
TcpOption 854
TcpStatus 855
UdpClose 856
UdpNReceive 856
UdpOpen 857
UdpReceive 858
UdpSend 859
Unhandle 860
Pascal sockets 7
pending activity 46
pending exception 50
pending read 50
performance 6
perror(), UNIX function 217
PING 828
PingRequest 839
PINGresponse (Pascal) 825
PL/I programs, required statement 472
port parameter on getservbyport – C socket call 151
Port parameter on TCP/UDP/IP (Pascal), on SayPorTy 845
ports, well known 9
POSIX standard
using z/OS UNIX C sockets API with 8
prerequisite information xxv
program variable definitions, call interface
assembler definition 472
COBOL PIC 472
PL/I declare 472
VS COBOL II PIC 472
programming with sockets 5
programs
IPv6 73
multicast 75
programs, client and server 15
proto parameter on C socket calls
on getprotobynumber() 148
on getservbyname() 150
on getservbyport() 151
PROTO parameter on call interface, on SOCKET 608
PROTO parameter on macro interface, on SOCKET 415
Protocol (Pascal) 823
protocol parameter on C socket call, on socket() 213
Protocol parameter on TCP/UDP/IP (Pascal), on
SayProTy 845
ProtocolNo parameter on TCP/UDP/IP (Pascal) procedure
on RawIpClose 840
on RawIpOpen 840
on RawIpReceive 841
on RawIpSend 842
prototyping 115

PushFlag parameter on TCP/UDP/IP (Pascal), on TcpFSend, TcpSend, TcpWaitSend 851

Q

QueryRecord parameter on TCP/UDP/IP (Pascal), on MonQuery 838

R

Raw Ip Interface 828
raw sockets 6
RawIpClose (Pascal) 839
RawIpOpen (Pascal) 840
RAWIPpacketsDELIVERED (Pascal) 825
RawIpReceive (Pascal) 841
RawIpSend (Pascal) 841
RAWIPspaceAVAILABLE (Pascal) 825
READ (call) 556
READ (macro) 361
read() 177
readfds parameter on C socket calls
  on select() 186
  on selectex() 190
READV (call) 558
READV (macro) 363
readv() 178
ReadXlateTable 842
RECEIVINGonly (Pascal) 820
RECV (call) 559
RECV (macro) 365
recv() 180
RECVFROM (call) 561
RECVFROM (macro) 368
recvfrom() 182
RECVMSG (call) 565
RECVMSG (macro) 372
recvmsg() 184
reentrant modules, compiling and link-editing 109
REQARG and RETARG parameter on call socket interface
  on FCNTL 486
  on IOCTL 549
REQARG parameter on macro socket interface
  on FCNTL 288
  on IOCTL 354
RESOLVE_VIA_LOOKUP, on C socket call 127, 136, 137
RESOURCESavailable (Pascal) 825
Result parameter on TCP/UDP/IP (Pascal), on GetIdentity 835
RETARG parameter on call interface, on IOCTL 550
RETARG parameter on macro interface, IOCTL call 354
RETCODE parameter on call socket interface
  on ACCEPT 475
  on BIND 478
  on BIND2ADDRSEL 481
  on CLOSE 482
  on CONNECT 485
  on EZACIC06 620
  on FCNTL 487
  on GETCLIENTID 499
  on GETHOSTBYADDR 500
  on GETHOSTBYNAME 503
  on GETHOSTID 505
  on GETHOSTNAME 506
  on GETIBMOPT 509
  on GETPEERNAME 515
RETCODE parameter on call socket interface *(continued)*
  on GETSOCKNAME 517
  on GETSOCKOPT 519
  on GIVESOCKET 535
  on INET6_IS_SRCADDR 538
  on INITAPI 540
  on IOCTL 550
  on LISTEN 552
  on READ 557
  on READV 559
  on RECV 561
  on RECVFROM 565
  on RECVMSG 569
  on SELECT 573
  on SELECTEX 579
  on SEND 581
  on SENDMSG 585
  on SENDTO 588
  on SETSOCKOPT 590
  on SHUTDOWN 606
  on SOCKET 608
  on TAKESOCKET 610
  on WRITE 612
  on WRITEV 614
RETCODE parameter on macro socket interface
  on ACCEPT 274
  on BIND 277
  on BIND2ADDRSEL 280
  on CANCEL 282
  on CLOSE 283
  on CONNECT 286
  on FCNTL 289, 290, 298, 488, 498
  on GETCLIENTID 300
  on GETHOSTBYADDR 301
  on GETHOSTID 305
  on GETHOSTNAME 307
  on GETIBMOPT 310
  on GETPEERNAME 316
  on GETSOCKNAME 319
  on GETSOCKOPT 321, 396
  on GIVESOCKET 338
  on GRTHOSTBYNAME 304
  on INET6_IS_SRCADDR 342
  on INITAPI 345
  on IOCTL 356
  on LISTEN 358
  on READV 365
  on RECV 367
  on RECVFROM 371
  on RECVMSG 375
  on SELECT 378
  on SELECTEX 383
  on SEND 386
  on SENDMSG 390
  on SENDTO 393
  on SHUTDOWN 412
  on TAKESOCKET 417
  on WRITE 421
  on WRITEV 423
return codes
  C sockets 116, 885
  call interface 473
  macro and call interface 904
  macro interface 265
  socket 885
return values, code dependency 113

ReturnCode parameter on TCP/UDP/IP (Pascal) procedure
on AddUserNote 831
on BeginTcpip 831
on GetNextNote 835
on Handle 836
on IsLocalAddress 837
on MonQuery 838
on Pingrequest 839
on RawIpClose 840
on RawIpOpen 840
on RawIpReceive 841
on RawIpSend 842
on ReadXlateTable 843
on TcpAbort 846
on TcpClose 847
on TcpFReceive, TcpReceive, TcpWaitReceive 849
on TcpFSend, TcpSend, TcpWaitSend 851
on TcpOpen, TcpWaitOpen 854
on TcpOption 855
on TcpStatus 856
on UdpClose 856
on UdpNReceive 857
on UdpOpen 858
on UdpReceive 859
on UdpSend 859
on Unhandle 860
REXX sockets
general description 8
RFC (request for comments) 927
accessing online xxvii
RRETMSK parameter on call interface, on SELECT 573
RSNDMSK parameter on call interface, on SELECT 572
RTL functions
and return codes 113
built-in 113

S

S, defines socket descriptor on C socket call
on accept() 117
on bind() 119
on close() 123
on connect() 124
on fcntl() 131
on getibmsockopt() 142
on getpeername() 146
on getsockname() 150
on getsockopt() 154
on ioctl() 170
on listen() 172
on read() 177
on readv() 178
on recv() 180
on recvfrom() 182
on recvmsg() 184
on send() 192
on sendmsg() 194
on sendto() 196
on setibmsockopt() 201
on setsockopt() 206
on shutdown() 210
on tcperror() 217
on write() 218
on writev() 219
S, defines socket descriptor on macro interface
on ACCEPT 272
on BIND 276
S, defines socket descriptor on macro interface *(continued)*
on BIND2ADDRSEL 279
on CLOSE 283
on CONNECT 285
on FCNTL 288, 290, 291, 292, 311, 488, 491, 510
on GETPEERNAME 315
on GETSOCKNAME 318
on GETSOCKOPT 321, 395
on GIVESOCKET 337
on IOCTL 347
on LISTEN 357
on READV 364
on RECV 367
on RECVFROM 369
on RECVMSG 373, 388
on SEND 386
on SENDTO 392
on SHUTDOWN 412
on WRITE 420
on WRITEV 422
S, defines socket descriptor on socket call interface
on ACCEPT 474
on BIND 477
on BIND2ADDRSEL 480
on CLOSE 482
on CONNECT 484
on FCNTL 486
on GETPEERNAME 514
on GETSOCKNAME 516
on GETSOCKOPT 518
on GIVESOCKET 534
on IOCTL 542
on LISTEN 552
on READ 557
on READV 559
on RECV 560
on RECVFROM 563
on RECVMSG 567
on SEND 580
on SENDMSG 583
on SENDTO 587
on SETSOCKOPT 589
on SHUTDOWN 606
on WRITE 612
on WRITEV 613
sample programs
C socket
TCP client 221
TCP server 224
UDP client 230
UDP server 227
call interface
CBLOCK, PL/I 651
client, PL/I 637
server, PL/I 633
IUCV sockets
client, C language 53, 879
server, C language 53, 869
subtask, C language 53, 876
macro interface
client, assembler language 434
server, assembler language 424
TCP/UDP/IP Pascal 860
SayCalRe 843
SayConSt 843
SayIntAd 844
SayIntNum 844

SayNotEn 844
SayPorTy 845
SayProTy 845
SCEERUN 113
SELECT (call) 569
SELECT (macro) 376
select mask 46
select, server, socket call, general 45
select() 186
SELECTEX (call) 574
SELECTEX (macro) 380
selectex() 190
selecting sockets 5
SEND (call) 579
SEND (macro) 384
send() 192
SENDINGonly 820
SENDMSG (call) 581
SENDMSG (macro) 387
sendmsg() 194
SENDTO (call) 585
SENDTO (macro) 390
sendto() 196
server
  allocate() 27
  select() 45
sethostent() 198
setibmopt() 199
setibmsockopt() 201
setnetent() 203
setprotoent() 204
setservent() 205
SETSOCKOPT (call) 589
SETSOCKOPT (macro) 394
setsockopt() 206
SetTimer 845
shortcut keys 945
shouldwait parameter on TCP/UDP/IP (Pascal), on GetNextNote 835
SHUTDOWN (call) 605
SHUTDOWN (macro) 411
shutdown() 210
smsg parameter on TCP/UDP/IP (Pascal), on GetSmsg 836
SMSGreceived (Pascal) 825
SO_BULKMODE, on C socket calls. 142
SO_NONBLOCKLOCAL, on C socket calls. 142
Sock_debug() 211
SOCK_DGRAM 6
Sock_do_teststor() 212
SOCK_RAW 6
SOCK_STREAM 117
SOCKET (call) 607
SOCKET (macro) 413
socket call syntax, C 115
socket definition 5
socket libraries
  Native TCP/IP environment 7
  UNIX environment 8
socket return codes 885
socket service types
  datagram socket 5
  raw socket 6
  stream socket 5
socket() 213
sockets
  addresses 12, 114
  connected 18, 69
sockets *(continued)*
  data transfer 6
  domain parameter 27
  guidelines for using 6
  header files
    MANIFEST.H 115
    SOCKET.H 172
  implementation 114
  interface
    datagram 5
    raw 6
    stream 5
    transaction 6
  library 114
  performance 6
  protocol parameter 27
  TCP socket 17
  type parameter 27
  typical TCP socket session 17
  typical UDP socket session 18
  UDP socket 18
  unconnected 18
sockets concepts 4
Sockets Extended
  definition of call instruction API 8
  definition of macro API 8
sockets programming 5
sockets, maximum number 11
SOCRECV parameter on call interface, TAKESOCKET call 609
SOCRECV parameter on macro interface, TAKESOCKET call 417
SOCTYPE parameter on call interface, on SOCKET 608
SOCTYPE parameter on macro interface, on SOCKET 414
softcopy information xxv
software requirements, Pascal 818
SOL_SOCKET, on C socket calls. 142, 154, 206
state parameter on TCP/UDP/IP (Pascal), on SayConSt 844
storage definition, macro interface
  STORAGE=CSECT on EZASMI 263
  STORAGE=DSECT on EZASMI 263, 264, 338, 418
STORAGE parameter on macro interface
  on GLOBAL call 339
  on TASK call 419
stream sockets 5
strerror() 113
structures, C 115
SUBTASK parameter on call interface, INITAPI call 540
SUBTASK parameter on macro interface, INITAPI call 344
Success parameter on TCP/UDP/IP (Pascal), on GetSmsg 836
syntax diagram, how to read xxii
syntax, C socket call 115
system errors, printing 105

T

T parameter on TCP/UDP/IP (Pascal) procedure
  on ClearTimer 832
  on CreateTimer 832
  on DestroyTimer 832
  on SetTimer 846
TableName parameter on TCP/UDP/IP (Pascal), on ReadXlateTable 843
TAKESOCKET (call) 608
TAKESOCKET (macro) 416
takesocket() 216
TASK (macro) 418

task management, macro calls 267
TCP
  communication procedures (PASCAL) 828
  socket session 17
TCP/IP
  online information xxvii
  protocol specifications 927
TCP/IP concepts 3
TCP/UDP/IP API (pascal language) 817
TCP/UDP/IP initialization procedures (Pascal) 827
TCP/UDP/IP termination procedure (Pascal) 827
TcpAbort (Pascal) 846
TcpClose (Pascal) 847
tcperror() 217
TcpFReceive (Pascal) 847
TcpFSend (Pascal) 849
TcpIpServiceName parameter on TCP/UDP/IP (Pascal), on GetIdentity 835
TcpNameChange 851
TcpOpen (Pascal) 852
TcpOption (Pascal) 854
TcpReceive (Pascal) 847
TcpSend (Pascal) 849
tcpserror() 113
TcpStatus (Pascal) 855
TcpWaitOpen (Pascal) 852
TcpWaitReceive 847
TcpWaitSend (Pascal) 849
Technotes xxv
TERMAPI (call) 610
TERMAPI (macro) 419
test address, loopback 22
test tools
  Character Generator 21
  Discard 21
  Echo 21
  loopback address 22
  miscellaneous server (MISCSRV) 21
timeout parameter on C socket calls
  on select() 186
  on selectex() 190
TIMEOUT parameter on call interface, on SELECT 572
TIMEOUT parameter on call socket interface
  on SELECTEX 578
TIMEOUT parameter on macro interface, on SELECT 379
TIMEOUT parameter on macro socket interface
  on SELECTEX 383
Timeout parameter on TCP/UDP/IP (Pascal), on PingRequest 839
Timer Routines 828
TIMERexpired (Pascal) 825
to parameter on C socket calls 196
TOKEN parameter on call interface, on EZACIC06 619
tolen parameter on C socket calls 196
totdesc parameter on C socket calls 173
trademark information 955
transaction sockets 6
transferring data between sockets 63
TranslateTableSpec parameter on TCP/UDP/IP (Pascal), on ReadXlateTable 843
transport, protocol layer 5
TRYINGtoOPEN (Pascal) 820
type parameter on C socket call
  on getnetbyaddr() 143
  on socket() 213
typical TCP socket session 17
typical UDP socket session 18

U

U4093, user abend 909
UDP
  communication procedures 828
  socket session 18
UdpClose (Pascal) 856
UDPdatagramDELIVERED (Pascal) 826
UDPdatagramSPACEavailable (Pascal) 826
UdpNReceive 856
UdpOpen (Pascal) 857
UdpReceive (Pascal) 858
UdpSend (Pascal) 859
Unhandle (Pascal) 860
UnpackedBytes 821
unsolicited event exit 270
urgentflag parameter on TCP/UDP/IP (Pascal) procedure, on TcpFSend, TcpSend, TcpWaitSend 851
URGENTpending (Pascal) 826
use of HOSTENT structure interpreter, EZACIC08 621
user abend U4093 909
USERdefinedNOTIFICATION (Pascal) 826
userid parameter on TCP/UDP/IP (Pascal), on GetIdentity 835
using socket implementation 114
utility programs 614
  EZACIC04 615
  EZACIC05 617
  EZACIC06 619
  EZACIC08 621
  EZACIC14 629
  EZACIC15 631

V

Versatile Message Transfer Protocol (VMTP) 6
VTAM, online information xxvii

W

WRETMSK parameter on call interface, on SELECT 573
WRITE (call) 611
WRITE (macro) 419
write() 218
writefds parameter on C socket calls
  on select() 186
  on selectex() 190
WRITEV (call) 612
WRITEV (macro) 421
writev() 219
WSNDMSK parameter on call interface, on SELECT 573

X

X/Open Transport Interface (XTI)
  fnctl() 236
  RFC1006 233
  select() 236
  selectex() 236
  t_accept() 235
  t_bind() 235
  t_close() 236
  t_connect() 235
  t_error() 236
  t_getinfo() 236
  t_getstate() 236

X/Open Transport Interface (XTI) *(continued)*
t_listen() 235
t_look() 236
t_open() 235
t_rcv() 235
t_rcvconnect() 235
t_rcvdis() 235
t_snd() 235
t_snddis() 235
t_unbind() 236
XPG4 standard
using z/OS UNIX C sockets API with 8
XTI call library 233
XTI management services 233

Z

z/OS Basic Skills information center xxv
z/OS Basic Skills Information Center xxv
z/OS UNIX return codes 904
z/OS, documentation library listing 957

Communicating your comments to IBM

If you especially like or dislike anything about this document, please use one of the methods listed below to send your comments to IBM. Whichever method you choose, make sure you send your name, address, and telephone number if you would like a reply.

Feel free to comment on specific errors or omissions, accuracy, organization, subject matter, or completeness of this document. However, the comments you send should pertain to only the information in this manual and the way in which the information is presented. To request additional publications, or to ask questions or make comments about the functions of IBM products or systems, you should talk to your IBM representative or to your IBM authorized remarketer.

When you send comments to IBM, you grant IBM a nonexclusive right to use or distribute your comments in any way it believes appropriate without incurring any obligation to you.

Please send your comments to us in either of the following ways:

- If you prefer to send comments by FAX, use this number: 1+919-254-1258
- If you prefer to send comments electronically, use this address:
  - comsvrcf@us.ibm.com
- If you prefer to send comments by post, use this address:

```
International Business Machines Corporation
Attn: z/OS Communications Server Information Development
P.O. Box 12195, 3039 Cornwallis Road
Department AKCA, Building 501
Research Triangle Park, North Carolina 27709-2195
```

Make sure to include the following in your note:

- Title and publication number of this document
- Page number or topic to which your comment applies.

© Copyright IBM Corp. 1989, 2010

Program Number: 5694–A01

Printed in USA

SC31-8788-09

Spine information:

z/OS Communications Server

z/OS V1R12.0 Comm Svr: IP Sockets Application Programming Interface Guide and Reference

Version 1
Release 12