z/OS Communications Server
Version 2 Release 3

IP IMS Sockets Guide

IBM

SC27-3653-30

Note:

Before using this information and the product it supports, be sure to read the general information under "Notices" on page 305.

This edition applies to Version 2 Release 3 of z/OS® (5650-ZOS), and to subsequent releases and modifications until otherwise indicated in new editions.

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About this document

This document describes how to use IP Services with IMS Version 7 and later. It describes the IMS call interface and the supporting functions.

This information includes descriptions of support for both IPv4 and IPv6 networking protocols. Unless explicitly noted, descriptions of IP protocol support concern IPv4. IPv6 support is qualified within the text.

This information 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 information 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.

This document addresses the following topics:

- IMS client/server application design
- The IMS Listener
- The IMS Assist function
- The IMS socket calls, including call syntax conventions

Who should read this document

This document is intended for programmers who have some familiarity with IMS Transaction Manager and IP Services, and who need to develop IMS client/server applications.

To ensure proper interprogram communication, the two halves of a client/server program must be developed together. At a minimum, they must agree on protocol and data formats. To complicate matters (particularly in the case of a UNIX processor talking to an IMS mainframe), the technology differences are so extensive that the two halves will often be coded by different individuals — one, an IP socket programmer; the other, an IMS programmer.

This document has been designed for users with a variety of backgrounds and needs:

- Application designers need to know how the various components of IMS TCP/IP interact to provide program-to-program communication. These readers should read Chapter 3, “Principles of operation of the Listener and the Assist module,” on page 19.
- Experienced IP socket programmers need to know the protocol and message formats necessary to establish communication with the IMS Listener and with the server program. These readers should read Chapter 4, “How to write an IMS TCP/IP client program,” on page 29 and Chapter 7, “CALL instruction application programming interface,” on page 51.
- Experienced IMS application programmers will be familiar with IMS input/output calls (GU, GN, ISRT). These programmers have two choices:
  - Programmers with IMS experience and little or no TCP/IP programming experience will probably want to use the IMS Assist module, which accepts standard IMS I/O calls, and converts them to equivalent socket calls. They should read the sections on implicit-mode programming.
  - IMS programmers with socket experience can choose to code native C language or use the Sockets Extended API. These programmers should read the sections on explicit-mode programming and Chapter 7, “CALL instruction application programming interface,” on page 51.
- IMS system programmers and communication programmers are responsible for the IMS system itself. These readers should read Chapter 6, “How to customize and operate the IMS Listener,” on page 45.

How this document is organized

z/OS Communications Server: IP IMS Sockets Guide contains the following information:

- An overview of TCP/IP as it is used with IMS and the types of applications for which it is intended to be used.
- Information about the IMS Listener, including principles of operation, writing and customizing client and server programs, use of the CALL Instruction API, and samples.
- Appendix A, "Return codes," on page 269, Appendix B, "Related protocol specifications," on page 281, and Appendix C, "Accessibility," on page 301 provide additional information for this document.
- "Notices" on page 305 contains notices and trademarks used in this information.
- "Bibliography" on page 309 contains descriptions of the documents in the z/OS Communications Server library.

How to use this document

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

How to contact IBM service

For immediate assistance, visit this website: http://www.software.ibm.com/support

Most problems can be resolved at this website, where you can submit questions and problem reports electronically, and 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 321.

Conventions and terminology that are used in this information

Commands in this information 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 information are *installation-wide exit routines*. The installation-wide exit routines also called installation-wide exits, exit routines, and exits throughout this information.

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 information might not be updated for each release. Evaluate a sample carefully before applying it to your system.

Note: In this information, you might see the following Shared Memory Communications over Remote Direct Memory Access (SMC-R) terminology:

- RoCE Express®, which is a generic term representing IBM 10 GbE RoCE Express, IBM 10 GbE RoCE Express2, and IBM 25 GbE RoCE Express2 feature capabilities. When this term is used in this information, the processing being described applies to both features. If processing is applicable to only one feature, the full terminology, for instance, IBM 10 GbE RoCE Express will be used.
- RoCE Express2, which is a generic term representing an IBM RoCE Express2® feature that might operate in either 10 GbE or 25 GbE link speed. When this term is used in this information, the processing being described applies to either link speed. If processing is applicable to only one link speed, the full terminology, for instance, IBM 25 GbE RoCE Express2 will be used.
- RDMA network interface card (RNIC), which is used to refer to the IBM® 10 GbE RoCE Express, IBM® 10 GbE RoCE Express2, or IBM 25 GbE RoCE Express2 feature.
- Shared RoCE environment, which means that the "RoCE Express" feature can be used concurrently, or shared, by multiple operating system instances. The feature is considered to operate in a shared RoCE environment even if you use it with a single operating system instance.

Clarification of notes

Information traditionally qualified as Notes is further qualified as follows:

Attention
Indicate the possibility of damage

Guideline
Customary way to perform a procedure

Note
Supplemental detail

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

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

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.

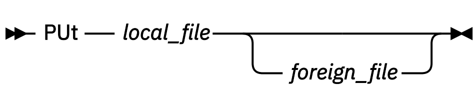
Parameters are classified as keywords or variables. For the TSO and MVS™ console commands, the keywords are not case sensitive. You can code them in uppercase or lowercase. If the keyword appears in the syntax diagram in both uppercase and lowercase, the uppercase portion is the abbreviation for the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

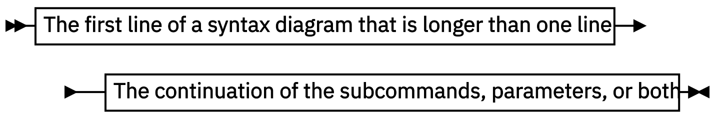
Syntax examples

In the following example, the PUt subcommand is a keyword. The required variable parameter is *local_file*, and the optional variable parameter is *foreign_file*. Replace the variable parameters with your own values.



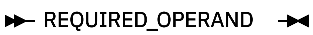
Longer than one line

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.

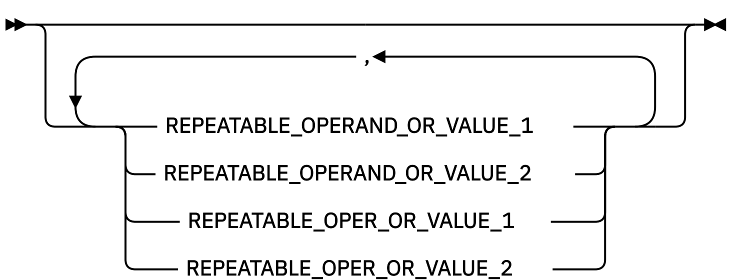


Optional values

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

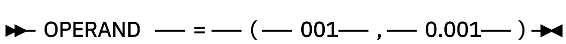
Selecting more than one operand

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).

```
►► 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.

```
     ┌─ DEFAULT ─┐
►►───┼───────────┼──►◄
     └─ OPERAND ─┘
```

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.

```
►► variable ─►◄
```

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 |─►◄
```

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 309, 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 collection.

Titles	Description
IBM Z Redbooks	The IBM Z®® subject areas range from e-business application development and enablement to hardware, networking, Linux, solutions, security, parallel sysplex, and many others. For more information about the Redbooks® publications, see http://www.redbooks.ibm.com/ and http://www.ibm.com/systems/z/os/zos/zfavorites/.

Other documents

This information explains how z/OS references information in other documents.

When possible, this information uses cross-document links that go directly to the topic in reference using shortened versions of the document title. For complete titles and order numbers of the documents for all products that are part of z/OS, see z/OS Information Roadmap (SA23-2299). The Roadmap describes what level of documents are supplied with each release of z/OS Communications Server, and also describes each z/OS publication.

To find the complete z/OS library, visit the z/OS library in IBM Knowledge Center (www.ibm.com/support/knowledgecenter/SSLTBW/welcome).

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	*SC14-7495*
z/OS IBM Tivoli Directory Server Administration and Use for z/OS	*SC23-6788*
z/OS JES2 Initialization and Tuning Guide	*SA32-0991*
z/OS Problem Management	*SC23-6844*
z/OS MVS Diagnosis: Reference	*GA32-0904*
z/OS MVS Diagnosis: Tools and Service Aids	*GA32-0905*
z/OS MVS Using the Subsystem Interface	*SA38-0679*
z/OS Program Directory	*GI11-9848*

Title	Number
z/OS UNIX System Services Command Reference	*SA23-2280*
z/OS UNIX System Services Planning	*GA32-0884*
z/OS UNIX System Services Programming: Assembler Callable Services Reference	*SA23-2281*
z/OS UNIX System Services User's Guide	*SA23-2279*
z/OS XL C/C++ Runtime Library Reference	*SC14-7314*
z Systems: Open Systems Adapter-Express Customer's Guide and Reference	*SA22-7935*

Redbooks publications

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

Title	Number
IBM z/OS Communications Server TCP/IP Implementation, Volume 1: Base Functions, Connectivity, and Routing	SG24-8096
IBM z/OS Communications Server TCP/IP Implementation, Volume 2: Standard Applications	SG24-8097
IBM z/OS Communications Server TCP/IP Implementation, Volume 3: High Availability, Scalability, and Performance	SG24-8098
IBM z/OS Communications Server TCP/IP Implementation, Volume 4: Security and Policy-Based Networking	SG24-8099
IBM Communication Controller Migration Guide	SG24-6298
IP Network Design Guide	SG24-2580
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 http://www.ibm.com/systems/z/os/zos/library/bkserv/

IBM Communications Server product

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

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

z/OS Communications Server product

The page contains z/OS Communications Server product introduction

http://www.ibm.com/software/products/en/commserver-zos

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/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 publications, 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

Tivoli® NetView® for z/OS

Use this site to view and download product documentation about Tivoli NetView for z/OS

http://www.ibm.com/support/knowledgecenter/SSZJDU/welcome

RFCs

Search for and view Request for Comments documents in this section of the Internet Engineering Task Force website, 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 website

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 websites are provided for convenience only and do not serve as an endorsement of these websites.

DNS websites

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 systems 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 website, which is available to all users (no login required): https://www.ibm.com/support/knowledgecenter/zosbasics/com.ibm.zos.zbasics/homepage.html?cp=zosbasics

Summary of changes for IP IMS Sockets Guide

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

Changes made in z/OS Communications Server Version 2 Release 3

This document contains information previously presented in z/OS Communications Server: IP IMS Sockets Guide, which supported z/OS Version 2 Release 1.

Changed information

- IPv6 getaddrinfo() API standards compliance, see Parameter values set by the application (GETADDRINFO code call).

Changes made in z/OS Communications Server Version 2 Release 2

This information contains no technical change for this release.

z/OS Version 2 Release 1 summary of changes

See the Version 2 Release 1 (V2R1) versions of the following publications for all enhancements related to z/OS V2R1:

- *z/OS Migration*
- *z/OS Planning for Installation*
- *z/OS Summary of Message and Interface Changes*
- *z/OS Introduction and Release Guide*

Chapter 1. Using TCP/IP in the IMS environment

For peer-to-peer applications that use SNA communication facilities, remote programmable devices communicate with IMS through the advanced program-to-program communication (APPC) API. For peer-to-peer applications that use TCP/IP communication facilities, remote programmable devices communicate with IMS through facilities provided by IMS TCP/IP.

The IMS TCP/IP feature provides the services necessary to establish and maintain connection between a TCP/IP-connected host and an IMS MPP. In addition, you can develop client/server applications by using the TCP/IP socket application programming interface.

In operation, when a TCP/IP client requires program-to-program communication with an IMS server message processing program (MPP), the client sends its request to TCP/IP Services. TCP/IP passes the request to the IMS Listener, which schedules the requested MPP and transfers control of the connection to it. After control of the connection is passed, data transfer between the server and the remote client is done by using socket calls.

The role of IMS TCP/IP

The IMS/ESA® database and transaction management facility is used throughout the world. For many enterprises, IMS is the data processing backbone, supporting large personnel and financial databases, manufacturing control files, and inventory management facilities. IMS backup and recovery features protect valuable data assets, and the IMS Transaction Manager provides high-speed access for thousands of concurrent users.

Traditionally, many IMS users have used 3270-type protocol to communicate with the IMS Transaction Manager. In that environment, all the processing, including display screen formatting, is done by the IMS mainframe. During the decade of the 1980s, users began to move some of the processing outboard into personal computers. However, these PCs were typically connected to IMS through SNA 3270 protocol.

During that period, although most IMS users were focused on 3270 PC emulation, many non-IMS users were busy building a network based on a different protocol, called TCP/IP. As this trend developed, the need for an access path between TCP/IP-communicating devices and the still-indispensable processing power of IMS became clear. IMS TCP/IP provides that access path. Its role can be more easily understood when one distinguishes between traditional 3270 applications (in which the IMS processor does all the work), and the more complex client/server applications (in which the application logic is divided between the IMS processor and another programmable device such as a TCP/IP host).

MVS TCP/IP supports both application types:

- When a TCP/IP host needs access to a traditional 3270 Message Format Service (MFS) application, it does not have touse the IMS TCP/IP feature; it can connect to IMS directly through Telnet which provides 3270 emulation services for TCP/IP-connected clients. Telnet is a part of the base TCP/IP Services product. (See z/OS Communications Server: IP User's Guide and Commands for more information).
- When a TCP/IP host has to support a client/server application, it should use the IMS TCP/IP feature of TCP/IP Services. This feature supports two-way client/server communication between an IMS message processing program (MPP) and a TCP/IP host.

As used in this information, the term *client* means a program that requests services of another program, which is known as the *server*. The client is often a UNIX-based program; however, DOS, Windows, Linux, CMS, and MVS-based programs can also act as clients. Similarly, the term *server* means a program that is often an IMS message processing program (MPP); however, the server can be a TCP/IP host, responding to an IMS MPP client.

IMS TCP/IP feature components

The IMS TCP/IP feature consists of the following components:

- The IMS Listener, which provides connectivity
- The IMS Assist module, which simplifies TCP/IP communications programming
- The Sockets Extended application programming interface (API)

The IMS Listener

The purpose of the Listener is to provide clients with a single point of contact to IMS. The IMS Listener is a batch program (BMP) that waits for connection requests from remote TCP/IP-connected hosts. When a request arrives, the Listener schedules the appropriate transaction (the server) and passes a TCP/IP socket (representing the connection) to that server.

The IMS Listener maintains connection requests until the requested MPP takes control of the socket. The Listener can maintain a variable number of concurrent connection requests.

Tip: The backlog value specified on the listen call cannot be larger than the value configured by the SOMAXCONN statement in the stack's TCPIP PROFILE (the default value is 10). No error is returned if a larger backlog is requested. If you want a larger backlog, update the SOMAXCONN statement. See z/OS Communications Server: IP Configuration Reference for details.

The IMS Assist module

The Assist module is a subroutine that is a part of the server program. Its use is optional. With the Assist module, you can use conventional IMS calls for TCP/IP communication between client and server. The Assist module intercepts the IMS calls and issues the corresponding socket commands. Consequently, IMS MPP programmers who use the IMS Assist module require no TCP/IP skills.

Programs that do use the Assist module are known as *implicit-mode* programs because the socket calls are issued implicitly by the Assist module.

Programs that do not use the Assist module issue socket calls directly. Such programs are known as *explicit-mode* programs because of their explicit use of the calls.

The MVS TCP/IP socket application programming interface (Sockets Extended)

The socket call interface provides a set of programming calls that can be used in an IMS message processing program to conduct a conversation with a peer program in another TCP/IP processor. The interface is derived from BSD 4.3 socket, a commonly used communications programming interface in the TCP/IP environment. Socket calls include connection, initiation, and termination functions, and basic read/write communication. The MVS TCP/IP socket call interface makes it possible to issue socket calls from programs written in COBOL, PL/I, and assembly language.

The IMS socket calls are a subset of the TCP/IP socket calls. They are designed to be used in programs written in other than C language; hence the term Sockets Extended.

Chapter 2. IMS TCP/IP

With the IMS TCP/IP feature, remote users can access IMS client/server applications over TCP/IP internets. It is a feature of TCP/IP Services. Figure 1 on page 3 shows how IMS TCP/IP gives a variety of remote users peer-to-peer communication with IMS applications.

It is important to understand that IMS TCP/IP is primarily intended to support *peer-to-peer* applications, as opposed to the traditional IMS mainframe interactive applications in which the IMS system contained all programmable logic, and the remote terminal was often referred to as a "dumb" terminal. To connect a TCP/IP host to one of those traditional applications, you should first consider the use of Telnet, a function of TCP/IP Services which provides 3270 emulation. With Telnet, you can access existing 3270-style Message Format Services applications without modification. You should consider IMS TCP/IP only when developing new peer-to-peer applications in which both ends of the connection are programmable.

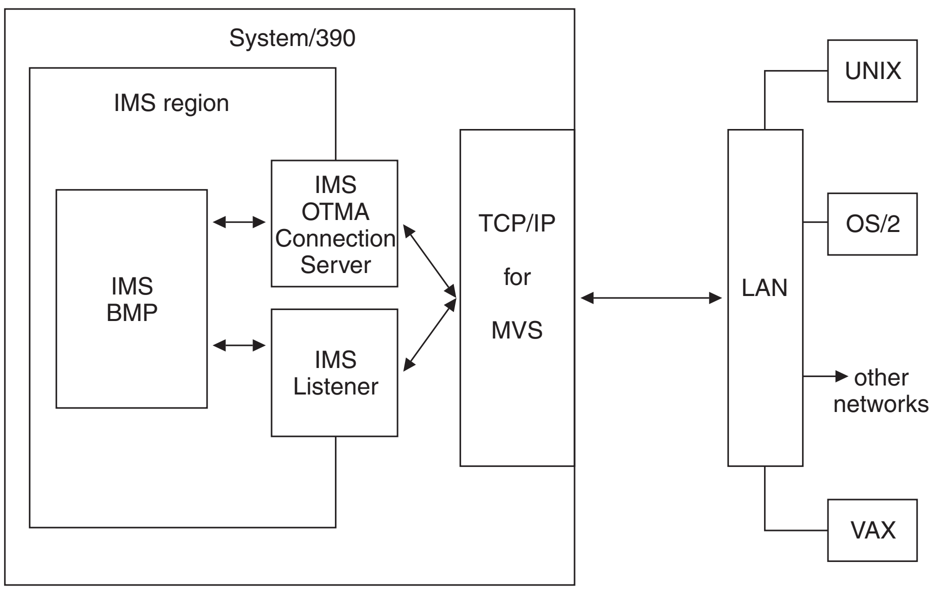


Figure 1. The use of TCP/IP with IMS

IMS TCP/IP provides a variant of the BSD 4.3 Socket interface, which is widely used in TCP/IP networks and is based on the UNIX system and other operating systems. The socket interface consists of a set of calls that IMS application programs can use to set up connections, send and receive data, and perform general communication control functions. The programs can be written in COBOL, PL/I, assembly language, or C.

Using IMS with SNA or TCP/IP

IMS is an online transaction processing system. This means that application programs that use IMS can handle large numbers of data transactions from large networks of computers and terminals.

Communication throughout these networks has often been based on the Systems Network Architecture (SNA) family of protocols. IMS TCP/IP offers IMS users an alternative to SNA — the TCP/IP family of protocols for those users whose native communications protocol is TCP/IP.

TCP/IP internets

This topic describes some of the basic ideas behind the TCP/IP family of protocols.

Like SNA, TCP/IP is a set of communication protocols used between physically separated computer systems. Unlike SNA and most other protocols, TCP/IP is not designed for a particular hardware technology. TCP/IP can be implemented on a wide variety of physical networks, and is specially designed for communicating between systems on different physical networks (local and wide area). This is called *internetworking*.

Mainframe interactive processing

TCP/IP Services supports traditional 3270 mainframe interactive (MFI) applications with an emulator function called Telnet (TN3270). For these applications, all program logic runs in the mainframe, and the remote host uses only that amount of logic necessary to provide basic communications services. Thus, if your requirement is simply to provide access from a remote TCP/IP host to existing IMS MFI applications, you should consider Telnet rather than IMS TCP/IP as the communications vehicle. Telnet 3270-emulation functions allow your TCP/IP host to communicate with traditional applications without modification.

Client/server processing

TCP/IP also supports *client/server* processing, where processes are either:

- **Servers** that provide a particular service and respond to requests for that service
- **Clients** that initiate the requests to the servers

With IMS TCP/IP, remote client systems can initiate communications with IMS and cause an IMS transaction to start. It is anticipated that this will be the most common mode of operation. (Alternatively, the remote system can act as a server with IMS initiating the conversation.)

TCP, UDP, and IP

TCP/IP is a family of protocols that is named after its two most important members. Figure 2 on page 4 shows the TCP/IP protocols used by IMS TCP/IP, in terms of the layered Open Systems Interconnection (OSI) model, which is widely used to describe data communication systems. For IMS users who might be more accustomed to SNA, the left side of Figure 2 on page 4 shows the SNA layers, which correspond very closely to the OSI layers.

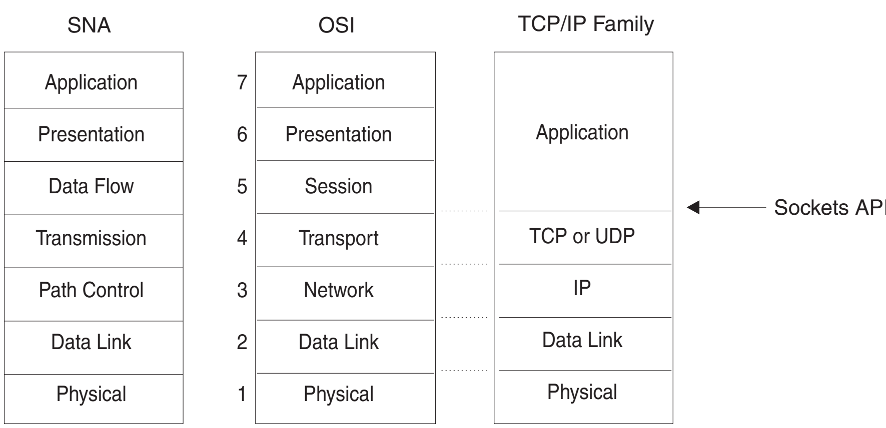


Figure 2. TCP/IP protocols when compared to the OSI Model and SNA

The protocols implemented by TCP/IP Services and used by IMS TCP/IP, are highlighted in Figure 2 on page 4:

Transmission Control Protocol (TCP)
In terms of the OSI model, TCP is a transport-layer protocol. It provides a reliable virtual-circuit connection between applications; that is, a connection is established before data transmission begins. Data is sent without errors or duplication and is received in the same order as it is sent. No boundaries are imposed on the data; TCP treats the data as a stream of bytes.

User Datagram Protocol (UDP)
UDP is also a transport-layer protocol and is an alternative to TCP. It provides an unreliable datagram connection between applications (that is, data is transmitted link by link; there is no end-to-end connection). The service provides no guarantees: data can be lost or duplicated, and datagrams can arrive out of order.

Internet Protocol (IP)
In terms of the OSI model, IP is a network-layer protocol. It provides a datagram service between applications, supporting both TCP and UDP.

The socket API

The socket API is a collection of socket calls that enable you to perform the following primary communication functions between application programs:

- Set up and establish connections to other users on the network
- Send and receive data to and from other users
- Close down connections

In addition to these basic functions, the API enables you to:

- Interrogate the network system to get names and status of relevant resources
- Perform system and control functions as required

IMS TCP/IP provides two TCP/IP socket application program interfaces (APIs), similar to those used on UNIX systems. One interfaces to C language programs, the other to COBOL, PL/I, and System/370* assembly language programs.

- **C language**. Historically, TCP/IP has been associated with the C language and the UNIX operating system. Textbook descriptions of socket calls are usually given in C, and most socket programmers are familiar with the C interface to TCP/IP. For these reasons, TCP/IP Services includes a C language API. If you are writing new TCP/IP applications and are familiar with C language programming, you might prefer to use this interface. Refer to the z/OS Communications Server: IP Sockets Application Programming Interface Guide and Reference for the C language socket calls supported by MVS TCP/IP.
- **Sockets Extended API (COBOL, PL/I, Assembly Language)**. The Sockets Extended API (Sockets Extended) is for those who want to write in COBOL, PL/I, or assembly language, or who have COBOL, PL/I, or assembly language programs that need to be modified to run with TCP/IP. The Sockets Extended API enables you to do this by using CALL statements. If you are writing new TCP/IP applications in COBOL, PL/I, or assembly language, you might prefer to use the Sockets Extended API. With this interface, C language is not required. See Chapter 7, “CALL instruction application programming interface,” on page 51 for details of this interface.

Programming with sockets

The original UNIX socket interface was designed to hide the physical details of the network. It included the concept of a *socket*, which represents the connection to the programmer, yet shields the program (as much as possible) from the details of communication programming. **A socket is an endpoint for communication that can be named and addressed in a network.** From an application program perspective, a socket is a resource that is allocated by the TCP/IP address space. A socket is represented to the program by an integer called a *socket descriptor*.

Socket types

The MVS socket APIs provide a standard interface to the transport and internetwork layer interfaces of TCP/IP. They support three socket types: *stream, datagram, and raw*. Stream and datagram sockets interface to the transport layer protocols, and raw sockets interface to the network layer protocols. All three socket types are described here for background purposes. While CICS® supports stream and datagram sockets, stream sockets provide the most reliable form of data transfer offered by TCP/IP.

Stream sockets transmit data between TCP/IP hosts that are already connected to one another. Data is transmitted in a continuous stream; in other words, there are no record length or newline character boundaries between data. Communicating processes [1] must agree on a scheme to ensure that both client and server have received all data. One way of doing this is for the sending process to send the *length* of the data, followed by the data itself. The receiving process reads the length and then loops, accepting data until all of it has been transferred.

In TCP/IP terminology, the stream socket interface defines a reliable connection-oriented service. In this context, the word *reliable* means that data is sent without error or duplication and is received in the same order as it is sent. Flow control is built in to avoid data overruns.

The **datagram** socket interface defines 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 that can be sent in a single transaction (currently the default is 8192 and the maximum is 65507). No disassembly and reassembly of packets is performed by TCP/IP.

The **raw** socket interface allows direct access to lower layer protocols, such as IP and Internet Control Message Protocol (ICMP). This interface is often used for testing new protocol implementations.

Addressing TCP/IP hosts

This information describes how one TCP/IP host addresses another TCP/IP host. [2]

Address families

An address family defines a specific addressing format. Applications that use the same addressing family have a common scheme for addressing socket end-points. TCP/IP for CICS IMS supports the AF_INET address family.

Socket addresses

A socket address in the AF_INET family comprises 4 fields: the name of the address family itself (AF_INET), a port, an IP address, and an 8-byte reserved field. In COBOL, a socket address looks like this:

```
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).
```

You will find this structure in every call that addresses another TCP/IP host.

In this structure, FAMILY is a half-word that defines which addressing family is being used. In CICS, IMS, FAMILY is always set to a value of 2, which specifies the AF_INET IP address family. [3] The PORT field identifies the application port number; it must be specified in network byte order. The IP_ADDRESS field is the IP address of the network interface used by the application. It also must be specified in network byte order. The RESERVED field should be set to all zeros.

IP addresses

An IP address is a 32-bit field that represents a network interface. An IP address is commonly represented in *dotted decimal* notation such as *129.5.25.1*. Every IP address within an administered AF_INET domain must be unique. A common misunderstanding is that a host must have only one IP address. In fact, a single host can have several IP addresses — one for each network interface.

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[1] In TCP/IP terminology, a *process* is essentially the same as an application program.

[2] In TCP/IP terminology, a host is simply a computer that is running TCP/IP. There is no connotation of "mainframe" or large processor within the TCP/IP definition of the word *host*.

[3] Note that sockets support many address families, but TCP/IP for CICS, IMS supports only the IP address family.

Ports

A port is a 16-bit integer that defines a specific application, within an IP address, in which several applications use the same network interface. The port number is a qualifier that TCP/IP uses to route incoming data to a specific application within an IP address. Some port numbers are reserved for particular applications and are called *well-known ports*, such as Port 23, which is the well-known port for Telnet.

As an example, an MVS system with an IP address of 129.9.12.7 might have CICS, IMS as port 2000, and Telnet as port 23. In this example, a client desiring connection to CICS, IMS would issue a CONNECT call, requesting port 2000 at IP address 129.9.12.7.

Note: It is important to understand the difference between a socket and a port. TCP/IP defines a port to represent a certain process on a certain machine (network interface). A port represents the location of one process in a host that can have many processes. A bound socket represents a specific port and the IP address of its host. In the case of CICS, the Listener has a listening socket which has a port to receive incoming connection requests. When a connection request is received, the Listener creates a new socket representing the endpoint of this connection and passes it to the applications by way of the givesocket/ takesocket calls.

Domain names

Because dotted decimal IP addresses are difficult to remember, TCP/IP also allows you to represent host interfaces on the network as alphabetic names, such as Alana.E04.IBM.COM, or CrFre@AOL.COM. Every Domain Name has an equivalent IP address or set of addresses. TCP/IP includes service functions (GETHOSTBYNAME and GETHOSTBYADDR) that will help you convert from one notation to another.

Network byte order

In the open environment of TCP/IP, IP addresses must be defined in terms of the architecture of the machines. Some machine architectures, such as IBM mainframes, define the lowest memory address to be the high-order bit, which is called *big endian*. However, other architectures, such as IBM PCs, define the lowest memory address to be the low-order bit, which is called *little endian*.

Network addresses in a given network must all follow a consistent addressing convention. This convention, known as network byte order, defines the bit-order of network addresses as they pass through the network. The TCP/IP standard network byte order is big-endian. In order to participate in a TCP/IP network, little-endian systems usually bear the burden of conversion to network byte order.

Note: The socket interface does not handle application data bit-order differences. Application writers must handle these bit order differences themselves.

A typical client/server program flow chart

Stream-oriented socket programs generally follow a prescribed sequence. See Figure 3 on page 8 for a diagram of the logic flow for a typical client and server. As you study this diagram, keep in mind the fact that a concurrent server typically starts before the client does, and waits for the client to request connection at step **3**. It then continues to wait for additional client requests after the client connection is closed.

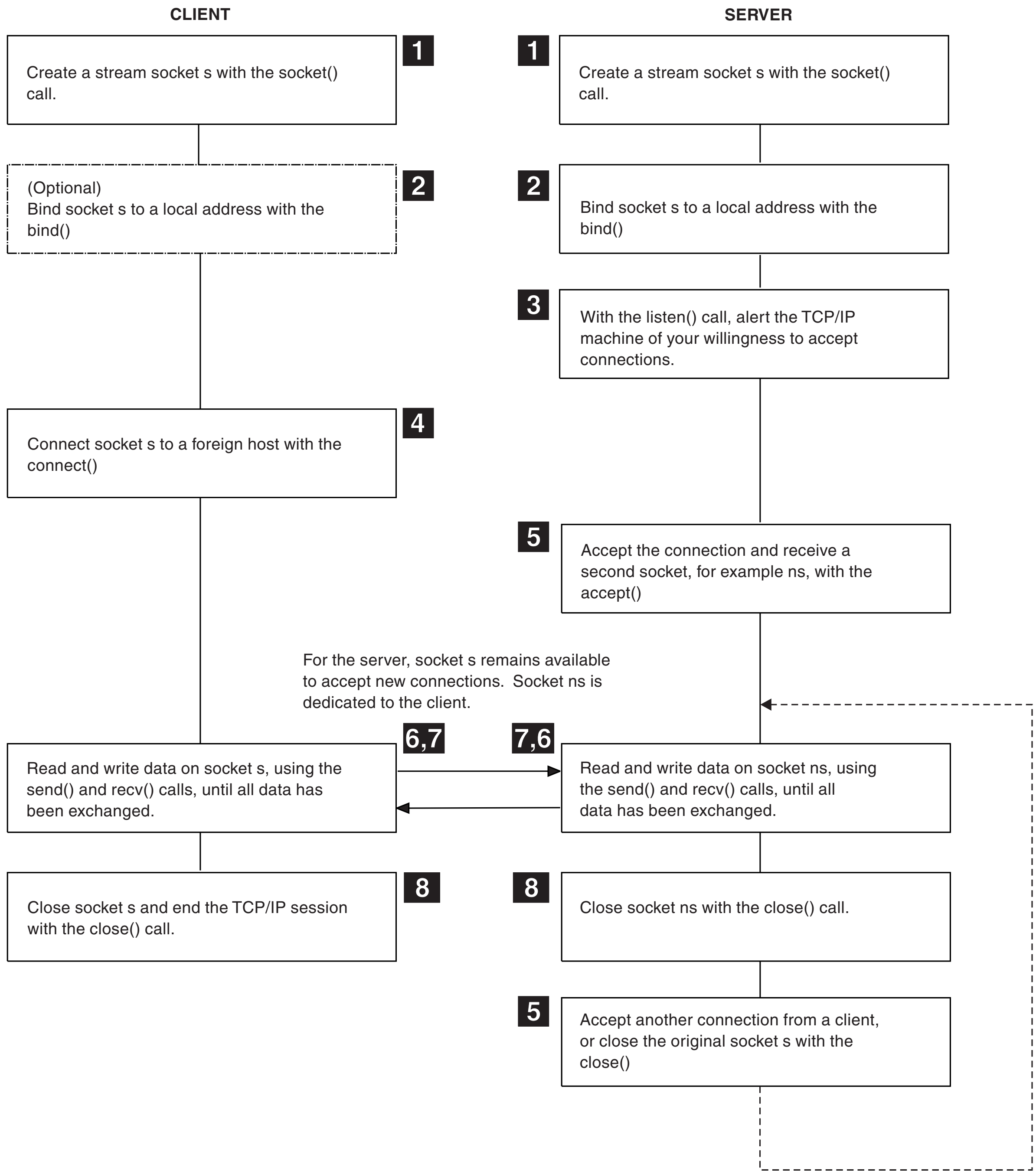


Figure 3. A typical client/server session

Concurrent and iterative servers

An *iterative server* handles both the connection request and the transaction involved in the call itself. Iterative servers are fairly simple and are suitable for transactions that do not last long.

However, if the transaction takes more time, queues can build up quickly. In Figure 4 on page 9, once Client A starts a transaction with the server, Client B cannot make a call until A has finished.

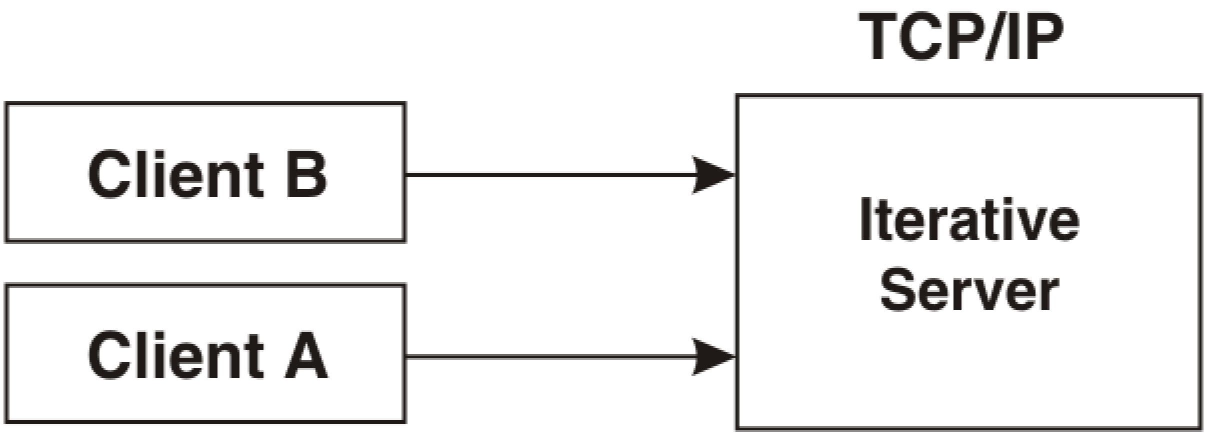


Figure 4. An iterative server

So, for lengthy transactions, a different sort of server is needed — the *concurrent server*, as shown in Figure 5 on page 9. Here, Client A has already established a connection with the server, which has then created a *child server process* to handle the transaction. This allows the server to process Client B's request without waiting for A's transaction to complete. More than one child server can be started in this way.

TCP/IP provides a concurrent server program called the **IMS Listener**. It is described in Chapter 6, "How to customize and operate the IMS Listener," on page 45.

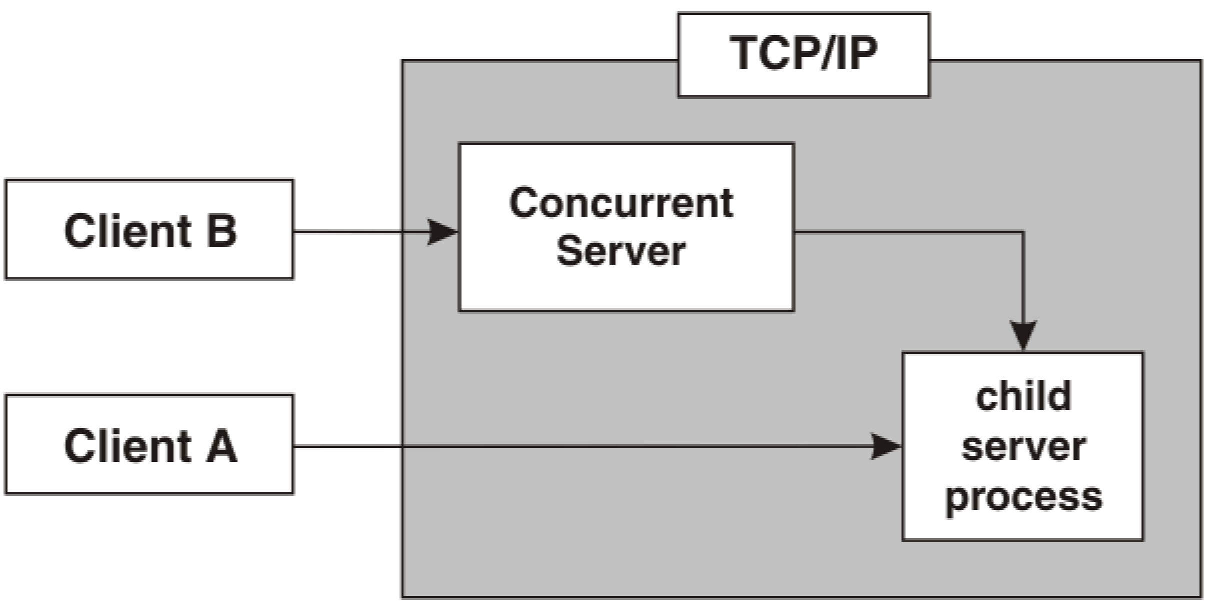


Figure 5. A concurrent server

Figure 3 on page 8 illustrates a concurrent server at work.

The basic socket calls

This topic provides an overview of the basic socket calls.

The following calls are used by the server:

SOCKET
: Obtains a socket to read from or write to.

BIND
: Associates a socket with a port number.

LISTEN
Tells TCP/IP that this process is listening for connections on this socket.

SELECT
Waits for activity on a socket.

ACCEPT
Accepts a connection from a client.

The following calls are used by a concurrent server to pass the socket from the parent server task (Listener) to the child server task (user-written application).

GIVESOCKET
Gives a socket to a child server task.

TAKESOCKET
Accepts a socket from a parent server task.

GETCLIENTID
Optionally used by the parent server task to determine its own address space name (if unknown) prior to issuing the GIVESOCKET.

The following calls are used by the client:

SOCKET
Allocates a socket to read from or write to.

CONNECT
Allows a client to open a connection to a server's port.

The following calls are used by both the client and the server:

WRITE
Sends data to the process on the other host.

READ
Receives data from the other host.

CLOSE
Terminates a connection, deallocating the socket.

For full discussion and examples of these calls, see Chapter 7, "CALL instruction application programming interface," on page 51.

Server TCP/IP calls

To understand Socket programming, the client program and the server program must be considered separately. In this topic the call sequence for the *server* is described. "Client TCP/IP calls" on page 12 contains the typical call sequence for a *client*. Server TCP/IP calls are presented first because the server is usually already in execution before the client is started. The step numbers (such as **5**) in this topic refer to the steps in Figure 3 on page 8.

Server SOCKET call

The server must first obtain a socket **1**. This socket provides an end-point to which clients can connect.

A socket is actually an index into a table of connections in the TCP/IP address space, so TCP/IP usually assigns socket numbers in ascending order. In COBOL, the programmer uses the SOCKET call to obtain a new socket.

The socket function specifies the address family (AF_INET), the type of socket (STREAM), and the particular networking protocol (PROTO) to use. (When PROTO is set to zero, the TCP/IP address space automatically uses the appropriate protocol for the specified socket type). Upon return, the newly allocated socket's descriptor is returned in RETCODE.

Server BIND call

At this point **2**, an entry in the table of communications has been reserved for the application. However, the socket has no port or IP address associated with it until the BIND call is issued. The BIND function requires three parameters:

- The socket descriptor that was just returned by the SOCKET call.
- The number of the port on which the server wants to provide its service
- The IP address of the network connection on which the server is listening. If the application wants to receive connection requests from any network interface, the IP address should be set to zeros.

Server LISTEN call

After the bind, the server has established a specific IP address and port upon which other TCP/IP hosts can request connection. Now it must notify the TCP/IP address space that it intends to listen for connections on this socket. The server does this with the LISTEN**3** call, which puts the socket into passive open mode. *Passive open mode* describes a socket that can accept connection requests, but cannot be used for communication. A passive open socket is used by a listener program like the CICS IMS Listener to await connection requests. Sockets that are directly used for communication between client and server are known as *active open* sockets. In passive open mode, the socket is open for client contacts; it also establishes a backlog queue of pending connections.

This LISTEN call tells the TCP/IP address space that the server is ready to begin accepting connections. Normally, only the number of requests specified by the BACKLOG parameter will be queued.

Tip: The backlog value specified on the listen call cannot be larger than the value configured by the SOMAXCONN statement in the stack's TCPIP PROFILE (the default value is 10). No error is returned if a larger backlog is requested. If you want a larger backlog, update the SOMAXCONN statement. See the z/OS Communications Server: IP Configuration Reference for details.

Server ACCEPT call

At this time **5**, the server has obtained a socket, bound the socket to an IP address and port, and issued a LISTEN to open the socket. The server main task is now ready for a client to request connection **4**. The ACCEPT call temporarily blocks further progress. [4]

The default mode for Accept is blocking. Accept behavior changes when the socket is non-blocking. The FCNTL() or IOCTL() calls can be used to disable blocking for a given socket. When this is done, calls that would normally block continue regardless of whether the I/O call has completed. If a socket is set to non-blocking and an I/O call issued to that socket would otherwise block (because the I/O call has not completed) the call returns with ERRNO 35 (EWOULDBLOCK).

When the ACCEPT call is issued, the server passes its socket descriptor, S, to TCP/IP. When the connection is established, the ACCEPT call returns a new socket descriptor (in RETCODE) that represents the connection with the client. **This is the socket upon which the server subtask communicates with the client**. Meanwhile, the original socket (S) is still allocated, bound and ready for use by the main task to accept subsequent connection requests from other clients.

To accept another connection, the server calls ACCEPT again. By repeatedly calling ACCEPT, a concurrent server can establish simultaneous sessions with multiple clients.

Server GIVESOCKET and TAKESOCKET calls

The GIVESOCKET and TAKESOCKET functions are not supported with the IMS TCP/IP OTMA Connection server. 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

[4] Blocking is a UNIX concept in which the requesting process is suspended until the request is satisfied. It is roughly analogous to the MVS wait. A socket is blocked while an I/O call waits for an event to complete. If a socket is set to block, the calling program is suspended until the expected event completes.

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.

In UNIX-based servers, the *fork()* system call is used to dispatch a new subtask after the initial connection has been established. When the *fork()* command is used, the new process automatically inherits the socket that is connected to the client.

Because of architectural differences, CICS sockets does not implement the *fork()* system call. Tasks use the GIVESOCKET and TAKESOCKET functions to pass sockets from parent to child. The task passing the socket uses GIVESOCKET, and the task receiving the socket uses TAKESOCKET. See "GIVESOCKET and TAKESOCKET calls" on page 15 for more information about these calls.

Server READ and WRITE calls

Once a client has been connected with the server, and the socket has been transferred from the main task (parent) to the subtask (child), the client and server exchange application data, using various forms of READ/WRITE calls. See "Client Read/Write calls — the conversation" on page 12 for details about these calls.

Client TCP/IP calls

The TCP/IP call sequence for a client is simpler than the one for a concurrent server. A client has to support only one connection and one conversation. A concurrent server obtains a socket upon which it can listen for connection requests, and then creates a new socket for each new connection.

Client SOCKET call

In the same manner as the server, the first call **1** issued by the client is the SOCKET call. This call causes allocation of the socket on which the client will communicate.

```
CALL 'EZASOKET' USING SOCKET-FUNCTION SOCTYPE PROTO ERRNO RETCODE.
```

Client CONNECT call

After the SOCKET call has allocated a socket to the client, the client can then request connection on that socket with the server through use of the CONNECT call **4**.

The CONNECT call attempts to connect socket descriptor (S) to the server with an IP address of NAME. The CONNECT call blocks until the connection is accepted by the server. On successful return, the socket descriptor (S) can be used for communication with the server.

This is essentially the same sequence as that of the server; however, the client need not issue a BIND command because the port of a client has little significance. The client need only issue the CONNECT call, which issues an implicit BIND. When the CONNECT call is used to bind the socket to a port, the port number is assigned by the system and discarded when the connection is closed. Such a port is known as an *ephemeral* port because its life is very short as compared with that of a concurrent server, whose port remains available for a prolonged time.

Client Read/Write calls — the conversation

A variety of I/O calls is available to the programmer. The READ and WRITE, READV and WRITEV, and SEND **6** and RECV **6** calls can be used only on sockets that are in the connected state. The SENDTO and RECVFROM, and SENDMSG and RECVMSG calls can be used regardless of whether a connection exists.

The WRITEV, READV, SENDMSG, and RECVMSG calls provide the additional features of scatter and gather data. Scattered data can be located in multiple data buffers. The WRITEV and SENDMSG calls gather the scattered data and send it. The READV and RECVMSG calls receive data and scatter it into multiple buffers.

The WRITE and READ calls specify the socket S on which to communicate, the address in storage of the buffer that contains, or will contain, the data (BUF), and the amount of data transferred (NBYTE). The server uses the socket that is returned from the ACCEPT call.

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

Client CLOSE call

When the conversation is over, both the client and server call CLOSE to end the connection. The CLOSE call also deallocates the socket, freeing its space in the table of connections.

Other socket calls

Several other calls that are often used — particularly in servers — are the SELECT call, the GIVESOCKET/TAKESOCKET calls, and the IOCTL and FCTL calls. These calls are discussed next.

The SELECT call

Applications such as concurrent servers often handle multiple sockets at once. In such situations, the SELECT call can be used to simplify the determination of which sockets have data to be read, which are ready for data to be written, and which have pending exceptional conditions. An example of how the SELECT call is used can be found in Figure 6 on page 13.

```
WORKING STORAGE
    01  SOC-FUNCTION    PIC X(16)  VALUE IS 'SELECT'.
    01  MAXSOC          PIC 9(8) BINARY VALUE 50.
    01  TIMEOUT.
        03  TIMEOUT-SECONDS   PIC 9(8) BINARY.
        03  TIMEOUT-MILLISEC  PIC 9(8) BINARY.
    01  RSNDMASK        PIC X(50).
    01  WSNDMASK        PIC X(50).
    01  ESNDMASK        PIC X(50).
    01  RRETMASK        PIC X(50).
    01  WRETMASK        PIC X(50).
    01  ERETMASK        PIC X(50).
    01  ERRNO           PIC 9(8) BINARY.
    01  RETCODE         PIC S9(8) BINARY.

PROCEDURE
     CALL 'EZASOKET' USING SOC-FUNCTION MAXSOC TIMEOUT
                    RSNDMASK WSNDMASK ESNDMASK
                    RRETMASK WRETMASK ERETMASK
                    ERRNO RETCODE.
```

Figure 6. The SELECT call

In this example, the application *sends* bit sets (the xSNDMASK sets) to indicate which sockets are to be tested for certain conditions, and *receives* another set of bits (the xRETMASK sets) from TCP/IP to indicate which sockets meet the specified conditions.

The example also indicates a time-out. If the time-out parameter is NULL, this is the C language API equivalent of a wait forever. (In Sockets Extended, a negative timeout value is a wait forever.) If the time-out parameter is nonzero, SELECT waits only the timeout amount of time for at least one socket to become ready on the indicated conditions. This is useful for applications servicing multiple connections that cannot afford to wait for data on a single connection. If the xSNDMASK bits are all zero, SELECT acts as a timer.

With the Socket SELECT call, you can define which sockets you want to test (the xSNDMASKs) and then wait (block) until one of the specified sockets is ready to be processed. When the SELECT call returns, the program knows only that some event has occurred, and it must test a set of bit masks (xRETMASKs) to determine which of the sockets had the event, and what the event was.

To maximize performance, a server should test only those sockets that are active. The SELECT call allows an application to select which sockets will be tested, and for what. When the Select call is issued, it blocks until the specified sockets are ready to be serviced (or, optionally) until a timer expires. When the select call returns, the program must check to see which sockets require service, and then process them.

To allow you to test any number of sockets with just 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 possible member of the set is represented by a 0 or a 1. If the member's bit is 0, the member is not to be tested. If the member's bit is 1, the member is to be tested. Socket descriptors are actually small integers. If socket 3 is a member of a bit set, then bit 3 is set; otherwise, bit 3 is zero.

Therefore, the server specifies 3 bit sets of sockets in its call to the SELECT function: one bit set for sockets on which to receive data; another for sockets on which to write data; and any sockets with exception conditions. The SELECT call tests each selected socket for activity and returns only those sockets that have completed. On return, if a socket's bit is raised, the socket is ready for reading data or for writing data, or an exceptional condition has occurred.

The format of the bit strings is a bit awkward for an assembler programmer who is accustomed to bit strings that are counted from left to right. Instead, these bit strings are counted from right to left.

The first rule is that the length of a bit string is always expressed as a number of fullwords. If the highest socket descriptor you want to test is socket descriptor number three, you have to 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:

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

Look at the first fullword you pass in a bit string in Table 1 on page 14.

Table 1. First fullword passed in a bit string in 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

In these examples, we use standard assembler numbering notation; the leftmost bit or byte is relative zero.

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'). If you want to test both socket descriptor 4 and 5, you raise both bit 2 and bit 3 in byte 3 of the first fullword (X'00000030').

If you want to test socket descriptor number 32, you must pass two 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. If you want to test socket descriptors 5 and 32, you pass two fullwords with the following content: X'0000002000000001'.

The bits in the second fullword represents the socket descriptor numbers shown in Table 2 on page 15. Subsequent mask words continue this pattern; word 3 for sockets 64 – 95, word 4 for sockets 96 – 127, and so on.

Table 2. Second fullword passed in a bit string in 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

If you develop your program in COBOL or PL/I, you might find that the EZACIC06 routine, which is provided as part of TCP/IP for MVS, will make it easier for you to build and test these bit strings. This routine translates between a character string mask (one byte per socket) and a bit string mask (one bit per socket).

In addition to its function of reporting completion on Read/Write events, the SELECT call can also be used to determine completion of events associated with the LISTEN and GIVESOCKET calls.

- When a connection request is pending on the socket for which the main process issued the LISTEN call, it will be reported as a pending read.
- When the parent process has issued a GIVESOCKET, and the child process has taken the socket, the parent's socket descriptor is selected with an exception condition. The parent process is expected to `close` the socket descriptor when this happens.

IOCTL and FCNTL calls

In addition to SELECT, applications can use the IOCTL or FCNTL calls to help perform asynchronous (nonblocking) socket operations.

The IOCTL call has many functions; establishing blocking mode is only one of its functions. The value in COMMAND determines which function IOCTL will perform. The REQARG of 0 specifies non-blocking (a REQARG of 1 would request that socket S be set to blocking mode). When this socket is passed as a parameter to a call that would block (such as RECV when data is not present), the call returns with an error code in RETCODE, and ERRNO set to `EWOULDBLOCK`. Setting the mode of the socket to nonblocking allows an application to continue processing without becoming blocked.

GIVESOCKET and TAKESOCKET calls

The GIVESOCKET and TAKESOCKET functions are not supported with the IMS TCP/IP OTMA Connection server. Tasks use the GIVESOCKET and TAKESOCKET functions to pass sockets from parent to child.

For programs using TCP/IP for MVS, each task has its own unique 8-byte name. The main server task passes three arguments to the GIVESOCKET call:

- The socket number it wants to give
- Its own name [5]
- The name of the task to which it wants to give the socket

[5] If a task does not know its address space name, it can use the GETCLIENTID function call to determine its unique name.

If the server does not know the name of the subtask that will receive the socket, it blanks out the name of the subtask. [6] The first subtask calling TAKESOCKET with the server's unique name receives the socket.

The subtask that receives the socket must know the main task's unique name and the number of the socket that it is to receive. This information must be passed from main task to subtask in a work area that is common to both tasks.

- In IMS, the parent task name and the number of the socket descriptor are passed from parent (Listener) to child (MPP) through the message queue.
- In CICS, the parent task name and the socket descriptor number are passed from the parent (Listener) to the transaction program by means of` the EXEC CICS START and EXEC CICS RETREIVE function.

Because each task has its own socket table, the socket descriptor obtained by the main task is not the socket descriptor that the subtask will use. When TAKESOCKET accepts the socket that has been given, the TAKESOCKET call assigns a new socket number for the subtask to use. This new socket number represents the same connection as the parent's socket. (The transferred socket might be referred to as socket number 54 by the parent task and as socket number 3 by the subtask; however, both socket descriptors represent the same connection.)

Once the socket has successfully been transferred, the TCP/IP address space posts an exceptional condition on the parent's socket. The parent uses the SELECT call to test for this condition. When the parent task SELECT call returns with the exception condition on that socket (indicating that the socket has been successfully passed) the parent issues CLOSE to complete the transfer and deallocate the socket from the main task.

To continue the sequence, when another client request comes in, the concurrent server (Listener) gets another new socket, passes the new socket to the new subtask, and dissociates itself from that connection. And so on.

Summary of passing the socket process

The process of passing the socket is accomplished in the following way:

- After creating a subtask, the server main task issues the GIVESOCKET call to pass the socket to the subtask. If the subtask's address space name and subtask ID are specified in the GIVESOCKET call, (as with CICS) only a subtask with a matching address space and subtask ID can take the socket. If this field is set to blanks, (as with IMS) any MVS address space requesting a socket can take this socket.
- The server main task then passes the socket descriptor and concurrent server's ID to the subtask using some form of commonly addressable technique such as the IMS Message Queue.
- The concurrent server issues the SELECT call to determine when the GIVESOCKET has successfully completed.
- The subtask calls TAKESOCKET with the concurrent server's ID and socket descriptor and uses the resulting socket descriptor for communication with the client.
- When the GIVESOCKET has successfully completed, the concurrent server issues the CLOSE call to complete the handoff.

An example of a concurrent server is the IMS Listener. It is described in Chapter 6, "How to customize and operate the IMS Listener," on page 45. Figure 5 on page 9 shows a concurrent server.

What you need to run IMS TCP/IP

IMS TCP/IP using the IMS Listener and IMS Assist Module is designed for use on an MVS/SP host system running IMS/ESA Version 4 or later.

A TCP/IP host can communicate with any remote IMS or non-IMS system that runs TCP/IP. The remote system can, for example, run a UNIX or OS/2 operating system.

[6] This is the case in IMS because the Listener has no way of knowing which Message Processing Region will inherit the socket.

TCP/IP services is not described in this information because it is a prerequisite for IMS TCP/IP. However, much material from the TCP/IP library has been repeated in this information in an attempt to make it independent of that library.

A summary of what IMS TCP/IP provides

Figure 7 on page 17 shows how IMS TCP/IP allows IMS applications to access the TCP/IP network. It shows that IMS TCP/IP makes the following facilities available to your application programs:

The sockets calls (1 and 2 in Figure 7 on page 17)

The socket API is available both in the C language and in COBOL, PL/I, or assembly language. Table 3 on page 17 shows the socket calls included in the socket API.

Table 3. Socket calls

Call type	Calls
Basic	socket, bind, connect, listen, accept, shutdown, close
Read/write	send, sendto, recvfrom, read, write
Advanced	gethostname, gethostbyaddr, gethostbyname, getpeername, getsockname, getsockopt, setsockopt, fcntl, ioctl, select
IBM-specific	initapi, getclientid, givesocket, takesocket

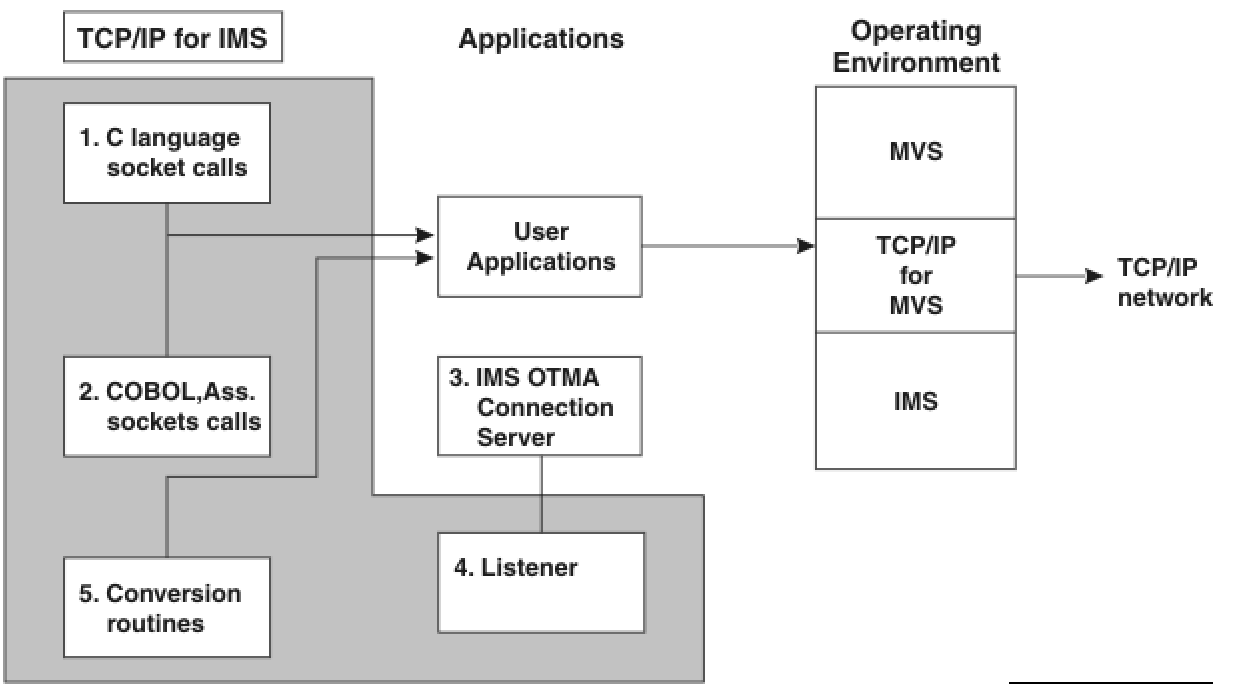


Figure 7. How user applications access TCP/IP networks with IMS TCP/IP

IMS TCP/IP provides for both connection-oriented and connectionless (datagram) services, using the TCP and UDP protocols respectively. TCP/IP does not support the IP (raw socket) protocol.

The Listener (4) in Figure 7 on page 17.

IMS TCP/IP includes a concurrent server application, called the Listener, to which the client makes initial connection requests. The Listener passes the connection request on to the user-written server, which is typically an IMS Message Processing Program.

Conversion routines (5) in Figure 7 on page 17.

IMS TCP/IP provides the following conversion routines, which are part of the base TCP/IP Services product:

- An EBCDIC-to-ASCII conversion routine, used to convert EBCDIC data to the ASCII format that is used in TCP/IP networks and workstations. The conversion routine is run by calling the EBCDIC-to-ASCII translation table EZACIC04, shown in the z/OS Communications Server: IP Configuration Reference.
- A corresponding ASCII-to-EBCDIC conversion routine (EZACIC05), shown in the z/OS Communications Server: IP Configuration Reference.
- An alternative EBCDIC-to-ASCII conversion routine (EZACIC14).
- Corresponding ASCII-to-EBCDIC conversion routine (EZACIC15).
- A module that converts COBOL character arrays into bit-mask arrays used in TCP/IP. This module, which is run by calling EZACIC06, is used with the socket SELECTSELECT call.
- A module that interprets a C language structure known as Hostent (EZACIC08).

Chapter 3. Principles of operation of the Listener and the Assist module

This information describes the operation of the Listener and the Assist module. Its purpose is to explain how a TCP/IP-to-IMS connection is established, and how the client and server exchange application data. For specific data formats and the socket protocols used when coding a TCP/IP client or server, see Chapter 4, “How to write an IMS TCP/IP client program,” on page 29 and Chapter 5, “How to write an IMS TCP/IP server program,” on page 37.

Overview of the Listener and the Assist module

The IMS TCP/IP feature consists of 3 components: the IMS Listener, the IMS Assist module, and the Sockets Extended API. [7] The Sockets Extended API can either be used independently, or with the other 2 components. When the Sockets Extended interface is used independently, an IMS MPP can either serve as a client or as a server.

When the IMS Listener is used, the IMS MPP acts as a server, and the TCP/IP remote acts as the client. The Assist module is dependent upon the IMS Listener; therefore, when the Assist module is used, IMS is the server.

Because the Listener and the Assist module are designed to support IMS as a server, this information is based on that assumption. For a discussion of IMS as **client**, see “When the client is an IMS MPP” on page 27, and the sample program on “Sample program - IMS MPP client” on page 255.

The role of the IMS Listener

Because the IMS Transaction Manager does not support direct connection with TCP/IP, some other program must establish that connection. When IMS is acting as a ***server*** to a TCP/IP-connected ***client***, that program is the IMS Listener — an IMS batch message program (BMP) whose main function it is to establish connection between the client and the requested IMS transaction.

When the client requests the services of an IMS message processing program (MPP), it sends a message to the IMS host containing the transaction code of that MPP. The IMS Listener receives that request and schedules the requested MPP; it then holds the connection until the MPP starts and accepts the connection. Once the MPP owns the connection, the Listener is no longer involved with it.

The role of the IMS Assist module

The IMS Assist module is a subroutine, called from an IMS MPP (server) that translates conventional IMS communication calls into the corresponding socket calls. Its use is optional. Its purpose is to shield the programmer from having to understand TCP/IP programming. To exchange data with the client, the server program issues traditional IMS message queue calls (GU, GN, ISRT). These calls are intercepted by the Assist module, which issues the appropriate socket calls.

Pros and cons for the use of the IMS Assist module

The Assist module makes message processing program (MPP) coding easier, but is accompanied by a series of trade-offs. This information discusses the trade-offs between implicit mode and explicit mode.

- Implicit-mode application programmers use conventional IMS Transaction Manager (TM) calls and require no special training; explicit-mode application programmers must understand TCP/IP socket calls and protocols.

[7] Shipped with the TCP/IP Services base product.

- Implicit-mode transactions must adhere to constraints imposed by the IMS Assist module. By contrast, explicit-mode transactions use the TCP/IP socket call interface and have no specific protocol requirements other than the orderly initiation and termination of the transaction.
- Implicit-mode transactions obtain their message input from the IMS message queue. Because the Listener must put the input message segments on the queue before the server begins execution, the client sends all application data with the transaction request. Explicit-mode transactions bypass the message queue for all application data — both input, and output.
- Implicit-mode transactions are limited to a single GU-GN/ISRT iteration (one input of one or more segments, followed by one output of one or more segments) for each message retrieved from the IMS message queue. By contrast, explicit-mode transactions have no such limit. Unlimited read/write sequences make it possible to design conversations in which the two programs talk back and forth without limit. [8]

Client/server logic flow

This information describes the flow of a client/server application through the system — starting with the client and continuing on through the Listener to the server. The complete transaction, including initiation, execution, and termination is traced.

How the connection is established

The following paragraphs describe the functions the Listener performs in coordinating between the client and the server. With the exception of paragraph 6, the Listener performs the same steps for both explicit- and implicit-mode servers. Paragraph numbers correspond to the step numbers in Figure 8.

[8] Because of the potential for long running conversations, MPPs with multiple conversational iterations should be carefully designed to avoid the possibility of extended message processing region occupancy.

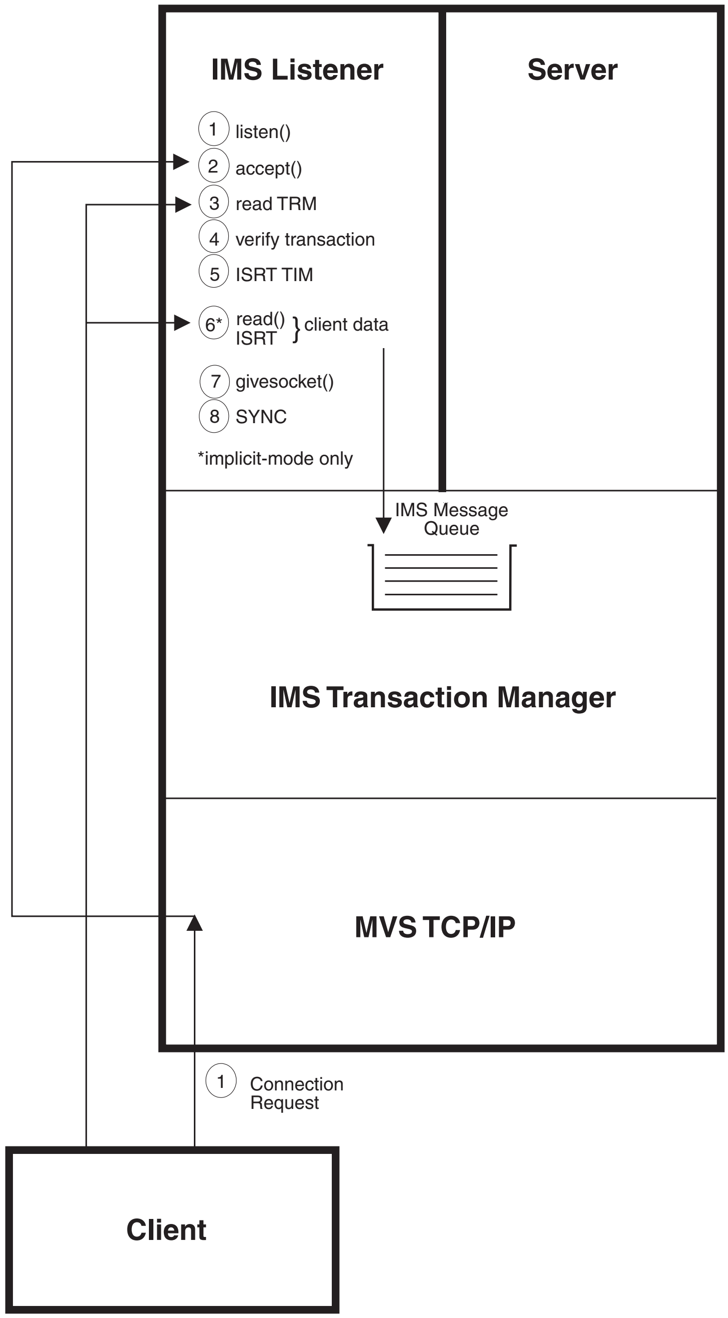


Figure 8. IMS TCP/IP message flow for transaction initiation

1. Connection request

   The IMS Listener is an IMS batch message processing program (BMP). When the Listener starts, it establishes a socket on which it can "listen" for connection requests. It binds itself to the specified port, and then listens for requests from TCP/IP clients. When a client sends a connection request, MVS TCP/IP notifies the Listener of the request.

2. Connection processing

   When the Listener receives a connection request, it issues a socket ACCEPT call, which creates a new socket specifically for that connection.

3. Transaction-Request Message

   The client then sends a transaction-request message (TRM) segment, which includes the 8-byte name of the requested IMS server transaction (otherwise known as the TRANCODE).

4. Transaction verification

   The Listener performs several tests to ensure that the requested transaction should be accepted:

   - The TRANCODE is tested against IMS Listener configuration file TRANSACTION statements to ensure that the requested transaction is eligible to be run from a TCP/IP client.
   - If security data is included in the transaction-request message (TRM), that data is passed to a user-written security exit. The purpose of this exit is to validate the credentials of the client before allowing the transaction to be scheduled.
   - The Listener issues an IMS CHNG call to a modifiable alternate PCB, specifying the TRANCODE of the required transaction. It then issues an IMS INQY call to ensure that the transaction is not stopped (due to previous abend or Master Terminal Operator action).

   The following actions depend on the results of the verification:

   - If the transaction request is *rejected*, the IMS Listener returns a request-status message (RSM) segment to the client with an indication of the reason for rejecting the request; it then closes the connection.
   - If the transaction request is *accepted* the requested transaction is scheduled (the Listener *does not* return a status message to the client).
5. Transaction Initiation Message (TIM)

   The Listener then inserts (ISRT) a transaction initiation message (TIM) segment to the IMS message queue. This message contains information needed by the server program when it takes responsibility for the connection.

   Note: The client sends the transaction *request* message (TRM) to the Listener. The Listener sends the transaction *initiation* message (TIM) to the server.
6. Client-to-server input data transfer (implicit mode only)

   If the transaction is in implicit mode, the Listener reads the client-to-server input data and places it on the message queue.
7. Pass the socket to the server

   Next, the Listener issues a GIVESOCKET call, which makes the socket available to the server program.
8. Schedule the transaction

   Finally, the Listener issues an IMS SYNC call to schedule the requested IMS transaction and waits for the server program to take responsibility for the connection.

When the server issues a TAKESOCKET call, the Listener has completed its responsibility for the socket and dissociates itself from the connection.

Note: The Listener is a never-ending IMS Batch Message Program, which processes multiple concurrent transactions.

How the server exchanges data with the client

Once the server begins execution, the protocol to pass input data to the server is a function of whether the transaction mode is explicit or implicit.

Explicit-mode transactions

The following information describes an explicit-mode server program which exchanges application data with a client.

Step numbers in Figure 9 correspond to the paragraph numbers below.

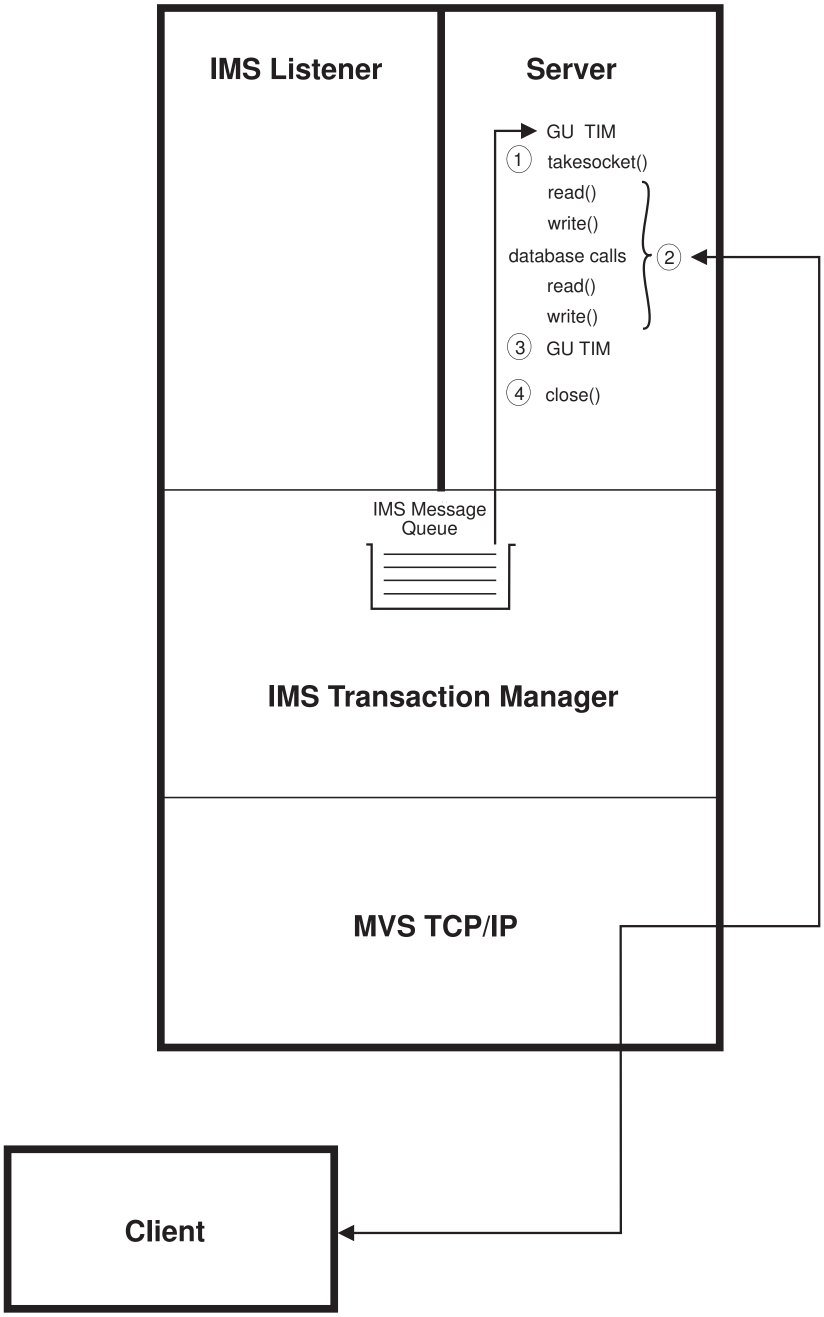


Figure 9. IMS TCP/IP message flow for explicit-mode input/output

1. Once an explicit-mode server begins execution, it issues an IMS GU call to obtain the transaction initiation message (TIM) segment, an INITAPI to establish connection with MVS TCP/IP, and a TAKESOCKET call to establish direct connection between client and server.
2. Subsequently, socket READ and WRITE commands are used to exchange data between client and server. The conversation can consist of any number of database calls and socket READ/WRITE exchanges. [9] Client data is not passed through the IMS message queue and is not subject to any predefined protocols.
3. The transaction indicates completion by issuing another GU to the I/O PCB. This notifies the Transaction Manager that the database changes should be committed. At this point, the server

[9] Because of the potential for long running conversations, MPPs with multiple conversational iterations should be carefully designed to avoid the possibility of extended message processing region occupancy.

program might send a message to the client indicating that the database changes have been successfully completed.

If another message awaits this transaction, the GU will cause the first segment of that message to be retrieved and the program should issue a new TAKESOCKET call to start the process again.

4. When the GU call returns with a QC status code, the server ends the conversation by closing the socket.

Implicit-mode transactions

The following information describes how the Assist module and the server program interact to exchange application data with the client. The paragraph numbers correspond to the step numbers in Figure 3.

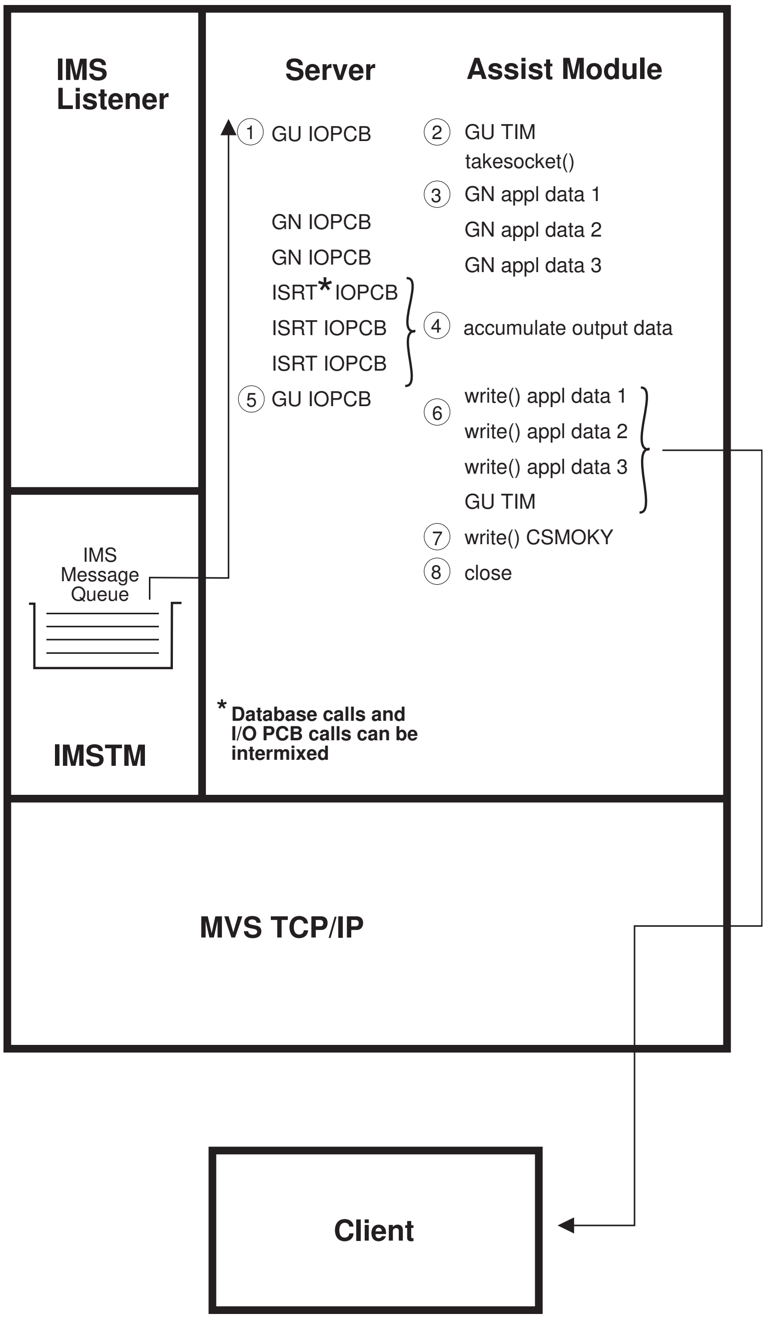


Figure 10. IMS TCP/IP message flow for implicit mode input/output

1. Server GU

GU must be the first IMS call issued by the server to the I/O PCB. The Assist module retrieves the first segment from the message queue and examines it (for *LISTNR* in the first field) to determine whether it is a transaction initiation message. (If the message was not sent by the Listener, the Assist module assumes the transaction was started by an SNA terminal and immediately passes the input segment to the server. In this case, subsequent I/O PCB calls (as well as database calls) are passed directly through to IMS without further consideration.)

2. Transaction Initiation Message (TIM)

   If the message was sent by the Listener, the initial message segment is the transaction initiation message (TIM); the Assist module ***does not*** return it to the server. Instead, the Assist module uses the TIM contents to issue the TAKESOCKET to establish connection between the client and the server program.

3. Server input data

   After the server owns the socket, the Assist module issues a GN to retrieve the first segment of the client input message and returns it to the server program. Thus, the server program never sees the TIM; it receives the first data segment in response to its GU. Subsequent GN calls from the server cause the Assist module to retrieve the remaining segments of the message. When the Assist module reads the last input segment for that transaction from the message queue, it receives a QD status code from IMS, which it returns to the server program.

   After the initial GU to the I/O PCB, server GN calls, ISRT calls, and database calls can be intermixed.

4. Server output data

   When the server program issues ISRT calls to send output message segments to the client, the IMS Assist module accumulates the output segments, up to maximum of 32KB, into a buffer.

5. Commit

   The server signals completion by issuing a GU to the I/O PCB.

6. TCP/IP writes application data to the client.

   When the server issues the GU, the Assist module issues WRITE calls to send the data to the client and passes the GU to the IMS Transaction Manager to commit the database changes.

7. Confirmation

   If the GU is successful, (that is, QC status or spaces) the Assist module sends a complete-status message segment (CSM) to the client to confirm the successful commit and passes the status code back to the server.

8. Close the socket

   After the complete-status message has been sent to the client, the Assist module closes the socket, ending the connection.

   If the GU in the previous step resulted in a 'bb' status code (indicating successful return of another message) the program logic returns to step 2 to process the new message.

How the IMS Listener manages multiple connection requests

The IMS Listener uses two queues for the management of connection requests:

1. The *backlog* queue (managed by MVS TCP/IP) contains client connection requests that have not yet been accepted by the Listener. If a client requests a connection while the backlog queue is full, TCP/IP rejects the connection request. The number of requests allowed in the backlog queue is specified in the LISTENER startup configuration statement (BACKLOG parameter), see "LISTENER statement" on page 46.
2. The *active sockets* queue contains the sockets that are held by the Listener while they wait for assignment to a server program. After the Listener has accepted the connection, the connection belongs to the Listener until it is accepted by the server. If the Listener uses all of its sockets and cannot accept any more connections, subsequent requests go into the backlog queue. The maximum

number of sockets available is specified in the LISTENER startup configuration statement, (MAXACTSKT parameter), see "LISTENER statement" on page 46.

Tip: The backlog value specified on the listen call cannot be larger than the value configured by the SOMAXCONN statement in the stack's TCPIP PROFILE (the default value is 10). No error is returned if a larger backlog is requested. If you want a larger backlog, update the SOMAXCONN statement. See the z/OS Communications Server: IP Configuration Reference for details.

Use of the IMS message queue

In conventional 3270 applications, the IMS message queue is a mechanism for passing communications between an MPP and another entity, such as a 3270-type terminal, or another message processing program (MPP). The IMS TCP/IP feature uses the message queue for communication between the Listener and the MPP. Messages from and to TCP/IP hosts bypass IMS message format services (MFS). The following information describes how IMS TCP/IP uses the IMS message queue:

Input messages

(Messages that are *input* to the MPP)

- Explicit-mode transactions use only the message queue to pass the transaction initiation message (TIM) from the Listener to the server. All application data sent by the client is received by the server using sockets READ calls, thus bypassing the IMS message queue.
- Implicit-mode transactions use the message queue both for the TIM (which is trapped by the Assist module and not passed on to the server) and for all client-to-server application data (which is passed to the server in response to IMS GU, GN calls).

Output messages

All messages that are *output* from the server go directly via TCP/IP to the client; they do not pass through the message queue.

- Explicit-mode servers use socket WRITE calls to send application data directly to the client.
- Implicit-mode servers use the IMS ISRT call for output, but the inserted data is trapped by the Assist module which, in turn, issues socket WRITE calls to send the data to the client.

Call sequence for the IMS Listener

Although you will probably not be writing a Listener program, it is important that you match the sequence of calls issued by the Listener when you write your client program. The Listener call sequence is:

INITIALIZE LISTENER

INITAPI
: Connect the Listener to MVS TCP/IP at Listener startup. (This call is used only in programs written to the Sockets Extended interface.

SOCKET
: Create a socket descriptor.

BIND
: Allocate the local port for the socket. This port is used by clients when requesting connection to IMS.

LISTEN
: Create a queue for incoming connections.

WAIT FOR CONNECTION REQUEST

SELECT
: Wait for an incoming connection request.

ACCEPT
: Accept the incoming connection request; create a new socket descriptor to be used by the server for this specific connection.

READ
Read TRM; determine the IMS TRANCODE.

CHNG
Change the modifiable alternate PCB to reflect the desired IMS TRANCODE.

INQY
Ensure the desired IMS TRANCODE is available for scheduling.

ISRT
Use the alternate PCB to insert the transaction initiation message (TIM) and pass control information and user input data to the server.

GIVESOCKET
Pass the newly created socket to the server.

SYNC
Schedule the requested transaction.

SELECT
Wait for the server to take the socket.

CLOSE
Release the socket.

END OF CONNECTION REQUEST

Return to "WAIT FOR CONNECTION REQUEST"

SHUTDOWN LISTENER

CLOSE
Close the socket through which the Listener receives connection requests from MVS TCP/IP.

TERMAPI
Disconnect the Listener from MVS TCP/IP before shutting down.

Application design considerations

The following information is a set of guidelines and limitations that should be considered when you are designing IMS TCP/IP applications.

Programs that are not started by the IMS Listener

In most cases, IMS server applications are started by the IMS Listener. Such programs are known as *dependent* programs because the Listener establishes the TCP/IP connection.

Under some circumstances, application design considerations require an application to establish its own connection between TCP/IP and IMS. For example, an IMS message processing program (MPP) might require the services of a UNIX processor that is connected through TCP/IP. An IMS application of this type is known as an *independent* program because it is not started by the Listener. Because independent programs do not use Listener services, they must define their own protocol.

When the client is an IMS MPP

For this example, the underlying assumption is that the TCP/IP host acts as client and the IMS MPP acts as server; however, this is not always the case.

Consider an IMS MPP that requires the services of an AIX® host that is connected through TCP/IP. Such an MPP (acting as a client) initiates a TCP/IP conversation by issuing the ***client*** TCP/IP call sequence. The TCP/IP host would respond with the ***server*** TCP/IP call sequence. This application design is supported because the MPP communicates directly with MVS TCP/IP. The IMS TCP/IP feature does not impose any unique restrictions on the type and usage of socket calls issued by such a program; however, because of the unique and unstructured communication requirements of this application design, you must use explicit mode for this type of program.

Abend processing

When a task that owns a socket fails, MVS TCP/IP closes the socket. Therefore, when an IMS MPP abnormally ends as a the result of an error condition, regardless of the reason, the socket is no longer available and communication between the server and the client is no longer possible.

True abends

If an IMS TCP/IP server program abnormally ends (for example, because of an S0Cx condition), database changes in progress are backed out and the transaction task is terminated, which breaks the TCP/IP connection. When the connection is broken, the client receives a negative status code and an error number that indicates that the connection has been broken. Upon receipt of this indication, the client should assume that the transaction did not complete and that the database changes have not been made. The client could reschedule the transaction, but the IMS TM will have probably stopped it from further running as a result of the abnormal end.

The solution is to correct the reason for the abnormal end and restart the transaction.

Pseudo abends

Under certain situations IMS applications cannot complete. When such a condition occurs, IMS abnormally ends the MPR with a status code (such as U0777) and reschedules it. This action is not apparent to the conventional 3270-type user.

However, when an IMS TCP/IP transaction is abnormally ended, the action is apparent to the client because the connection between client and server is lost when the server MPR is abnormally ended. In this case, IMS TM reschedules the transaction and places the input message (including the TIM) back on the message queue. When the transaction is rescheduled and issues a GU for the TIM, the socket described in the TIM no longer represents a valid connection. and the associated TAKESOCKET call fails. At this time, the Assist module detects the failure of the socket call and returns a ZZ status code to the server program. Upon receipt of this status code, the server program should end normally.

Note: At the time of the abnormal end, the IMS TM backs out database changes, so the client should restart the transaction.

Guideline: For deadlock situations you should define the transaction as INIT STATUS GROUP B, which allows the application program to regain control after a deadlock with a BC status code (instead of terminating with a U0777 abend). The server program can regain control after the deadlock and notify the client while the connection is still available.

Implicit-mode support for ROLB processing

If a server program issues the IMS ROLB call, all database changes are reversed, and all output messages are erased from the IMS message queue. However, the client is not automatically notified of this action and will (when the transaction completes normally) receive a CSMOKY message, indicating normal completion.

As a result, for transactions that conditionally issue the ROLB call, the server should send a message to the client indicating whether the ROLB command was issued. Otherwise, the client might incorrectly interpret the CSMOKY message to mean that database changes have been made (when in fact, the message simply denotes successful termination of the transaction).

Restrictions for operation of the Listener and the Assist module

- Transactions must be defined as MODE=SNGL in the IMS TRANSACT macro; this ensures that the database buffers are emptied (flushed) to direct access storage when the second and subsequent GU calls are issued.
- Transactions must not reference other systems (MSC is not supported).
- Transactions must not be conversational [that is, they must not use the IMS Scratch Pad Area (SPA)].

Chapter 4. How to write an IMS TCP/IP client program

When writing an IMS TCP/IP client program, the programmer must follow conventions established by the IMS Listener and by the IMS Assist module (if used). This information describes the call sequences and input/output data formats to be used by the client program. For server programming, see Chapter 5, “How to write an IMS TCP/IP server program,” on page 37.

In this information, a "client" is typically a TCP/IP host that is requesting the services of an IMS message processing program (MPP). This is considered to be the normal case. However, in some situations, an MPP can start as a server and then (because it needs the services of another program) switch roles from server to client.

In this information, the client will be assumed to be the TCP/IP host and the server, the IMS MPP.

General client program logic flow

For both explicit- and implicit-mode clients the logic flow is essentially the same:

The client initiates the request for a specific IMS MPP server by communicating with MVS TCP/IP, which passes the request on to the IMS Listener. The Listener schedules the transaction and the client then exchanges application data with the server. When the transaction is complete, the connection is closed; each client request for an IMS transaction requires a new TCP/IP connection.

The following topics provide more details about the programming requirements for explicit-mode and implicit-mode clients, respectively.

Explicit-mode client program logic flow

When the client requests the services of an explicit-mode server, the only protocol imposed by IMS TCP/IP is that the client must begin by establishing TCP/IP connectivity and sending a transaction-request message (TRM).

The Listener uses contents of the transaction-request message (TRM) to determine which transaction to schedule. If the request is not accepted (for example, because of failure to pass the security exit, or because the transaction was stopped by the IMS master terminal operator), the Listener returns a request-status message (RSM) to the client with an indication of the cause of failure. (See “Request-status message segment” on page 34 for the format of the request-status message).

Once an explicit-mode client and server are in communication, there is no predefined input/output protocol. Rules of the conversation are established by agreement between the two programs. Any number of READ/WRITE calls can be issued. Upon termination, the server program should commit any database changes, notify the server of successful completion, and close the socket.

It is suggested that, when all database updates have been committed, the server notify the client by sending a "success" message to the client. This notifies the client that the transaction has completed properly and that all database updates have been committed. Unless such a message is sent, the client has no way of knowing that the transaction completed properly.

Explicit-mode client call sequence

The call sequence to be used by an explicit-mode client program is:

Call
  Explanation of Function

INITAPI
Open the interface. (Required only for client programs that use MVS TCP/IP socket calls).

SOCKET
Obtain a socket descriptor.

CONNECT
Request connection to the IMS Listener port.

WRITE
Send a transaction-request message (TRM).

READ
Test for successful transaction initiation. [10]

WRITE/READ
Explicit-mode transactions can issue any number of READ or WRITE socket call sequences.

READ
Ensure that the server ended normally and that the database changes are committed.

CLOSE
Terminate the connection and release socket resources.

Explicit-mode application data

The following information describes explicit-mode application data.

Format

Explicit-mode clients must initiate the connection with the server by sending the transaction-request message (TRM) to the IMS host. The format of this message is defined later in this topic. Explicit-mode application data is formatted according to agreement between client and server. Explicit-mode imposes no application data format requirements.

Data translation

In explicit-mode, application data translation from ASCII to EBCDIC (if necessary) is the responsibility of the client and server programs. Data is not translated by the IMS TCP/IP feature.

Network byte order

Fixed-point binary integers (used for segment lengths in TRM and RSM) are specified using the TCP/IP network byte ordering convention (big-endian notation). This means that if the high-order byte is stored at address n, the low-order byte is stored at address n+1. (Little-endian notation stores the other way around).

MVS also uses the big-endian convention. Because this is the same as the network convention, IMS TCP/IP MPP's should not need to convert data from little-endian to big-endian notation. If the client uses little-endian notation, it is responsible for the conversion.

End-of-message indicator

IMS TCP/IP does not define an End-of-message indicator for explicit-mode messages.

[10] If the Listener is unable to initiate the transaction, it sends a request-status message (RSM) to the client indicating the reason for failure. Therefore, the client must be prepared to receive that message. It is suggested that a convention be established that the server initiate the conversation by sending an opening message. By following this convention, the client will receive either positive or negative notification of transaction status before initiating application data exchange.

Implicit-mode client logic flow

When the client requests the services of an implicit-mode client, the protocol is predefined by IMS TCP/IP.

The client requests an IMS MPP by sending the transaction-request message (TRM). (See "Transaction-request message segment (client to Listener)" on page 33 for the format of the TRM.) The TRM includes the name of the transaction the Listener is to schedule.

If the transaction cannot be scheduled (for example, because of failure to pass the security exit, or because the transaction was stopped by the IMS master terminal operator), the Listener returns the request-status message with an indication of the cause of failure. (See "Request-status message segment" on page 34 for the format of the request-status message).

For implicit-mode applications, the input data stream consists of the TRM, immediately followed by all segments of application data and an end-of message-segment. The Listener uses the TRM contents to schedule the server and then places the TIM and all of the application data on the IMS message queue for retrieval by the Assist module.

Implicit-mode transactions are limited to one multisegment input message and one multisegment output message. In other words, implicit-mode applications cannot enter into conversations.

When the transaction is complete, the IMS Assist module sends a complete-status message (CSMOKY) segment to the client. If the client receives this message, the client can safely assume that the database changes have been committed. If the client doesn't receive this message, the client cannot determine what has happened. The transaction might have completed normally and database changes committed, or the transaction might have failed with database changes backed out. For this reason, clients that work with implicit mode servers should include application logic that, upon failure to receive the CSMOKY message segment, reestablishes contact with IMS and confirms the success of the previously submitted update.

Implicit-mode client call sequence

The call sequence to be used by an implicit-mode client program is:

Call
: **Explanation of Function**

INITAPI
: Open the interface. (Required only for client programs that use MVS TCP/IP Sockets calls).

SOCKET
: Obtain a socket descriptor.

CONNECT
: Request connection to the IMS Listener port.

WRITE
: Send a transaction-request message (TRM).

WRITE
: Send server input data formatted as IMS segments.

READ
: Receive response.

- If the request was rejected, a request-status message (RSM) will be received.
- If the transaction was scheduled and executed properly, application data will be received.

Thus, logic in the client must test the output message for the characters *REQSTS* to distinguish between application data and a request-status message (RSM).

READ
: Upon successful completion of the database updates, the Assist module sends a complete-status message (*CSMOKY*) to the client, indicating that the transaction has completed successfully.

If this message is not received, the client must assume that the application failed to complete properly; in this case, a return code of –1 and ERRNO (typically set to 54) will indicate that application failed. The client must take whatever action is appropriate (for example, reschedule the transaction, resynchronize data).

CLOSE
Terminate the connection and release the socket resources.

Implicit-mode application data stream

The following information describes the types of implicit-mode application data streams.

Client-to-server data stream

In implicit mode, the client sends the following data stream:

llzz transaction-request message (TRM) *llzz* application data segment 1 *llzz* application data segment 2 (optional) *llzz* ... *llzz* application data segment n (optional) *04zz* end-of-message segment

WHERE:

ll
The length in bytes of this data segment in binary.

zz
Reserved; must be set to binary.

transaction-request message (TRM)
The initial client request.

application data segment 1 – n
Data to be passed to the server application.

end of message segment
A segment with no data. Therefore, its segment length is 04 (2 for the length field plus 2 for the reserved field.)

Server-to-client data stream

Data received by the client is formatted (by the Assist module) as above. It consists of n segments of application data including the CSM segment, followed by an end-of-message segment.

Implicit-mode application data

The following information describes implicit-mode application data.

Format

Data exchanged between implicit-mode client and server is transmitted in a format that resembles an IMS message segment. These segments have the following format: [11]

Field	Format	Description
Length	H	Length of the data segment (including this field)
Reserved *(zz)*	CL2	Reserved field
Data	CLn	Client-supplied data

The length field contains the total length of the message in binary. The length (*ll*) includes the length of the *ll* and *zz* fields.

[11] This example uses Assembly language notation. See Chapter 7, “CALL instruction application programming interface,” on page 51 for COBOL and PL/I equivalents.

Data translation

The IMS Listener tests the initial input data string (the TRM) to determine whether the terminal is transmitting in ASCII. If the terminal is transmitting in ASCII, and the transaction is defined as ***implicit***-mode in the TRANSACTION configuration statement, the Listener translates the ASCII application data into EBCDIC.

Note: When data translation takes place, the entire application data portion of the segment is translated from ASCII to EBCDIC, and vice versa; therefore, the segment should contain only printable characters that are common to both character sets. (For example, the EBCDIC cent sign and the ASCII left square bracket are both printable in their respective native environments, but they are not translated because they do not have an equivalent in the other character set.)

End-of-message segment

The last segment in a message (either sent by the client, or received from the server) is indicated by an end-of-message (EOM) segment. (See "End-of-message segment (EOM)" on page 35).

- Implicit-mode messages sent by the client are received by the Listener. When the client program sends an EOM segment, the Listener interprets the EOM as an indication that no more message segments are to be received and inserts the segments onto the IMS message queue.
- Implicit-mode messages received by the client are actually written by the Assist module on behalf of the server program. When the server program sends application data to the client (using the ISRT call), the Assist module intercepts the output data and accumulates it in an output buffer. When the server program issues a subsequent GU to the I/O PCB, the Assist module interprets the GU as an indication that the server has inserted the last segment for that message. The Assist module then adds an end-of-message segment to the output data and issues WRITE commands, which transmit the data to the client. (The client program should test for the EOM segment to determine when the last segment of the message has been sent by the server program.)

IMS TCP/IP message segment formats

The client sends or receives several types of message segments whose formats are defined by the Listener and the Assist module.

- Transaction-request message segment (TRM)
- Request-status message segment (RSM)
- Complete-status message segment (CSMOKY)
- End-of-message segment (EOM)

The following paragraphs describe the formats for each of these segments:

Transaction-request message segment (client to Listener)

To initiate a connection with an IMS server, the client first issues a transaction-request message segment (TRM), which tells the Listener which transaction to schedule.

The format of the transaction-request message segment (TRM) is:

Field	Format	Meaning
TRMLen	H	Length of the segment (in binary) including this field. This field is sent in network byte order.
TRMRsv	CL2	Reserved

Field	Format	Meaning
TRMId	CL8	Identifying string. Always *TRNREQ*. If the client data stream will be sent in ASCII, the TRMId field should also be transmitted in ASCII because the Listener uses this field to determine whether ASCII to EBCDIC translation is required.
TRMTrnCod	CL8	The transaction code (TRANCODE) of the IMS transaction to be started. It must not begin with a / character; it must follow the naming rules for IMS transactions. If the Listener has determined that data will be transmitted in ASCII, it translates the transaction code to EBCDIC before any further processing is done.
TRMUsrDat	XLn	This variable-length field contains client data that is passed directly to the security exit without translation.

Request-status message segment

If a transaction request is accepted, the IMS Listener does not send the request-status message segment; if the transaction request is rejected, the IMS Listener sends a request-status message segment (RSM) to the client. This segment has the following format:

Field	Format	Description
RSMLen	H	Length of message (in binary), including this field.
RSMRsv	CL2	Reserved
RSMId	CL8	Identifying string. Always *REQSTS*. This field is translated to ASCII if the Listener has determined that the client is transmitting in ASCII.
F	Return code, sent in network byte order. Set to nonzero (for example, 4, 8, 12) to indicate an error. The nonzero value is further explained by the reason code (RSMRsnCod).	
RSMRsnCod	F	Reason Code, sent in network byte order. Reason codes 0 — 100 are reserved for use by the IMS Listener. Codes greater than 100 can be assigned by the user-written security exit.

Request-status message reason codes

If the IMS Listener sends a request-status message (RSM) segment to the client (indicating that it is unable to complete the processing of the client's transaction-request message (TRM), it sets the return and reason code in the RSM.

- If the security exit rejects a transaction request, it sets the return code and reason code, and returns control to the Listener, which sends the request-status message segment to the client.
- If the Listener detects other errors that cause a request to be rejected, it sets a return code of 8 and a reason code from the following list.

1
: The transaction was not defined to the IMS Listener.

2
: An IMS error occurred and the transaction was unable to be started.

3
: The transaction failed to perform the TAKESOCKET call within the 3 minute time frame.

4
: The input buffer is full as the client has sent more than 32KB of data for an implicit transaction.

5
: An AIB error occurred when the IMS Listener tried to confirm if the transaction was available to be started.

6
: The transaction is not defined to IMS or is unavailable to be started.

7
: The transaction-request message (TRM) segment was not in the correct format.

9
: The application data buffer for the Client-to-Server Data Stream contains an invalid value for the data segment length.

100 up
: Reason codes of 100 or higher are defined by the user-supplied security exit.

Complete-status message segment

The complete-status message segment is sent by the Assist module to indicate the successful completion of an implicit-mode transaction, including the fact that database updates have been committed. The format of the complete-status message segment is:

Field	Format	Description
Length	H	Length of the data segment (in binary) including this field
CSMRsv	H	Reserved field; must be set to zero
CSMId	CL8	*CSMOKY* This field is translated to ASCII if the client is transmitting in ASCII.

End-of-message segment (EOM)

The end-of-message segment is defined as an IMS-type segment (with *llzz* fields) but no application data. Thus, the EOM segment has an *llzz* field of '0400'; 04 is the length of the *llzz* field.

PL/I coding

PL/I programmers should note that (although the segments exchanged between the Listener and implicit-mode servers resemble IMS segments) the segments are actually sent by TCP/IP socket calls and do not necessarily follow the standard IMS convention for the PL/I language interface. Specifically, the length field in a segment (TRM or RSM), which is passed via a TCP/IP socket call, ***must*** be a halfword (FIXED BIN(15)) and not a fullword.

Chapter 5. How to write an IMS TCP/IP server program

When writing an IMS TCP/IP server program, the programmer must follow conventions established by the IMS Listener; by the IMS Assist module (if the server program uses it); and by the TCP/IP client. This topic describes the call sequences and input/output formats necessary for communication between a TCP/IP client program and an IMS server program. (See Chapter 4, "How to write an IMS TCP/IP client program," on page 29 for a discussion of client programming).

General server program logic flow

An IMS TCP/IP server program is executed in response to a transaction request from a TCP/IP host. The server program can either explicitly issue TCP/IP socket calls, or implicitly issue them through the IMS Assist module. However, the same TCP/IP functions are completed in either case.

The following topics describe the server logic flow for each mode.

Explicit-mode server program logic flow

When an explicit-mode server begins execution, the Listener has received the transaction-request message (TRM) from the client and has inserted the transaction-initiation message (TIM) to the IMS message queue. The Listener has also issued a GIVESOCKET call to pass the connection to the server.

The server's first action is to obtain the TIM from the IMS message queue. This message contains the information needed to issue the INITAPI and TAKESOCKET calls.

Once the server has issued the TAKESOCKET call, the connection is between client and server; the two can now communicate directly using socket READ/WRITE calls. The number of reads/writes, and the format of the data exchanged, is determined by agreement between the two programs.

At the end of processing a client's request, the application program should follow the IMS DC programming standard of issuing another GU to the IO/PCB. This informs IMS that the database changes should be committed, and that the database buffers should be emptied (flushed).

Note: For this reason, a transaction invoked by a TCP/IP client should be defined (by the IMS-gen TRANSACT macro) as MODE=SNGL.

Explicit-mode call sequence

The suggested call sequence for an explicit-mode server follows. See Chapter 7, "CALL instruction application programming interface," on page 51 for the call syntax of the socket calls.

Server call
: **Explanation of Function**

CALL CBLTDLI (GU) I/O PCB
: Obtain transaction-initiation message (TIM) from IMS message queue.

INITAPI
: Initialize the connection with TCP/IP.

  Parameter
  : **Meaning**

  ADSNAME
  : Server address space (TIMSrvAddrSpc from the TIM)

SUBTASK
Server task ID (TIMSrvTaskID from the TIM)

TCPNAME
TCP address space (TIMTCPAddrSpc from the TIM)

TAKESOCKET
Accept the socket from the Listener.

Parameter
Meaning

CLIENT.name
Listener address space (TIMLstAddrSpc from the TIM)

CLIENT.task
Listener task ID (TIMLstTaskID from the TIM)

SOCRECV
Socket descriptor (TIMSktDesc from the TIM)

Note that the TAKESOCKET call returns a new socket descriptor which must be used for the rest of the process. (Do not continue to use the descriptor passed by the Listener in TIMSktDesc.)

READ/WRITE
Exchange application data with the client.

Database calls
Read/write database records.

Note: TCP/IP and database calls can be intermixed.

GU
Force IMS synchronization point; update the database from the buffers.

WRITE
Send complete-status message to the client.

CLOSE
Shut down the socket and release resources associated with it.

TERMAPI
End processing on the call interface.

Explicit-mode application data

The following information describes explicit-mode application data.

Format

Other than the initial transaction-initiation message, explicit-mode imposes no restrictions on the format of application data exchanged between client and server.

EBCDIC and ASCII data translation

If the TCP/IP host is transmitting ASCII data, explicit-mode servers are responsible for data translation from EBCDIC to ASCII and from ASCII to EBCDIC. Data translation is not performed by IMS TCP/IP. You can use the data translation subroutines (EZACIC04 and EZACIC05 or EZACIC14 and EZACIC15) described in Chapter 7, "CALL instruction application programming interface," on page 51 for this purpose.

When the conversation is complete, the server should force an IMS commit and close the connection. This causes IMS to complete the database updates. Explicit-mode server logic is responsible for notifying the client of the success or failure of the commit process.

Transaction-initiation message segment

Once the server has been started, the first segment it receives from the message queue is the transaction-initiation message (TIM) segment, which was created by the IMS Listener.

Field	Format	Explanation
TIMLen [12]	H	The length of the transaction-initiation message segment (in binary) , including the length of this field. (X'0038')
TIMRsv	H	Reserved field set to zero. (X'0000').
TIMId	CL8	Identifies the message as having been created by the IMS Listener. Always contains the characters *LISTNR*.
TIMLstAddrSpc	CL8	Listener address space name. Used in server TAKESOCKET.
TIMLstTaskId	CL8	Listener task ID. Used in server TAKESOCKET.
TIMSrvAddrSpc	CL8	Server address space name. Used in server INITAPI. Server address space IDs are generated by the Listener and consist of the 2-character prefix specified in the Listener configuration file (Listener statement) followed by a unique 6-character hexadecimal number.
TIMSrvTaskID	CL8	Server task ID. Used in server INITAPI.
TIMSktDesc	H	Contains the descriptor of the socket given by Listener. Used in server TAKESOCKET.
TIMTCPAddrSpc	CL8	The TCP/IP address space name of TCP/IP. Used in INITAPI.
TIMDataType	H	Indicates the data type of the client messages: ASCII(0) or EBCDIC(1).

Program design considerations

- Because MVS TCP/IP ends the connection when a server MPP completes, the client has no way of knowing that the database changes have been committed. Therefore, it is suggested that explicit-mode servers send a message to the client confirming the COMMIT before terminating. (Implicit-mode servers send the CSMOKY segment when the database changes have been committed.)
- When an explicit-mode server issues a ROLB command, the client has no automatic way of knowing that the database updates have been rolled back. It is suggested, therefore, that the server send a message to the client when a rollback call completes.

[12] If you use PL/I, you must define the LLLL field as a binary fullword.

I/O PCB explicit-mode server

When an IMS MPP issues a call for IMS TM services (like a GU or an ISRT), IMS returns information about the results of the call in a control block called the I/O program control block (I/O PCB). The contents of the I/O PCB are:

LTERM NAME
Blanks (8 bytes)

RESERVED
X'00' (2 bytes)

STATUS CODE
See "Status codes" on page 40 (2 bytes)

DATE/TIME
Undefined (8 bytes)

INPUT MSG. SEQ. #
Undefined (4 bytes)

MESSAGE OUTPUT DESC. NAME
Blanks (8 bytes)

USERID
PSBname of Listener (8 bytes)

Status codes

The I/O PCB status code is set by IMS in response to the server GU for the TIM. A status code of bb indicates successful completion of the GU call. Because the only data explicit-mode servers receive from the message queue is the TIM, the only call issued by the server is a GU, requesting a new TIM. Thus, the only status codes an explicit-mode server should receive are bb, which indicates successful completion of the GU; and QC, which indicates that there are no more messages on the message queue for that transaction. In response to the QC status code, the server program should end normally.

Explicit-mode server PL/I programming considerations

PL/I programmers should note that I/O areas used to retrieve IMS segments must follow standard IMS conventions. That is, the length field for the TIM segment must be defined as a fullword (FIXED BIN(31)).

Implicit-mode server program logic flow

An implicit-mode server must perform all of the functions previously described for an explicit-mode server (see "Explicit-mode server program logic flow" on page 37). However, the IMS Assist module issues the TCP/IP calls on behalf of the server program; consequently, the implicit-mode application programmer need issue only standard IMS Input/Output calls.

Implicit-mode server call sequence

When writing an implicit-mode program, you must call the IMS Assist module (CBLADLI, PLIADLI, ASMADLI, CADLI, as appropriate for the language you are using) instead of the conventional IMS equivalent (CBLTDLI, PLITDLI, ASMTDLI, CTDLI). This will cause the I/O PCB calls to be intercepted and processed (if necessary) by the Assist module. The Assist module will pass database calls directly to IMS for processing; it will intercept I/O PCB calls and issue the appropriate sockets calls. A sample call sequence (using COBOL syntax) for an implicit-mode server follows:

IMS Server Call
Resulting Assist Module Function

CALL CBLADLI (GU) I/O PCB
Issue CALL CBLTDLI (GU) to obtain the (TIM).

CALL CBLADLI (GN) I/O PCB
(optional) Issue CALL CBLTDLI (GN), which returns a subsequent segment of client input data for each call.

CALL CBLADLI
Read/write database records. [13]

CALL CBLADLI (ISRT) I/O PCB
Store segments in the sockets output buffer.

CALL CBLADLI (GU) I/O PCB
Issue WRITE to empty output buffers.

Implicit-mode application data

The following information describes implicit-mode application data.

Format

All data exchanged between the client and an implicit-mode server is formatted into IMS segments. Each data segment has the following format:

Field	Format	Description
Length	H	Length of the data segment (in binary) including this field.
Reserved	H	Reserved field; must be set to zero.
Data	CLn	Application data.

Data translation

Translation of input data (when necessary) is done by the Listener. As a result, all data on the IMS message queue is in EBCDIC; output data is translated (when necessary) by the Assist module.

Note that when data translation takes place, the entire application data portion of the segment is translated from ASCII to EBCDIC, and vice versa; therefore, the segment should contain only printable characters common to both character sets. (For example, the EBCDIC cent sign and the ASCII left bracket are both printable in their respective environments but are not translated because they do not have an equivalent in the other character set.)

End-of-message segment

The last segment in a message (either sent by the client, or received from the server) is indicated by an end-of-message (EOM) segment. (See "End-of-message segment (EOM)" on page 35).

- Implicit-mode messages sent by the client are received by the Listener and inserted onto the IMS message queue. The end-of-message segment indicates to the Listener that there are no more segments to be inserted for this message.

  Note: The server program will ***not*** receive the EOM segment; it will receive a QD status code, indicating that there are no more segments for this message.

- Implicit-mode messages to be sent by the server are actually written by the Assist module on behalf of the server program. When the server program sends application data to the client (using the ISRT call), the Assist module intercepts the output data and accumulates it in an output buffer. When the server program issues a subsequent GU to the I/O PCB, the Assist module interprets the GU as an indication that the server has inserted the last segment for that message. The Assist module then adds an end-of-message segment to the output data and issues WRITE commands, which transmit the data to the client.

  Note: The server program should ***not*** attempt to insert an EOM segment to the I/O PCB.

[13] Database PCB and I/O PCB calls can be intermixed.

Programming to the Assist module interface

Programs written to the Assist module interface are very similar (in terms of I/O calls) to conventional IMS Transaction Manager (TM) MPPs.

- To communicate with IMS TM, use the following calls (depending upon programming language) — CBLADLI, PLIADLI, ASMADLI, or CADLI — instead of CBLTDLI, PLITDLI, ASMTDLI, and CADLI, respectively.
- Use the same parameters as with the IMS TM counterparts.
- The first IMS call to the I/O PCB must be GU. Subsequent IMS calls to the I/O PCB can be GN and/or ISRT (with intervening database calls, as appropriate).
- When the transaction is complete, the server program should issue another GU to the I/O PCB to finalize processing of the present message. If the server program receives a bb status code, (indicating another message has been received for that program), it should loop back and process that message. Note that the Assist module will have closed the previous connection and opened a new connection associated with the new message. When the GU returns a QC status code, no more messages have been received for that program and the program should end.

  A set of one GU, one or more GN calls, and one or more ISRT calls to the I/O PCB (with intervening database calls, as required) constitute a transaction. The Assist module interprets each GU as the start of a new transaction.
- The PURG call cannot be used to indicate end-of-message; the server should not issue PURG calls to the I/O PCB.
- The Assist module GU reads the TIM into the I/O area defined in the server program; consequently, the I/O area you define in the server must be at least 56 bytes in length (the length of the TIM).
- If the server program attempts to insert more than 32KB, the Assist module flags this as an error by terminating processing and returning a status code of ZZ.

Implicit-mode server PL/I programming considerations

PL/I programmers should note that I/O areas passed to the Assist module must follow standard IMS conventions. That is, the length field for a segment must be defined as a fullword (FIXED BIN(31)). This applies to both input and output data segments; however, the actual segment that is received from and sent to the client uses a halfword (FIXED BIN(15)) length field. Thus, the messages exchanged between the client and server are programming-language independent.

Implicit-mode server C language programming considerations

The following statements are required in IMS implicit-mode servers written in C language:

```
#pragma runopts(env(IMS),plist(IMS))
#pragma linkage(cadli, OS)
```

This is in addition to the standard requirements for using C language programs in IMS.

I/O PCB implicit-mode server

When an IMS MPP issues a call for IMS TM services (like a GU or an ISRT), IMS returns information about the results of the call in a control block called the I/O program control block (I/O PCB). When using the Assist module, the contents of the I/O PCB are:

LTERM NAME
Blanks (8 bytes)

RESERVED
See "Status codes" on page 43 (2 bytes)

STATUS CODE
See "Status codes" on page 43 (2 bytes)

DATE/TIME
Undefined (8 bytes)

INPUT MSG. SEQ. #
Undefined (4 bytes)

MESSAGE OUTPUT DESC. NAME
Blanks (8 bytes)

USERID
PSBname of Listener (8 bytes)

Status codes

The I/O PCB status code is set by IMS in response to the IMS calls that the Assist module makes on behalf of the server. For example, GU and GN calls usually result in bb, QC, or QD status codes. However, when the Assist module detects a TCP/IP error, it sets the status code field of the I/O PCB to ZZ with further information about the error in the **reserved** field of the I/O PCB. This field should be initially tested as a signed, fixed binary halfword:

- If the halfword is positive, then a socket error has occurred, and the field should continue to be treated as a signed fixed binary halfword. The field contains the 2 low-order bytes from the ERRNO resulting from the socket call. (See Appendix A, “Return codes,” on page 269).
- If the halfword is negative, then an IMS or other type of error has occurred, and the field should be treated as a fixed-length, 2-byte character string containing one of the following information:

  Code
  Meaning

  EA
  A call that used the AIB interface to determine the I/O PCB address failed.

  EB
  The output buffer is full. An attempt was made to insert (ISRT) more than 32KB (including the segment length and reserved bytes) to be sent to the client.

  EC
  A QD status code was received in response to a GU or ROLB call when attempting to retrieve the first segment of data after the transaction-initiation message (TIM) segment. This implies that the client sent only the TIM segment followed by an end-of-message segment with no actual data segments.

Chapter 6. How to customize and operate the IMS Listener

The IMS Listener is an IMS batch message program (BMP) whose main purpose is to validate connection requests from TCP/IP clients and to schedule IMS message processing programs (MPP) servers.

This topic describes the IMS Listener and the user-written security exit that can be used to validate incoming transaction requests.

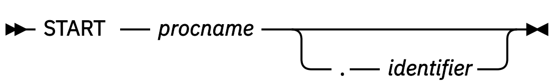
How to start the IMS Listener

The IMS Listener is executed as an MVS 'started task' using job control language (JCL) statements. Copy the sample job in the *hlq*.SEZAINST(EZAIMSJL) to your system or recognized PROCLIB and modify it to suit your conditions. The following information shows a sample of the JCL needed for the Listener BMP. Note the STEPLIB statements pointing to MVS TCP/IP. Also note the `EZAIMSJL G.LSTNCFG DD` statement points to the Listener configuration file. For more information on configuring the IMS Listener, see "The IMS Listener configuration file" on page 46.

```
//EZAIMSJL   PROC MBR=EZAIMSLN,PSB=EZAIMSLN,IMSID=IMS,CFG=TCPIMS,SOUT=A
//*
//LISTENER   EXEC PROC=IMSBATCH,MBR=&MBR.,SOUT=&SOUT.,IMSID=&IMSID.,
//           PSB=&PSB.,CPUTIME=1440
//G.STEPLIB  DD DSN=IMSVS31.&SYS2.RESLIB,DISP=SHR
//           DD DSN=IMSVS31.&SYS2.PGMLIB,DISP=SHR
//           DD DSN=TCPIP.SEZALOAD,DISP=SHR
//           DD DSN=TCPIP.SEZATCP,DISP=SHR
//G.LSTNCFG  DD DSN=TCPIP.LSTNCFG(&CFG.),DISP=SHR
//G.SYSPRINT DD SYSOUT=&SOUT,DCB=(LRECL=137,RECFM=VBA,BLKSIZE=1374),
//             SPACE=(141,(2500,100),RLSE,,ROUND)
```

Figure 11. JCL: Sample run Listener procedure

Once you have configured your JCL, you can start the Listener using the MVS START command. The basic syntax and parameters of this command are:

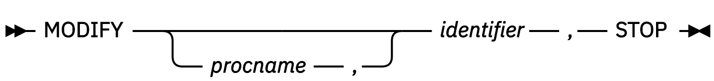


procname
The name of the cataloged procedure that defines the IMS Listener job to be started.

identifier
A user-determined name which, with the procedure name, (*procname*) uniquely identifies the started job. This name can be up to 8 characters long with the first character being alphabetic. If the identifier is omitted, MVS automatically uses the procedure name as the identifier.

How to stop the IMS Listener

The Listener is normally ended by issuing an MVS MODIFY command. The syntax and parameters of this command are:



procname

The name of the cataloged procedure that was used to start the Listener. This is required only if an identifier that was different from *procname* was specified with the START command when the Listener was started.

identifier

The user-determined identifier used on the START command when the Listener was started. If an explicit identifier was not specified (on the START command), MVS automatically uses the procedure name (*procname*) on the START command as the default identifier.

stop

Stops the Listener.

On receipt of a MODIFY command, the Listener closes the socket bound to the listening port so that no new requests can be accepted. It ends once all other sockets have been closed following acceptance of each socket by the corresponding server.

As a BMP, the Listener can be forcibly ended by issuing the IMS STOP REGION command with the ABDUMP option.

The IMS Listener configuration file

The IMS Listener obtains startup parameters from a configuration file. In the `EZAIMSJL G.LSTNCFG DD` statement points to the Listener configuration file. This statement will be in the JCL sample you customize.

The configuration file contains three types of statements which must appear in the following order:

1. TCPIP statement
2. LISTENER statement
3. TRANSACTION statements

The following information describes each of the configuration statements and their respective parameters.

TCPIP statement

Description: This statement is required and is used to specify the name of the TCP/IP address space.

```
►► TCPIP ── ADDRSPC=name ─►◄
```

ADDRSPC= ***name***

Specifies the name of the TCP/IP address space. The name can be 1 to 8 characters long, consisting of the numbers 0–9, the letters A–Z, and the characters $, @, and #.

LISTENER statement

Description: This statement is required. It is used to specify configuration information used by the IMS Listener.

```
►► LISTENER ── PORT=port ── MAXTRANS=maxtrans ── MAXACTSKT=maxskt ── ADDRSPCPFX=prefix ─►

       ┌── BACKLOG=10 ──────┐
 ►─────┼────────────────────┼─►◄
       └── BACKLOG=backlog ─┘
```

PORT= ***port***

Port number that the Listener binds to for connection requests. Use an integer between 0 and 65535, inclusive.

MAXTRANS= ***maxtrans***
: The maximum number of TRANSACTION statements to be processed in the configuration file. Use an integer between 1 and 32767, inclusive.

MAXACTSKT= ***maxskt***
: The maximum number of sockets the Listener can have open awaiting an MPP TAKESOCKET at one time. This value is an integer from 1 to 2000, inclusive. The number includes the socket bound to the port through which it accepts incoming requests.

ADDRSPCPFX= ***prefix***
: One or two characters (consisting of the numbers 0–9, the letters A–Z, and the characters $, @, and #) used in generating unique identifiers for started IMS transactions.

BACKLOG= ***backlog***
: This parameter is optional and is used to specify the length of the backlog queue maintained in TCP/IP for connection requests that have not yet been assigned sockets by the Listener. Use an unsigned number from 1 to 32767 inclusive. The default value is 10.

  Tip: The backlog value specified on the listen call cannot be larger than the value configured by the SOMAXCONN statement in the stack's TCPIP PROFILE (the default value is 10), no error is returned if a larger backlog is requested. If you want a larger backlog, update the SOMAXCONN statement. See the z/OS Communications Server: IP Configuration Reference for details.

TRANSACTION statement

Description: This statement specifies which transactions can be started by the Listener. One statement is required for each transaction that can be initiated by a TCP/IP-connected client.

Note that the transactions named here are subject to limitations:

- They must be defined to IMS as MODE=SNGL in the IMS TRANSACT macro; this will ensure that the database buffers are emptied (flushed) to direct access storage when the second and subsequent GU calls are issued.
- They must not be IMS conversational transactions.
- They cannot name transactions that are executed in a remote Multiple Systems Coupling (MSC) environment.
- They must not use Message Format Services for messages to the client.

```
>>-- TRANSACTION -- NAME=transid -- TYPE= --+-- EXPLICIT --+-->◄
                                            '-- IMPLICIT --'
```

NAME= ***transid***
: The name of an IMS transaction that is designed to interact with a TCP/IP-connected program. This parameter must be 1 to 8 characters long, containing alphanumeric characters, or the characters @, $, and #.

TYPE=
: This parameter specifies whether the transaction uses the IMS Assist module. It must specify either EXPLICIT or IMPLICIT.

The IMS Listener security exit

The IMS Listener includes an exit (IMSLSECX), which can be programmed by the user to perform a security check on the incoming transaction-request. This Listener exit can be designed to validate the contents of the UserData field in the transaction request message.

To use the user-supplied security exit, you must define an entry point named IMSLSECX. If a module with this name is link-edited with the Listener (EZAIMSLN) load module, the security exit is called as part of transaction verification. The security exit is called using standard MVS linkage with register 1 (R1) pointing to the parameter list, shown in Table 4 on page 48. Note that the security exit must have the attribute AMODE(31).

The exit returns 2 indicators: a return code and a reason code. The Listener uses the return code to determine whether to honor the request. Both the return code and the reason code are passed back to the client. Data passed in the UserData field is not translated from ASCII to EBCDIC; this translation is the responsibility of the security exit. (EZACIC05 and EZACIC04 can be used to accomplish translation between ASCII and EBCDIC. See CALL instructions in z/OS Communications Server: IP Sockets Application Programming Interface Guide and Reference for a description of these utilities.)

Table 4. Format of data passed to the security exit

Field	Format	Description
IpAddr	F	The address of a fullword containing the client's IP address.
Port	H	The address of a halfword containing the client's port number.
TransNam	CL8	The address of an 8-character string defining the name of the requested transaction.
DataType	H	The address of a halfword containing the data type (0 if ASCII or 1 if EBCDIC).
DataLen	F	The address of a fullword containing the length of the user data.
Userdata	XLn	The address of the user-supplied data.
RetnCode	F	The address of a fullword set by the security exit to indicate the return status. Set to nonzero (4, 8, 12, ...) to indicate an error.
ReasnCode	F	The address of a fullword set by the security exit as a reason code associated with the value of the return code. Reason codes 0–100 are reserved for use by the Listener. The security exit can use reason codes greater than 100.

TCP/IP services definitions

To run IMS, you need to modify the *tcpip*.PROFILE.TCPIP data set and the *hlq*.TCPIP.DATA data set that are part of the TCP/IP Services configuration file.

Guideline: In this information, the abbreviation *hlq* stands for an installation-dependent *high level qualifier* which you must supply.

The *hlq*.PROFILE.TCPIP data set

You define the hlq.PROFILE.TCPIP data set. In it, you must provide entries for the IMS socket Listener started task name in the PORT statement, as shown in Figure 12 on page 49.

The format for the PORT statement is:

►► port_number — TCP — IMS_socket_Listener_jobname ►◄

As an example, assume you want to define two different IMS control regions. Create a different line for each port that you want to reserve. Figure 12 on page 49 shows 2 entries, allocating port number 4000 for SERVA, and port number 4001 for SERVB. SERVA and SERVB are the names of the IMS socket Listener started task names.

These 2 entries reserve port 4000 for exclusive use by SERVA and port 4001 for exclusive use by SERVB. The Listener transactions for SERVA and SERVB should be bound to ports 4000 and 4001 respectively. Other applications that want to access TCP/IP on MVS are prevented from using these ports.

Ports that are not defined in the PORT statement can be used by any application, including SERVA and SERVB if they need other ports.

```
;
; hlq.PROFILE.TCPIP
; ===================
;
; This is a sample configuration file for the TCPIP address space.
; For more information about this file, see "Configuring the TCPIP
; Address Space" and "Configuring the Telnet Server" in the Planning and
; Customization Manual.
       ..........
       ..........
; ----------------------------------------------------------------------
; Reserve PORTs for the following servers.
;
; NOTE:  A port that is not reserved in this list can be used by
;        any user.  If you have TCP/IP hosts in your network that
;        reserve ports in the range 1-1023 for privileged
;        applications, you should reserve them here to prevent users
;        from using them.
PORT
       ..........
       ..........
  4000 TCP SERVA            ; IMS Port for SERVA
  4001 TCP SERVB            ; IMS Port for SERVB
```

Figure 12. Definition of the TCP/IP profile

The *hlq*.TCPIP.DATA data set

For IMS, you do not have to make any extra entries in *hlq*.TCPIP.DATA. However, you need to check the TCPIPJOBNAME parameter that was entered during TCP/IP Services setup. This parameter is the name of the started procedure used to start the TCP/IP MVS address space. This must match the job name in the Listener configuration file TCPIP statement, as described in "TCPIP statement" on page 46. In the example shown in Figure 13 on page 49, TCPIPJOBNAME is set to TCPV3. The default name is TCPIP.

```
;***********************************************************************
;                                                                     *
;   Name of Data Set:      hlq.TCPIP.DATA                             *
;                                                                     *
;   This data, TCPIP.DATA, is used to specify configuration           *
;   information required by TCP/IP client programs.                   *
;                                                                     *
;***********************************************************************
; TCPIPJOBNAME specifies the name of the started procedure which was
; used to start the TCP/IP address space.    TCPIP is the default.
;
TCPIPJOBNAME TCPV3
       ..........
       ..........
       ..........
```

Figure 13. The TCPIPJOBNAME Parameter in the DATA data set

Chapter 7. 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" on page 51
- "CALL instruction API output register information" on page 52
- "CALL instruction API compatibility considerations" on page 52
- "CALL instruction application programming interface (API)" on page 53
- "Understanding COBOL, Assembler, and PL/I call formats" on page 53
- "Converting parameter descriptions" on page 54
- "Diagnosing problems in applications using the CALL instruction API" on page 54
- "CALL instruction API error messages and return codes" on page 54
- "Code CALL instructions" on page 55
- "Using data translation programs for socket call interface" on page 189
- "Call interface sample programs" on page 203

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 be invoked only in TCB mode (task mode).
Cross-memory mode	These APIs can be invoked only 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.

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 Assembly language. The format and parameters are described for each socket call.

Note:

- Unless your program is running in a CICS environment, reentrant code and multithread applications are not supported by this interface.
- For a PL/I program, include the following statement before your first call instruction.

  ```
  DCL EZASOKET ENTRY OPTIONS(ASM,INTER) EXT;
  ```

- 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.
- 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 syntax shows the 'EZASOKET' call format for COBOL language programs:

```
CALL 'EZASOKET' USING SOC-FUNCTION parm1, parm2, ..ERRNO,RETCODE.
```

SOC-FUNCTION
A 16-byte character field, left-aligned 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.

Assembly language call format

The following syntax shows the EZASOKET call format for assembly language programs.

```
CALL EZASOKET,(SOC-FUNCTION,parm1, parm2, ... ERRNO,RETCODE),VL
```

PL/I language call format

The following syntax shows the EZASOKET call format for PL/I language programs:

```
CALL EZASOKET (SOC-FUNCTION parm1, parm2, ... ERRNO,RETCODE);
```

SOC-FUNCTION
A 16-byte character field, left-aligned 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 14 on page 54 shows examples of storage definition statements for COBOL, PL/I, and assembly 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 14. Storage definition statements 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 might 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 A, "Return codes," on page 269.

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.

Note:

- 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.
- 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.
- 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.
- 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.

Table 5. ACCEPT call requirements

Condition	Requirement
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 the addressability mode (Amode) considerations under "CALL instruction API environmental restrictions and programming requirements" on page 51.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.

Table 5. ACCEPT call requirements (continued)

Condition	Requirement
Control parameters:	All parameters must be addressable by the caller and in the primary address space.

Figure 15 on page 56 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 15. ACCEPT call instructions example

For equivalent PL/I and assembly language declarations, see “Converting parameter descriptions” on page 54.

Parameter values set by the application

SOC-FUNCTION

A 16-byte character field containing ACCEPT. Left-align 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 A, "Return codes," on page 269 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 interested in receiving only 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.

Condition	Requirement
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 the addressability mode (Amode) considerations under "CALL instruction API environmental restrictions and programming requirements" on page 51.
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.

Table 6. BIND call requirements

Figure 16 on page 58 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 16. BIND call instruction example

For equivalent PL/I and assembly language declarations, see "Converting parameter descriptions" on page 54.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing BIND. The field is left-aligned and padded to the right with blanks.

S
A halfword binary number specifying the socket descriptor for the socket to be bound.

NAME

See z/OS Communications Server: IP Sockets Application Programming Interface Guide and Reference 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 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.

Parameter values returned to the application

ERRNO
A fullword binary field. If RETCODE is negative, this field contains an error number. See Appendix A, “Return codes,” on page 269 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.

Table 7. BIND2ADDRSEL call requirements

Condition	Requirement
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 the addressability mode (Amode) considerations under “CALL instruction API environmental restrictions and programming requirements” on page 51.
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 17 on page 61 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 17. BIND2ADDRSEL call instruction example

For equivalent PL/I and assembly language declarations, see "Converting parameter descriptions" on page 54.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing BIND2ADDRSEL. The field is left-aligned 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 A, "Return codes," on page 269 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 180 for more information.

  Note:

  – If a stream socket is closed while input or output data is queued, the TCP connection is reset and data transmission might 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 time after the CLOSE call is issued. See SO-LINGER in the description of "SETSOCKOPT" on page 163.

  – 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.

  – 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.

Table 8. CLOSE call requirements

Condition	Requirement
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 the addressability mode (Amode) considerations under "CALL instruction API environmental restrictions and programming requirements" on page 51.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.

Table 8. CLOSE call requirements (continued)

Condition	Requirement
Locks:	Unlocked.
Control parameters:	All parameters must be addressable by the caller and in the primary address space.

Figure 18 on page 63 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 18. CLOSE call instruction example

For equivalent PL/I and assembly language declarations, see “Converting parameter descriptions” on page 54.

Parameter values set by the application

SOC-FUNCTION
A 16-byte field containing CLOSE. Left-align 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 A, “Return codes,” on page 269 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.

CONNECT

The CONNECT call is issued by a client to establish a connection between a local socket and a remote socket.

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. However, because 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 146.

Table 9. CONNECT call requirements

Condition	**Requirement**
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 the addressability mode (Amode) considerations under "CALL instruction API environmental restrictions and programming requirements" on page 51.
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 19 on page 64 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 19. CONNECT call instruction example

For equivalent PL/I and assembly language declarations, see "Converting parameter descriptions" on page 54.

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.

Parameter values set by the application

SOC-FUNCTION
A 16-byte field containing CONNECT. Left-align 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 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.

Parameter values returned to the application

ERRNO
A fullword binary field. If RETCODE is negative, this field contains an error number. See Appendix A, "Return codes," on page 269 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.

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 119 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 Programming: Assembler Callable Services Reference for more information.

Table 10. FCNTL call requirements

Condition	Requirement
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 the addressability mode (Amode) considerations under "CALL instruction API environmental restrictions and programming requirements" on page 51.
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 20 on page 67 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 20. FCNTL call instruction example

For equivalent PL/I and assembly language declarations, see “Converting parameter descriptions” on page 54.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing FCNTL. The field is left-aligned 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 A, “Return codes,” on page 269 for information about ERRNO return codes.

RETCODE
A fullword binary field that returns one of the following values.

- 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.

Table 11. FREEADDRINFO call requirements

Condition	Requirement
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 the addressability mode (Amode) considerations under "CALL instruction API environmental restrictions and programming requirements" on page 51.
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 21 on page 68 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 21. 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-aligned 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 A, “Return codes,” on page 269 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.

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.

Table 12. GETADDRINFO call requirements

Condition	Requirement
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 the addressability mode (Amode) considerations under “CALL instruction API environmental restrictions and programming requirements” on page 51.
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 22 on page 70 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 22. 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-aligned 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 IP address of the queried host 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 might 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 (127.0.0.1) 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 accepts IPv4-mapped IPv6 addresses.
  - If the AF field is AF_INET6, a query for IPv4 addresses is made if the AI-ALL flag is specified or if no IPv6 addresses are found. Any IPv4 addresses that are found are returned as IPv4-mapped IPv6 addresses.
  - If the AF field is AF_UNSPEC, queries are made for both IPv6 and IPv4 addresses. If IPv4 addresses are found and IPv6 is supported, the IPv4 addresses are returned as IPv4-mapped IPv6 addresses.
- Otherwise, this flag is ignored.

AI-ALL (X'00000020') or the decimal value 32.

- If 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.
- If the AF field has a value of AF_UNSPEC, AI-ALL is accepted, but has no impact on the processing. No matter if AI-ALL is specified or not, the caller accepts both IPv6 and IPv4 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:
  - If AI-V4MAPPED is also specified and the system supports IPv6, the IPv4 addresses are returned as IPv4-mapped IPv6 addresses.
  - If AI-V4MAPPED is not specified or the system does not support IPv6, the IPv4 addresses are returned.
- Otherwise, 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 values 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 an 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 table shows 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 be 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 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 values:

- 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 table shows 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 values:

- 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 cryptographically 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 can 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 can 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 can 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 A, "Return codes," on page 269 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.

The ADDRINFO structure uses indirect addressing to return a variable number of NAMES. If you are coding in PL/I or assembly language, this structure can be processed in a relatively straight-forward manner. If you are coding in COBOL, this structure might 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 112 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.

Table 13. GETCLIENTID call requirements

Condition	Requirement
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 the addressability mode (Amode) considerations under "CALL instruction API environmental restrictions and programming requirements" on page 51.
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 23 on page 77 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 23. GETCLIENTID call instruction example

For equivalent PL/I and assembly language declarations, see "Converting parameter descriptions" on page 54.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing GETCLIENTID. The field is left-aligned 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 a 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 A, "Return codes," on page 269 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.

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.

Table 14. GETHOSTBYADDR call requirements

Condition	Requirement
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 the addressability mode (Amode) considerations under "CALL instruction API environmental restrictions and programming requirements" on page 51.
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 24 on page 78 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 24. GETHOSTBYADDR call instruction example

For equivalent PL/I and assembly language declarations, see "Converting parameter descriptions" on page 54.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing GETHOSTBYADDR. The field is left-aligned 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 A, "Return codes," on page 269 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 values:

Value
: **Description**

0
: Successful call.

-1
: Check **ERRNO** for an error code.

GETHOSTBYADDR returns the HOSTENT structure shown in Figure 25 on page 79.

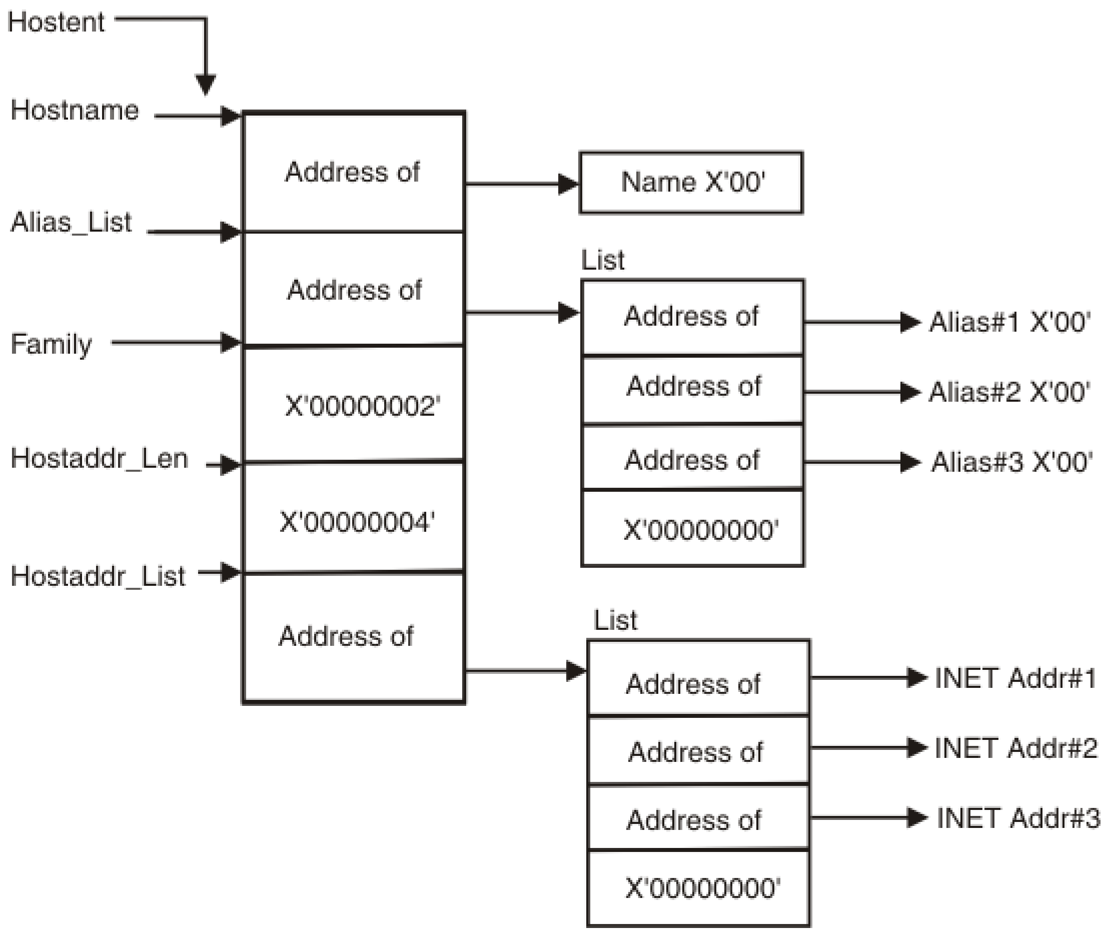


Figure 25. HOSTENT structure that is returned by the GETHOSTBYADDR call

GETHOSTBYADDR returns the HOSTENT structure shown in figure Figure 25 on page 79. 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 assembly language, this structure can be processed in a relatively straight-forward manner. If you are coding in COBOL, this structure might 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 194.

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.

Table 15. GETHOSTBYNAME call requirements

Condition	Requirement
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 the addressability mode (Amode) considerations under "CALL instruction API environmental restrictions and programming requirements" on page 51.
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 26 on page 80 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 26. GETHOSTBYNAME call instruction example

For equivalent PL/I and assembly language declarations, see "Converting parameter descriptions" on page 54.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing GETHOSTBYNAME. The field is left-aligned 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 values:

Value
Description

0
Successful call.

-1
An error occurred.

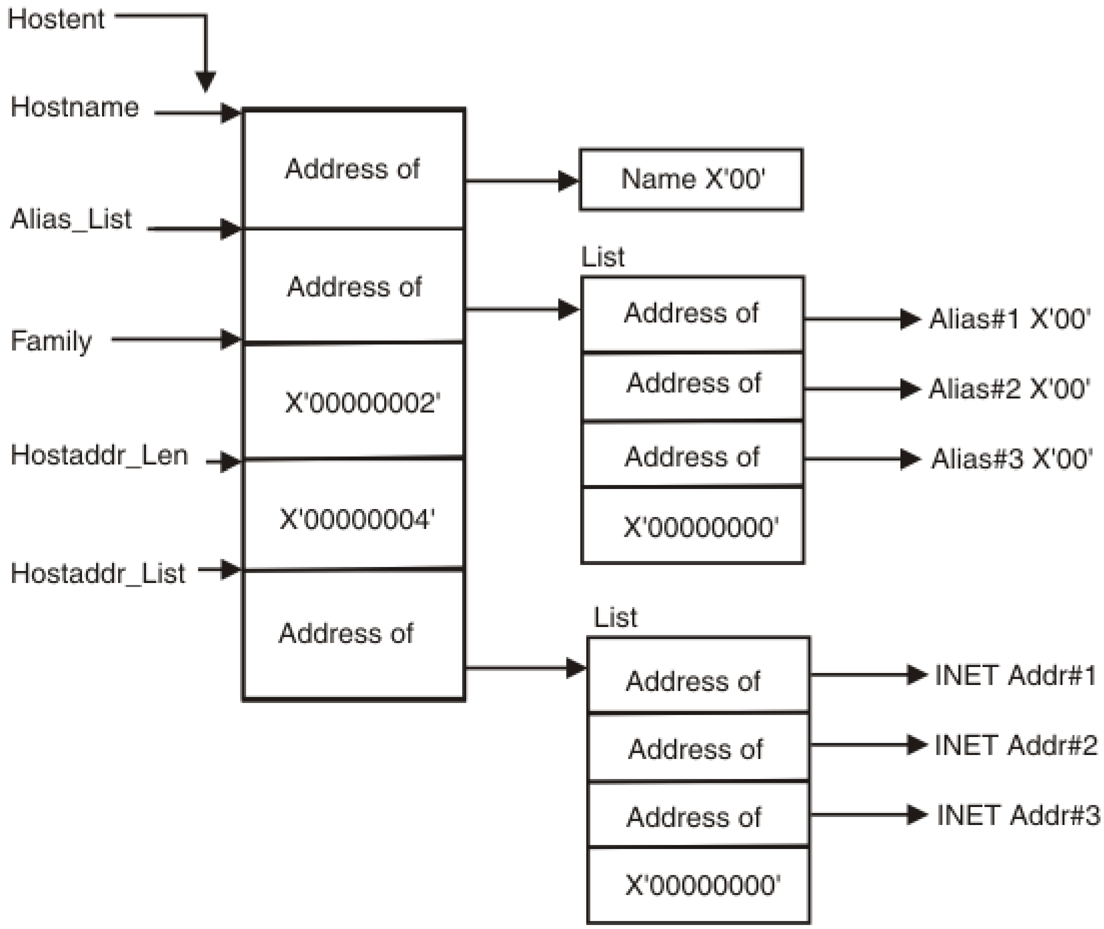


Figure 27. HOSTENT structure returned by the GETHOSTYBYNAME call

GETHOSTBYNAME returns the HOSTENT structure shown in Figure 27 on page 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 assembly language, this structure can be processed in a relatively straight-forward manner. If you are coding in COBOL, this structure might 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 194.

GETHOSTID

The GETHOSTID call returns the 32-bit IP address for the current host.

Table 16. GETHOSTID call requirements

Condition	Requirement
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 the addressability mode (Amode) considerations under "CALL instruction API environmental restrictions and programming requirements" on page 51.
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 28 on page 83 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 28. GETHOSTID call instruction example

For equivalent PL/I and assembly language declarations, see "Converting parameter descriptions" on page 54.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing GETHOSTID. The field is left-aligned 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.

Condition	Requirement
Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.

Condition	Requirement
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See the addressability mode (Amode) considerations under "CALL instruction API environmental restrictions and programming requirements" on page 51.
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 29 on page 84 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 29. GETHOSTNAME call instruction example

For equivalent PL/I and assembly language declarations, see "Converting parameter descriptions" on page 54.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing GETHOSTNAME. The field is left-aligned 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 A, "Return codes," on page 269 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.

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.

Table 17. GETIBMOPT call requirements

Condition	Requirement
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 the addressability mode (Amode) considerations under "CALL instruction API environmental restrictions and programming requirements" on page 51.
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 30 on page 85 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 30. GETIBMOPT call instruction example

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing GETIBMOPT. The field is left-aligned 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 preceding 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-aligned, 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 31. Example of name field

ERRNO
A fullword binary field. If RETCODE is negative, this field contains an error number. See Appendix A, "Return codes," on page 269 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.

Table 18. GETNAMEINFO call requirements

Condition	**Requirement**
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 the addressability mode (Amode) considerations under "CALL instruction API environmental restrictions and programming requirements" on page 51.
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 32. 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-aligned 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 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 will return the host name up to the storage specified and truncation might occur. If the host name cannot be located, the numeric form of the host 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. HOST 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 in 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. HOSTLEN 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 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 will return 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 numeric form of the service address is returned instead of its name. SERVICE 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. SERVLEN 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. FLAGS 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	Return only 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	Return only 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	Return only 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 A, “Return codes,” on page 269 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.

GETPEERNAME

The GETPEERNAME call returns the name of the remote socket to which the local socket is connected.

:

Table 19. GETPEERNAME call requirement

Condition	Requirement
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 the addressability mode (Amode) considerations under “CALL instruction API environmental restrictions and programming requirements” on page 51.
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 33 on page 92 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 33. GETPEERNAME call instruction example

For equivalent PL/I and assembly language declarations, see "Converting parameter descriptions" on page 54.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing GETPEERNAME. The field is left-aligned 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 A, "Return codes," on page 269 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.

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.

Because 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.

Table 20. GETSOCKNAME call requirements

Condition	Requirement
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 the addressability mode (Amode) considerations under "CALL instruction API environmental restrictions and programming requirements" on page 51.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.

Condition	Requirement
Control parameters:	All parameters must be addressable by the caller and in the primary address space.

Table 20. GETSOCKNAME call requirements (continued)

Figure 34 on page 94 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 34. GETSOCKNAME call instruction example

For equivalent PL/I and assembly language declarations, see "Converting parameter descriptions" on page 54.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing GETSOCKNAME. The field is left-aligned 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 A, "Return codes," on page 269 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.

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 in Table 22 on page 96. You must specify the option to be queried when you issue the GETSOCKOPT call.

Table 21. GETSOCKOPT call requirements

Condition	Requirement
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 the addressability mode (Amode) considerations under "CALL instruction API environmental restrictions and programming requirements" on page 51.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.

Condition	Requirement
Control parameters:	All parameters must be addressable by the caller and in the primary address space.

Table 21. GETSOCKOPT call requirements (continued)

Figure 35 on page 96 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 35. GETSOCKOPT call instruction example

For equivalent PL/I and assembly language declarations, see "Converting parameter descriptions" on page 54.

Table 22. 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 22. 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 22. 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 22. 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 22. 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 22. 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 22. 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.

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 22. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

Table 22. 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 22. 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. **Note:** 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 22. 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.
Note:
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 waits only 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 22. 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 65535 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.

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 - 2678400 (equal to 31 days), and the microseconds can be a value in the range 0 - 1000000 (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 - 2678400 (equal to 31 days). The number of microseconds value that is returned is in the range 0 - 1000000.

Table 22. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

Table 22. 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 of the TCP/IP send buffer is protocol specific and is based on the following values: • 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 65535 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 22. 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 - 2678400 (equal to 31 days), and the microseconds value is in the range 0 - 1000000 (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 - 2678400 (equal to 31 days). The microseconds value that is returned is in the range 0 - 1000000.
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 – 2147460. 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.

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.

Table 22. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing GETSOCKOPT. The field is left-aligned 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 the GETSOCKOPT command values information in z/OS Communications Server: IP Sockets Application Programming Interface Guide and Reference for the numeric values of **OPTNAME**.

Note: COBOL programs cannot contain field names with the underscore 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 A, “Return codes,” on page 269 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.

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.

Table 23. GIVESOCKET call requirements

Condition	Requirement
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 the addressability mode (Amode) considerations under "CALL instruction API environmental restrictions and programming requirements" on page 51.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.

Table 23. GIVESOCKET call requirements (continued)

Condition	Requirement
Control parameters:	All parameters must be addressable by the caller and in the primary address space.

Figure 36 on page 113 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 36. GIVESOCKET call instruction example

For equivalent PL/I and assembly language declarations, see “Converting parameter descriptions” on page 54.

Parameter values set by the application

SOC-FUNCTION

A 16-byte character field containing GIVESOCKET. The field is left-aligned 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 be taken only by a TAKESOCKET with the same DOMAIN (AF_INET or AF_INET6).

NAME

Specifies an 8-character field, left-aligned, 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 (as in IMS), 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 A, “Return codes,” on page 269 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.

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 B, “Related protocol specifications,” on page 281 for information about accessing RFCs.

Table 24. INET6_IS_SRCADDR call requirements

Condition	Requirement
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 the addressability mode (Amode) considerations under “CALL instruction API environmental restrictions and programming requirements” on page 51.
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 37 on page 115 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 37. INET6_IS_SRCADDR call instruction example

For equivalent PL/I and assembly language declarations, see "Converting parameter descriptions" on page 54.

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]

Note:

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 A, "Return codes," on page 269 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

Table 25. INITAPI call requirements

Condition	**Requirement**
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 the addressability mode (Amode) considerations under “CALL instruction API environmental restrictions and programming requirements” on page 51.
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 38 on page 118 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 38. INITAPI call instruction example

For equivalent PL/I and assembly language declarations, see "Converting parameter descriptions" on page 54.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing INITAPI. The field is left-aligned 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 65535 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. It is the name of the CICS startup job. 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 must 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 A, "Return codes," on page 269 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.

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 27 on page 126 for information about REQARG and RETARG.

Table 26. IOCTL call requirements

Condition	Requirement
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 the addressability mode (Amode) considerations under "CALL instruction API environmental restrictions and programming requirements" on page 51.
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 39 on page 120 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 39. IOCTL call instruction example

For equivalent PL/I and assembly language declarations, see "Converting parameter descriptions" on page 54.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing IOCTL. The field is left-aligned 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. To request OSM interfaces the application must have READ authorization to the EZB.OSM.sysname.tcpname resource.

- When the SIOCGHOMEIF6 IOCTL is issued, the REGARQ must contain a Network Configuration Header. The NETCONFHDR is defined in the SYS1.MACLIB(BPXYIOC6) for assembly 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 27 on page 126.

```
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 40. 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 returned for an interface only if it has at least one available IP address. To request OSM interfaces the application must have READ authorization to the EZB.OSM.sysname.tcpname resource.

The configuration consists of IF_NAMEINDEX structure, which is defined in SYS1.MACLIB(BPX1IOCC) for the assembly 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 41. 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 assembly 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 27 on page 126.

Table 27. 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 40 on page 121 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.

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 41 on page 123 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.

Table 27. IOCTL call arguments (continued)

Table 27. IOCTL call arguments (continued)

COMMAND/CODE	SIZE	REQARG	SIZE	RETARG

Note:

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 27 on page 126 for information about REQARG and RETARG.

ERRNO
A fullword binary field. If RETCODE is negative, the field contains an error number. See Appendix A, "Return codes," on page 269 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.

The COMMAND SIOGIFCONF returns a variable number of network interface configurations. Figure 42 on page 128 contains an example of a COBOL II routine that can be used to work with such a structure.

Note: This call can be programmed only in languages that support address pointers. Figure 42 on page 128 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 42. 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.

Table 28. LISTEN call requirements

Condition	**Requirement**
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 the addressability mode (Amode) considerations under “CALL instruction API environmental restrictions and programming requirements” on page 51.
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 43 on page 129 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 43. LISTEN call instruction example

For equivalent PL/I and assembly language declarations, see “Converting parameter descriptions” on page 54.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing LISTEN. The field is left-aligned 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 A, “Return codes,” on page 269 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.

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.

Table 29. NTOP call requirements

Condition	Requirement
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 the addressability mode (Amode) considerations under “CALL instruction API environmental restrictions and programming requirements” on page 51.
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 44 on page 131 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 44. 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 A, “Return codes,” on page 269 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.

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.

Table 30. PTON call requirements

Condition	Requirement
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 the addressability mode (Amode) considerations under “CALL instruction API environmental restrictions and programming requirements” on page 51.
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 45 on page 133 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 45. 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 A, “Return codes,” on page 269 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.

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 191 for a subroutine that will translate ASCII input data to EBCDIC.

Table 31. READ call requirements

Condition	Requirement
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 the addressability mode (Amode) considerations under “CALL instruction API environmental restrictions and programming requirements” on page 51.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.

Condition	Requirement
Control parameters:	All parameters must be addressable by the caller and in the primary address space.

Table 31. READ call requirements (continued)

Figure 46 on page 135 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 46. READ call instruction example

For equivalent PL/I and assembly language declarations, see "Converting parameter descriptions" on page 54.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing READ. The field is left-aligned 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 A, "Return codes," on page 269 for information about ERRNO return codes.

RETCODE
A fullword binary field that returns one of the following values:

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.

Table 32. READV call requirements

Condition	Requirement
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 the addressability mode (Amode) considerations under "CALL instruction API environmental restrictions and programming requirements" on page 51.
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 47 on page 136 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 47. READV call instruction example

For equivalent PL/I and assembly language declarations, see "Converting parameter descriptions" on page 54.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing READV. The field is left-aligned 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 A, "Return codes," on page 269 for information about ERRNO return codes.

RETCODE
: A fullword binary field that returns one of the following values:

  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 66 or "IOCTL" on page 119 for a description of how to set nonblocking mode.

For raw sockets, RECV adds a 20-byte header.

Note: See "EZACIC05 " on page 191 for a subroutine that will translate ASCII input data to EBCDIC.

Table 33. RECV call requirements

Condition	Requirement
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 the addressability mode (Amode) considerations under "CALL instruction API environmental restrictions and programming requirements" on page 51.
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 48 on page 138 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 48. RECV call instruction example

For equivalent PL/I and assembly language declarations, see "Converting parameter descriptions" on page 54.

Parameter values set by the application

SOC-FUNCTION

A 16-byte character field containing RECV. The field is left-aligned 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.

Literal Value	Binary Value	Description
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 A, “Return codes,” on page 269 for information about ERRNO return codes.

RETCODE
A fullword binary field that returns one of the following values:

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 66 or “IOCTL” on page 119 for a description of how to set nonblocking mode.

Note: See “EZACIC05 ” on page 191 for a subroutine that will translate ASCII input data to EBCDIC.

Table 34. RECVFROM call requirements

Condition	**Requirement**
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 the addressability mode (Amode) considerations under “CALL instruction API environmental restrictions and programming requirements” on page 51.
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 49 on page 141 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 49. RECVFROM call instruction example

For equivalent PL/I and assembly language declarations, see "Converting parameter descriptions" on page 54.

Parameter values set by the application

SOC-FUNCTION

A 16-byte character field containing RECVFROM. The field is left-aligned 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.

Literal Value	Binary Value	Description
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 A, “Return codes,” on page 269 for information about ERRNO return codes.

RETCODE
A fullword binary field that returns one of the following values:

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.

Table 35. RECVMSG call requirements

Condition	Requirement
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 the addressability mode (Amode) considerations under "CALL instruction API environmental restrictions and programming requirements" on page 51.
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.

RECVMSG call instruction example

```
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.
```

```
    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.
```

For equivalent PL/I and assembly language declarations, see “Converting parameter descriptions” on page 54.

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 A, "Return codes," on page 269 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 actions:

- Set the read, write, and exception arrays to zeros.
- Specify MAXSOC <= 0.

Table 36. SELECT call requirements

Condition	Requirement
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 the addressability mode (Amode) considerations under "CALL instruction API environmental restrictions and programming requirements" on page 51.
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 conditions 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.

For information about selecting requests in a concurrent server program, see z/OS Communications Server: IP Sockets Application Programming Interface Guide and Reference.

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 193.

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 is 0 - 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 50 on page 149 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 50. 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 assembly language declarations, see "Converting parameter descriptions" on page 54.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing SELECT. The field is left-aligned 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 A, “Return codes,” on page 269 for information about ERRNO return codes.

RETCODE
A fullword binary field that returns one of the following values:

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 tasks:

- Set the read, write, and exception arrays to zeros.

- Specify MAXSOC ≤ 0.

Table 37. SELECTEX call requirements

Condition	Requirement
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 the addressability mode (Amode) considerations under "CALL instruction API environmental restrictions and programming requirements" on page 51.
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 51 on page 152 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 shown in the following example:

```
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 51. SELECTEX call instruction example

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 conditions 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.

For information about selecting requests in a concurrent server program, see z/OS Communications Server: IP Sockets Application Programming Interface Guide and Reference.

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 193.

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 is 0 - 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.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing SELECT. The field is left-aligned 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 A, “Return codes,” on page 269 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 190 for a subroutine that will translate EBCDIC input data to ASCII.

Table 38. SEND call requirements

Condition	Requirement
Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.
Cross memory mode:	PASN = HASN.

Table 38. SEND call requirements (continued)

Condition	Requirement
Amode:	31-bit or 24-bit. **Note:** See the addressability mode (Amode) considerations under "CALL instruction API environmental restrictions and programming requirements" on page 51.
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 52 on page 156 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 52. SEND call instruction example

For equivalent PL/I and assembly language declarations, see "Converting parameter descriptions" on page 54.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing SEND. The field is left-aligned 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 A, "Return codes," on page 269 for information about ERRNO return codes.

RETCODE
A fullword binary field that returns one of the following values:

Value
Description

≥0
A successful call. The value is set to the number of bytes transmitted.

-1
Check **ERRNO**be for an error code.

SENDMSG

The SENDMSG call sends messages on a socket with descriptor S passed in an array of messages.

Table 39. SENDMSG call requirements

Condition	Requirement
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 the addressability mode (Amode) considerations under "CALL instruction API environmental restrictions and programming requirements" on page 51.
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.

"SENDMSG call instruction example (part 1 of 2)" on page 157 and "SENDMSG call instruction example (part 2 of 2)" on page 159 show an example of SENDMSG call instructions.

SENDMSG call instruction example (part 1 of 2)

```
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.
```

```
 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.
```

SENDMSG call instruction example (part 2 of 2)

```
                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.
```

For equivalent PL/I and assembly language declarations, see "Converting parameter descriptions" on page 54.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing SENDMSG. The field is left-aligned 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 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.

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 information:

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 A, "Return codes," on page 269 for information about ERRNO return codes.

RETCODE
A fullword binary field that returns one of the following values:

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 190 for a subroutine that will translate EBCDIC input data to ASCII.

Table 40. SENDTO call requirements

Condition	**Requirement**
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 the addressability mode (Amode) considerations under "CALL instruction API environmental restrictions and programming requirements" on page 51.
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 53 on page 162 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 53. SENDTO call instruction example

For equivalent PL/I and assembly language declarations, see "Converting parameter descriptions" on page 54.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing SENDTO. The field is left-aligned 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 information:

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 an 8-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 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.

Parameter values returned to the application

ERRNO
A fullword binary field. If RETCODE is negative, the field contains an error number. See Appendix A, “Return codes,” on page 269 for information about ERRNO return codes.

RETCODE
A fullword binary field that returns one of the following values:

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.

Table 41. SETSOCKOPT call requirements

Condition	Requirement
Authorization:	Supervisor state or problem state, any PSW key.
Dispatchable unit mode:	Task.

Condition	Requirement
Cross memory mode:	PASN = HASN.
Amode:	31-bit or 24-bit. **Note:** See the addressability mode (Amode) considerations under "CALL instruction API environmental restrictions and programming requirements" on page 51.
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.

Table 41. SETSOCKOPT call requirements (continued)

Figure 54 on page 164 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 54. SETSOCKOPT call instruction example

For equivalent PL/I and assembly language declarations, see "Converting parameter descriptions" on page 54.

Table 42. 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 42. 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 42. 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 42. 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 42. 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 42. 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 42. 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 42. 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

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 42. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

Table 42. 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 42. 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 waits only 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 42. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

<table>
<tr><th>OPTNAME options (input)</th><th>SETSOCKOPT, OPTVAL (input)</th><th>GETSOCKOPT, OPTVAL (output)</th></tr>
<tr><td>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.</td><td>A 4-byte binary field.

To enable, set to 1 or a positive value.

To disable, set to 0.</td><td>A 4-byte binary field.

If enabled, contains a 1.

If disabled, contains a 0.</td></tr>
<tr><td>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 65535 for a raw socket</td><td>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.</td><td>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.</td></tr>
</table>

Table 42. 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 - 2678400 (equal to 31 days), and the microseconds can be a value in the range 0 - 1000000 (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 - 2678400 (equal to 31 days). The number of microseconds value that is returned is in the range 0 - 1000000.

Table 42. 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 values: • 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 65535 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 42. 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 - 2678400 (equal to 31 days), and the microseconds value is in the range 0 - 1000000 (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 - 2678400 (equal to 31 days). The microseconds value that is returned is in the range 0 - 1000000.
`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 147460. 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 42. 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.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing SETSOCKOPT. The field is left-aligned 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 the GETSOCKOPT command values information in z/OS Communications Server: IP Sockets Application Programming Interface Guide and Reference 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 A, “Return codes,” on page 269 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.

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 the Effect of shutdown socket call table in the z/OS Communications Server: IP Sockets Application Programming Interface Guide and Reference to determine the effects of this operation on the outstanding socket calls.

Table 43. SHUTDOWN call requirements

Condition	Requirement
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 the addressability mode (Amode) considerations under "CALL instruction API environmental restrictions and programming requirements" on page 51.
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 55 on page 181 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 55. SHUTDOWN call instruction example

For equivalent PL/I and assembly language declarations, see "Converting parameter descriptions" on page 54.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing SHUTDOWN. The field is left-aligned 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 A, "Return codes," on page 269 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.

SOCKET

The SOCKET call creates an endpoint for communication and returns a socket descriptor representing the endpoint.

Table 44. SOCKET call requirements	
Condition	**Requirement**
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 the addressability mode (Amode) considerations under "CALL instruction API environmental restrictions and programming requirements" on page 51.
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 56 on page 182 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 56. SOCKET call instruction example

For equivalent PL/I and assembly language declarations, see "Converting parameter descriptions" on page 54.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing SOCKET. The field is left-aligned 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 values:

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 A, “Return codes,” on page 269 for information about ERRNO return codes.

RETCODE
A fullword binary field that returns one of the following values:

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 112 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.

Table 45. TAKESOCKET call requirements

Condition	Requirement
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 the addressability mode (Amode) considerations under "CALL instruction API environmental restrictions and programming requirements" on page 51.
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 57 on page 184 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 57. TAKESOCKET call instruction example

For equivalent PL/I and assembly language declarations, see "Converting parameter descriptions" on page 54.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing TAKESOCKET. The field is left-aligned 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 acquire only 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 A, "Return codes," on page 269 for information about ERRNO return codes.

RETCODE
A fullword binary field that returns one of the following values:

Value
Description

≥ 0
Contains the new socket descriptor.

-1
Check **ERRNO** for an error code.

TERMAPI

This call terminates the session created by INITAPI.

Table 46. TERMAPI call requirements

Condition	Requirement
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 the addressability mode (Amode) considerations under "CALL instruction API environmental restrictions and programming requirements" on page 51.

Table 46. TERMAPI call requirements (continued)

Condition	Requirement
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 58 on page 186 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 58. TERMAPI call instruction example

For equivalent PL/I and assembly language declarations, see "Converting parameter descriptions" on page 54.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing TERMAPI. The field is left-aligned 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 wants 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 190 for a subroutine that will translate EBCDIC output data to ASCII.

Table 47. WRITE call requirements

Condition	Requirement
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 the addressability mode (Amode) considerations under "CALL instruction API environmental restrictions and programming requirements" on page 51.
ASC mode:	Primary address space control (ASC) mode.
Interrupt status:	Enabled for interrupts.
Locks:	Unlocked.

Table 47. WRITE call requirements (continued)

Condition	Requirement
Control parameters:	All parameters must be addressable by the caller and in the primary address space.

Figure 59 on page 187 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 59. WRITE call instruction example

For equivalent PL/I and assembly language declarations, see “Converting parameter descriptions” on page 54.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing WRITE. The field is left-aligned 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 A, “Return codes,” on page 269 for information about ERRNO return codes.

RETCODE
A fullword binary field that returns one of the following values:

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.

Table 48. WRITEV call requirements	
Condition	**Requirement**
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 the addressability mode (Amode) considerations under "CALL instruction API environmental restrictions and programming requirements" on page 51.
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 60 on page 188 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 60. WRITEV call instruction example

For equivalent PL/I and assembly language declarations, see "Converting parameter descriptions" on page 54.

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 A, “Return codes,” on page 269 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.

Assembly language utility programs call format

The following example shows the assembly 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 69 on page 200.
- EZACIC15 provides an alternative to EZACIC05 and translates ASCII data to EBCDIC data using the translation table documented in Figure 71 on page 202.

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, because bit strings are difficult to decode in COBOL, TCP/IP includes the following information:

- 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 61 on page 190 shows how EZACIC04 translates a byte of EBCDIC data.

```
 --------------------------------------------------------------
 | ASCII      |    second hex digit of byte of EBCDIC data    |
 | output by  |-----------------------------------------------|
 | EZACIC04   | 0| 1| 2| 3| 4| 5| 6| 7| 8| 9| A| B| C| D| E| F|
 |------------+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--|
 |         | 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|
 |         |---+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--|
 | first   | 6 |2D|2F|DF|DC|9A|DD|DE|98|9D|AC|BA|2C|25|5F|3E|3F|
 | hex     |---+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--|
 | digit   | 7 |D7|88|94|B0|B1|B2|FC|D6|FB|60|3A|23|40|27|3D|22|
 | of      |---+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--|
 | byte    | 8 |F8|61|62|63|64|65|66|67|68|69|96|A4|F3|AF|AE|C5|
 | of      |---+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--|
 | EBCDIC  | 9 |8C|6A|6B|6C|6D|6E|6F|70|71|72|97|87|CE|93|F1|FE|
 | data    |---+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--|
 |         | 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 61. EZACIC04 EBCDIC-to-ASCII table

Figure 62 on page 190 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.
     IF RETURN-CODE > 0
        THEN
        DISPLAY 'TRANSLATION FAILED ' RETURN-CODE.
```

Figure 62. EZACIC04 call instruction example

For equivalent PL/I and assembly language declarations, see “Converting parameter descriptions” on page 54.

OUT-BUFFER
A buffer that contains the following information:

- When called, EBCDIC data
- Upon return, ASCII data

LENGTH
Specifies the length of the data to be translated.

RETURN-CODE
Upon return, register 15 contains a return code value, which indicates if the data translation occurred successfully. The return code can be one of the following values:

0
The data translation occurred.

8
Too many parameters passed, translation did not occur.

12
Zero buffer length passed, translation did not occur.

16
Zero buffer address passed, translation did not occur.

EZACIC05

The EZACIC05 program is used to translate ASCII data to EBCDIC data. EBCDIC data is required by COBOL, PL/I, and assembly language programs. Figure 63 on page 192 shows how EZACIC05 translates a byte of ASCII data.

```
-------------------------------------------------------------
| EBCDIC     |    second hex digit of byte of ASCII data     |
| output by  |-----------------------------------------------|
| EZACIC05   | 0| 1| 2| 3| 4| 5| 6| 7| 8| 9| A| B| C| D| E| F|
|------------+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--|
|        | 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|
|        |---+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--|
|  first | 6 |79|81|82|83|84|85|86|87|88|89|91|92|93|94|95|96|
|  hex   |---+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--|
|  digit | 7 |97|98|99|A2|A3|A4|A5|A6|A7|A8|A9|C0|4F|D0|A1|07|
|  of    |---+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--|
|  byte  | 8 |00|01|02|03|37|2D|2E|2F|16|05|25|0B|0C|0D|0E|0F|
|  of    |---+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--|
|  ASCII | 9 |10|11|12|13|3C|3D|32|26|18|19|3F|27|22|1D|35|1F|
|  data  |---+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--|
|        | 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 63. EZACIC05 ASCII-to-EBCDIC table

Figure 64 on page 192 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.         IF RETURN-CODE > 0
        THEN
        DISPLAY 'TRANSLATION FAILED ' RETURN-CODE.
```

Figure 64. EZACIC05 call instruction example

For equivalent PL/I and assembly language declarations, see “Converting parameter descriptions” on page 54.

IN-BUFFER
A buffer that contains the following information:

- When called, ASCII data
- Upon return, EBCDIC data

LENGTH
Specifies the length of the data to be translated.

RETURN-CODE
Upon return, register 15 contains a return code value, which indicates if the data translation occurred successfully. The return code can be one of the following values:

0
: The data translation occurred.

8
: Too many parameters passed, translation did not occur.

12
: Zero buffer length passed, translation did not occur.

16
: Zero buffer address passed, translation did not occur.

EZACIC06

The SELECT and SELECTEX 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 EZACIC06 utility program to translate them to character strings to be used with the SELECT or SELECTEX call.

Figure 65 on page 193 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 65. EZACIC06 call instruction example

For equivalent PL/I and assembly language declarations, see “Converting parameter descriptions” on page 54.

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 rightmost bit in the first fullword represents socket 0 and the leftmost bit represents socket 31. The rightmost bit in the second fullword represents socket 32 and

the leftmost 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 values:

Value
Description

0
Successful call.

-1
Check **ERRNO** for an error code.

Examples

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 assembly 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 information:
   - 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 66 on page 195 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 66. EZAZIC08 call instruction example

For equivalent PL/I and assembly language declarations, see “Converting parameter descriptions” on page 54.

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 assembly 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 information: 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 67 on page 198 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.
```

```
     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.
```

Figure 67. EZACIC09 call instruction example (Part 1 of 2)

```
      *
      * 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.
```

```
       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 68. EZACIC09 call instruction example (Part 2 of 2)

For equivalent PL/I and assembly language declarations, see "Converting parameter descriptions" on page 54.

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 69 on page 200 shows how EZACIC14 translates a byte of EBCDIC data.

```
 ---------------------------------------------------------------
| ASCII      |    second hex digit of byte of EBCDIC data    |
| output by  |-----------------------------------------------|
| EZACIC14   | 0| 1| 2| 3| 4| 5| 6| 7| 8| 9| A| B| C| D| E| F|
|------------+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--|
|         | 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|
|         |---+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--|
| first   | 6 |2D|2F|C2|C4|C0|C1|C3|C5|C7|D1|A6|2C|25|5F|3E|3F|
| hex     |---+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--|
| digit   | 7 |F8|C9|CA|CB|C8|CD|CE|CF|CC|60|3A|23|40|27|3D|22|
| of      |---+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--|
| byte    | 8 |D8|61|62|63|64|65|66|67|68|69|AB|BB|F0|FD|FE|B1|
| of      |---+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--|
| EBCDIC  | 9 |B0|6A|6B|6C|6D|6E|6F|70|71|72|AA|BA|E6|B8|C6|A4|
| data    |---+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--|
|         | 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|B3|DB|DC|D9|DA|9F|
 ---------------------------------------------------------------
```

Figure 69. EZACIC14 EBCDIC-to-ASCII table

Figure 70 on page 201 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.         IF RETURN-CODE > 0
            THEN
            DISPLAY 'TRANSLATION FAILED ' RETURN-CODE.
```

Figure 70. EZACIC14 call instruction example

For equivalent PL/I and assembly language declarations, see “Converting parameter descriptions” on page 54.

OUT-BUFFER
A buffer that contains the following information:

- When called, EBCDIC data
- Upon return, ASCII data

LENGTH
Specifies the length of the data to be translated.

RETURN-CODE
Upon return, register 15 contains a return code value, which indicates if the data translation occurred successfully. The return code can be one of the following values:

0
The data translation occurred.

8
Too many parameters passed, translation did not occur.

12
Zero buffer length passed, translation did not occur.

16
Zero buffer address passed, translation did not occur.

EZACIC15

The EZACIC15 program is an alternative to EZACIC05, which translates ASCII data to EBCDIC data. Figure 71 on page 202 shows how EZACIC15 translates a byte of ASCII data.

```
--------------------------------------------------------------
| EBCDIC      |    second hex digit of byte of ASCII data     |
| output by   |-----------------------------------------------|
| EZACIC15    | 0| 1| 2| 3| 4| 5| 6| 7| 8| 9| A| B| C| D| E| F|
|------------+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--|
|        | 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|
|        |---+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--|
| first  | 6 |79|81|82|83|84|85|86|87|88|89|91|92|93|94|95|96|
| hex    |---+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--|
| digit  | 7 |97|98|99|A2|A3|A4|A5|A6|A7|A8|A9|C0|4F|D0|A1|07|
| of     |---+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--|
| byte   | 8 |20|21|22|23|24|15|06|17|28|29|2A|2B|2C|09|0A|1B|
| of     |---+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--|
| ASCII  | 9 |30|31|1A|33|34|35|36|08|38|39|3A|3B|04|14|3E|FF|
| data   |---+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--|
|        | 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 71. EZACIC15 ASCII-to-EBCDIC table

Figure 72 on page 202 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.         IF RETURN-CODE > 0
        THEN
        DISPLAY 'TRANSLATION FAILED ' RETURN-CODE.
```

Figure 72. EZACIC15 call instruction example

For equivalent PL/I and assembly language declarations, see “Converting parameter descriptions” on page 54.

OUT-BUFFER

A buffer that contains the following infomation:

- When called, ASCII data
- Upon return, EBCDIC data

LENGTH

Specifies the length of the data to be translated.

RETURN-CODE

Upon return, register 15 contains a return code value, which indicates if the data translation occurred successfully. The return code can be one of the following values:

0

The data translation occurred.

8
: Too many parameters passed, translation did not occur.

12
: Zero buffer length passed, translation did not occur.

16
: Zero buffer address passed, translation did not occur.

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                                                       */
/*                                                                      */
/************************************************************************/

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                                                       */
/*                                                                      */
/************************************************************************/
```

```
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;

/********************************************************************/
/*                                                                  */
/* 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 73. EZASOKPS PL/1 sample server program for IPv4

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);
   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;
   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 74. EZASOKPC PL/1 sample client program for IPv4

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                                                    */
/*                                                                   */
/*********************************************************************/

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          */
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;
   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;

/*********************************************************************/
/*                                                                   */
/* 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;
   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 75. EZASO6PS PL/1 sample server program for IPv6

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);
   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                                           */
/*                                                                 */
/*******************************************************************/

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               */
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 76. EZASO6PC PL/1 sample client program for IPv6

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);
                                     /* 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           */
 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),
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      2 PORT   BIT(16),
      2 FLOWINFO FIXED BIN(31),
      2 ADDRESS CHAR(16),
      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         */
      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                */
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         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        */
         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          */
        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      */
```

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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   */
      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);
/* 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 */
```

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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);
                                   /* 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          */
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');
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);                */
/* 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 77. CBLOCK PL/1 common variables

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.        *

*                                                               *
* Note:         COBOL variable names can contain a maximum of   *
*               30 characters.                                  *

*                                                               *
* 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'.
 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).
   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).
        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).
     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.

      *
      * 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'.
*
* 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.
 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 78. EZACOBOL COBOL common variables

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.       *

      *                                                              *
      * Note:         COBOL variable names can contain a maximum of  *
      *               30 characters.                                 *

      *                                                              *
      * 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     '.
           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                    *
      *---------------------------------------------------------------*
       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.
*---------------------------------------------------------------*
* 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.
*---------------------------------------------------------------*
* 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
               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                                      *
*---------------------------------------------------------------*
 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.
     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
         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'
         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.

*--------------------------------------------------------------*
*   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
              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.

      *---------------------------------------------------------------*
      * 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 79. EZASO6CS COBOL call interface sample IPv6 server program

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.        *

*                                                               *
* Note:         COBOL variable names can contain a maximum of   *
*               30 characters.                                  *

*                                                               *
* 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     '.
     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).
     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.
     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='.
     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.
      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.

*---------------------------------------------------------------*
* 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.
        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.
       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 80. EZASO6CC COBOL call interface sample IPv6 client program

Chapter 8. IMS Listener samples

This topic includes sample programs using the IMS Listener. The following samples are included:

- "IMS TCP/IP control statements" on page 241
- "Sample program explicit-mode" on page 243
- "Sample program implicit-mode" on page 249
- "Sample program - IMS MPP client" on page 255

IMS TCP/IP control statements

This topic contains examples of the control statements required to define and initiate the various IMS TCP/IP components.

JCL for starting a message processing region

This topics shows an example of the JCL that is required to start an IMS message processing region in which TCP/IP servers can operate. Note the STEPLIB statements that point to TCP/IP and the C run-time library. A C run-time library is required when you use the GETHOSTBYADDR or GETHOSTBYNAME call. For more information, see *z/OS Program Directory* or the topic on C compilers and run-time libraries in the z/OS Communications Server: IP Sockets Application Programming Interface Guide and Reference.

This sample is based on the IMS procedure (DFSMPR). You might have to modify the language run-time libraries to match your programming language requirements.

```
//       PROC SOUT=A,RGN=2M,SYS2=,
//             CL1=001,CL2=000,CL3=000,CL4=000,
//             OPT=N,OVLA=0,SPIE=0,VALCK=0,TLIM=00,
//             PCB=000,PRLD=,STIMER=,SOD=,DBLDL=,
//             NBA=,OBA=,IMSID=IMS1,AGN=,VSFX=,VFREE=,
//             SSM=,PREINIT=,ALTID=,PWFI=N,
//             APARM=
//*
//REGION EXEC  PGM=DFSRRC00,REGION=&RGN,;
//             TIME=1440,DPRTY=(12,0),
//             PARM=(MSG,&CL1&CL2&CL3&CL4,;
//             &OPT&OVLA&SPIE&VALCK&TLIM&PCB,;
//             &PRLD,&STIMER,&SOD,&DBLDL,&NBA,;
//             &OBA,&IMSID,&AGN,&VSFX,&VFREE,;
//             &SSM,&PREINIT,&ALTID,&PWFI,;
//             '&APARM')
//&*;
//STEPLIB  DD DSN=IMS31.&SYS2;RESLIB,DISP=SHR
//         DD DSN=IMS31.&SYS2;PGMLIB,DISP=SHR
//         DD DSN=PLI.LL.V2R3M0.SIBMLINK,DISP=SHR
//         DD DSN=PLI.LL.V2R3M0.PLILINK,DISP=SHR
//         DD DSN=C370.LL.V2R2M0.SEDCLINK,DISP=SHR
//*        Use the following for LE/370 C run-time libraries:
//*        DD  DSN=CEE.V1R3M0.SCEERUN,DISP=SHR
//         DD DSN=TCPIP.SEZATCP,DISP=SHR
//PROCLIB  DD DSN=IMS31.&SYS2;PROCLIB,DISP=SHR
//SYSUDUMP DD  SYSOUT=&SOUT,DCB=(LRECL=121,BLKSIZE=3129,RECFM=VBA),;
//             SPACE=(125,(2500,100),RLSE,,ROUND)
//
```

JCL for linking the IMS Listener

The following examples are JCL that can be used to link the IMS Listener.

EZAIMSCZ JCLIN

```
//EZAIMSCZ JOB (accounting,information),programmer.name,
```

```
//            MSGLEVEL=(1,1),MSGCLASS=A,CLASS=A
//*************************************************************
//*NOTE: ANY ZONE UPDATED WITH THE LINK COMMAND OR CROSS-ZONE   *
//*      INFORMATION CANNOT BE PROCESSED BY SMP/E R6 OR EARLIER.*
//*************************************************************
//*
//*   5694-A01 Copyright IBM Corp. 1997, 2007
//*   Licensed Materials - Property of IBM
//*   This product contains "Restricted Materials of IBM"
//*   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.
//*
//*
//*    Function: Perform SMP/E LINK for IMS module
//*
//*    Instructions:
//*         Change all lower case characters to values
//*         suitable for your installation.
//*
//*    targetzone:   z/OS Target Zone
//*      imszone :   IMS Target Zone
//*
//*
//*   Change the high-level qualifier 'imshlq' to match the
//*   high-level qualifier for your installation's IMS target
//*   data set.
//*
//*   Beginning with IMS V1R7 the target lib has changed from
//*   RESLIB to SDFSRESL. If you are running IMS V1R7 or higher,
//*   you must comment or delete the RESLIB DD card and uncomment
//*   the SDFSRESL DD card.
//*
//EZAIMSCZ EXEC PGM=GIMSMP,REGION=4096K
//*************************************************************
//RESLIB   DD DISP=SHR,DSN=imshlq.RESLIB
//*SDFSRESL DD DISP=SHR,DSN=imshlq.SDFSRESL
//*************************************************************
//*
//SMPCSI     dd  dsn=zos.global.csi,disp=old
//*
//SYSUT1   DD UNIT=SYSDA,SPACE=(1700,(900,200))
//SYSUT2   DD UNIT=SYSDA,SPACE=(1700,(600,100))
//SYSUT3   DD UNIT=SYSDA,SPACE=(1700,(600,100))
//SYSUT4   DD UNIT=SYSDA,SPACE=(1700,(600,100))
//SMPWRK1  DD UNIT=SYSDA,SPACE=(8800,(75,0,216)),
//         DCB=(BLKSIZE=8800,LRECL=80)
//SMPWRK2  DD UNIT=SYSDA,SPACE=(8800,(75,0,216)),
//         DCB=(BLKSIZE=8800,LRECL=80)
//SMPWRK3  DD UNIT=SYSDA,SPACE=(3200,(75,0,216)),
//         DCB=(BLKSIZE=3200,LRECL=80)
//SMPWRK4  DD UNIT=SYSDA,SPACE=(3200,(75,0,216)),
//         DCB=(BLKSIZE=3200,LRECL=80)
//SMPWRK6  DD UNIT=SYSDA,SPACE=(3200,(75,0,216))
//*
//SMPLIST     DD  SYSOUT=*
//SMPOUT      DD  SYSOUT=*
//SMPRPT      DD  SYSOUT=*
//SMPSNAP     DD  SYSOUT=*
//SMPHOLD     DD  DUMMY
//SYSPRINT    DD  SYSOUT=*
//*
//*************************************************************
//*
//SMPCNTL   DD  *
SET BDY(targetzone).      /* z/OS target zone  */
LINK MODULE(DFSLI000)
FROMZONE(imszone)         /* IMS target zone     */
INTOLMOD(EZAIMSLN)
RC(LINK=00).
```

Figure 81. Cross zone Lnk IMS application interface

EZAIMSPL JCLIN

```
//LINKIMS JOB (accounting,information),programmer.name,
//           MSGLEVEL=(1,1),MSGCLASS=A,CLASS=A
//************************************************************
```

```
//*                                                             *
//*   THIS JOB SERVES AS AN ALTERNATIVE TO THE CROSS ZONE LINK *
//*   PERFORMED BY RUNNING EZAIMSCZ.                            *
//*                                                             *
//*   UPDATE THE JOB, SYSLMOD AND RESLIB DD CARDS TO SUIT YOUR *
//*   INSTALLATION .                                            *
//*                                                             *
//***************************************************************
//LNKIMS   EXEC PGM=IEWL,PARM='XREF,LIST,REUS'
//SYSPRINT  DD SYSOUT=*
//SYSUT1    DD UNIT=SYSDA,SPACE=(CYL,(1,1))
//SYSLMOD  DD DSN=tcpip.v3r1.SEZALINK,DISP=SHR
//RESLIB   DD DSN=ims.RESLIB,DISP=SHR
//SYSLIN    DD *
  ORDER CMCOPYR
  INCLUDE RESLIB(DFSLI000)
  INCLUDE SYSLMOD(EZAIMSLN)
  ENTRY EZAIMSLN
  MODE RMODE(24) AMODE(31)
  NAME EZAIMSLN(R)
/*
```

Listener IMS definitions

The following statements define the Listener as an IMS BMP application and the PSB that it uses. Note that the name ALTPCB is required.

PSB definition

```
ALTPCB   PCB    TYPE=TP,MODIFY=YES
         PSBGEN PSBNAME=EZAIMSLN,IOASIZE=1000
         SSASIZE=1000,LANG=ASSEM
```

TRANSACT MODE=SNGL

Application definition

```
         APPLCTN  PSB=EZAIMSLN,PGMTYPE=BATCH
```

Sample program explicit-mode

This topic shows an example of an explicit-mode client server program pair. The client program name is EZAIMSC2; you can find it in SEZAINST(EZAIMSC2). The server program name is EZASVAS2; its IMS trancode is DLSI102. You can find the sample in SEZAINST(EZASVAS2).

Sample explicit-mode program flow

The client begins execution and obtains the host name and port number from startup parameters. It then issues SOCKET and CONNECT calls to establish connectivity to the specified host and port. Upon successful completion of the connect, the client sends the TRM, which tells the Listener to schedule the specified transaction (DLSI102). The Listener schedules that transaction and places a TIM on the IMS message queue. Finally, it issues a GIVESOCKET call and waits for the server to take the socket.

When the requested server (EZASVAS2) begins execution, it issues a GU call to obtain the TIM. Using addressability information from the TIM, it issues INITAPI and TAKESOCKET calls. The server then sends `SERVER MSG #1` to the client.

When the client receives the message, it displays `SERVER MSG #1` on stdout and then sends `END CLIENT MSG #2` to the server, and displays a success message on stdout. It then blocks on another receive() until the server responds.

The server, upon receipt of a message with the characters END as the first 3 characters, sends `SERVER MSG #2` back to the client and closes the socket.

When the client receives this message, it prints `SERVER MSG #2` on stdout, closes the socket, and ends.

Sample explicit-mode client program (C language)

```
/*
 * Include Files.
 */
/*  #define RESOLVE_VIA_LOOKUP */
#pragma runopts(NOSPIE NOSTAE)
#define lim 50
#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 ??(lim??);        /* sned receive buffers 0 -3           */
    char buf1 ??(lim??);
    char buf2 ??(lim??);
    char buf3 ??(lim??);

    struct hostent *hostnm;    /* server host name information        */
    struct sockaddr_in server; /* server address                      */
    int s;                     /* client socket                       */

    /*
     * Check Arguments Passed. Should be hostname and port.
     */
    if (argc != 3)
    {
    /*  fprintf(stderr, "Usage: %s hostname port\n", argv[0]); */
         printf("Usage: %s hostname port\n", argv        [0]);
        exit(1);
    }

         printf("Usage: %s hostname port\n", argv        [0]);
    /*
     * 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"); */
         printf("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,"2000*TRNREQ*DLSI102 ");

    /*
     * 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)
    {
        tcperror("Send()");
        exit(5);
    }

    printf("send one complete\n");

    /*
     * The server sends message #1. Receive it into buffer1
     */

    if (recv(s, buf1, sizeof(buf1), 0) < 0)
    {
        tcperror("Recv()");
        exit(6);
    }

    printf("receive one complete\n");

    printf(buf1,"\n");
    /* fprintf(stdout,buf1,"\n"); */

    /*
     * Put end message into the buffer.
     */

     strcpy(buf2, "END CLIENT MESSAGE #2 ");

    if (send(s, buf2, sizeof(buf2), 0) < 0)
    {
        tcperror("Send()");
        exit(7);
    }

    printf("send two complete\n");

    /*
     * The server sends back message #2. Receive it into buffer 2.
     */
    if (recv(s, buf3, sizeof(buf3), 0) < 0)
    {
        tcperror("Recv()");
        exit(8);
    }

    printf("receive two complete\n");

    /* fprintf(stdout,buf3,"\n"); */
    printf(buf3,"\n");

    /*
     * Close the socket.
     */
    close(s);

    printf("Client Ended Successfully\n");
    exit(0);

}
```

Figure 82. Sample C client to drive IMS Listener

Sample explicit-mode server program (Assembly language)

```
EZASVAS2  CSECT                        ENTRY POINT
          USING EZASVAS2,BASE          ADDRESSABILITY
          SAVE  (14,12)                SAVE DL/I REGS
          LR    BASE,15
          ST    R13,SAVEAREA+4         SAVE AREA CHAINING
          LA    R13,SAVEAREA           NEW SAVE AREA
          MVC   PSBS(L'PSBS*3),0(1)    SAVE PCB LIST
*
* REG 1 CONTAINS PTR TO PCB ADDR LIST
* REG 13 CONTAINS PTR TO DL/I SAVE AREA
* REG 14 CONTAINS PTR DL/I RETURN ADDRESS
* REG 15 CONTAINS PROGRAMS ENTRY POINT
*
          L     R2,0(R0,R1)             LOAD ADDR OF I/O PCB
*
          USING IOPCB,R2                ADDRESSABILITY
*
          L     R3,4(R0,R1)             LOAD ADDR OF ALT PCB
*
```

```
         USING ALTPCB1,R3              ADDRESSABILITY
*
         L     R4,8(R0,R1)             LOAD ADDR OF ALT PCB
         LA    R4,0(R0,R4)             REMOVE HIGH ORDER BIT
*
         USING ALTPCB2,R4              ADDRESSABILITY
*
         LA    R5,IOAREAIN
         LA    R7,IOAREAOT             POINT TO OUTPUT AREA FOR TCPIP
*
GUCALL   DS    0H                      GET UNIQUE CALL
*******************************************************************
*  Get Transaction-initiation message containing Sockets data     *
*******************************************************************
         CALL  ASMTDLI,(GUFUNCT,(2),(5)),VL     GET TIM
         CLC   STATUS(L'STATUS),=CL2'QC'    IF NO MESSAGES
         BE    GOBACK                       RETURN TO IMS
*                                           ELSE NEXT INSTR
         CLC   STATUS(L'STATUS),=CL2'  '    IF BLANK OK
         BNE   ERRRTN                       SOME WRONG HERE
*                                           ELSE NEXT INSTR
*
         XR  R6,R6                          CLEAR REG
         BAL R6,INITAPI                     GO INSERT SEGMENT
         B   GUCALL                         SET RETURN ADDRESS
*
*
INITAPI   DS   0H
* Set up for INITAPI
         MVC  TCPNAME(L'TCPNAME),TIMTCPAS     TCP Address space
         MVC  ASDNAME(L'ASDNAME),TIMSAS       Server address space
         MVC  SUBTASK(L'SUBTASK),TIMSTD       Server task id
* Set up for takeSOCKET
         MVC  NAME(L'NAME),TIMLAS             Listener address space
         MVC  TASK(L'TASK),TIMLTD             Listener task id
         MVC  S(L'S),TIMSD                    Socket descriptor
*
         XC   ERRNO(L'ERRNO),ERRNO
         XC   RETCODE(L'RETCODE),RETCODE
*        EX   0,*
***********************************************************************
*    Issue INITAPI                                                    *
***********************************************************************
         CALL EZASOKET,(INITFUNC,MAXSOC,IDENT,SUBTASK,                X
              MAXSNO,ERRNO,RETCODE),VL
         L    R9,RETCODE
         LTR  R9,R9
         BNM  TAKESOC
*
INITERR   DC   CL21'INITAPI COMMAND ERROR'
*
TAKESOC   DS   0H
***********************************************************************
*   Issue takeSOCKET                                                  *
***********************************************************************
         CALL EZASOKET,(TAKEFUNC,S,CLIENT,ERRNO,RETCODE),VL
*
         L    R9,RETCODE
         LTR  R9,R9
         BNM  SENDTEXT
*
TAKERR    DC   CL16'TAKESOCKET ERROR'
*Set up to send "SERVER MSG #1"
SENDTEXT  DS   0H
*
         MVC  S(L'S),RETCODE+2
         XC   BUF(LENG),BUF
         MVC  BUF(13),=CL13'SERVER MSG #1'
*Translate to ASCII, if necessary
*        CALL EZACIC04,(BUF,LENGTH),VL
*********************************************************************
*     Send "SERVER MSG #1"                                          *
*********************************************************************
         CALL EZASOKET,(SENDFUNC,S,FLAGS,NBYTE,BUF,ERRNO,RETCODE),    X
              VL
         L    R9,RETCODE
         LTR  R9,R9
         BNM  RECVTEXT
*
SENDERR1  DC   CL16'SEND ERROR'                Abend on error
RECVTEXT  DS   0H
***********************************************************************
```

```
*     Receive client message #2                                          *
***********************************************************************
          CALL EZASOKET,(RECVFUNC,S,FLAGS,NBYTE,BUF,ERRNO,RETCODE),    X
               VL
* Translate to EBCDIC if necessary
*         CALL EZACIC05,(BUF,LENGTH),VL
*
          L    R9,RETCODE
          LTR  R9,R9
          BNM  CHECKTXT
*
          DC   CL16'RECEIVE ERROR'            Abend on error
*
CHECKTXT  DS   0H
*
          CLC  BUF(3),=CL3'END'               Test for end of message
          BNE  RECVTEXT                       If not eom, read again
*
*    Set up to send shutdown message
SENDEND   DS   0H
*
          XC   BUF(LENG),BUF
          MVC  BUF(13),=CL13'SERVER MSG #2'
*    Translate to ASCII if necessary
*         CALL EZACIC04,(BUF,LENGTH),VL
*********************************************************************
*    Send "SERVER MSG #2" to indicate shutdown                      *
*********************************************************************
          CALL EZASOKET,(SENDFUNC,S,FLAGS,NBYTE,BUF,ERRNO,RETCODE),    X
               VL
          L    R9,RETCODE
          LTR  R9,R9
          BNM  SOCKCLOS
*
SENDERR2  DC   CL16'SEND ERROR'               Abend on error
*
SOCKCLOS  DS   0H
*******************************************************************
*    Close the socket                                             *
*******************************************************************
          CALL EZASOKET,(CLOSFUNC,S,ERRNO,RETCODE),VL
*
          L    R9,RETCODE
          LTR  R9,R9
          BNM  TERMAPI
*
CLOSERR   DC   CL16'CLOSE ERROR'
*
TERMAPI   DS   0H
*******************************************************************
*    Terminate the API                                            *
*******************************************************************
          CALL EZASOKET,(TERMFUNC),VL
*
PROCTCP   DS    0H                        Talk to TCPIP Client
*                                                AND ALTERNATE
*                                                SUCESSFUL MSG
          XR    R9,R9                            CLEAR REG
          LA    R9,OTLEN                         LOAD LENGTH
          STH   R9,OTLTH                         STORE LEN THERE
          XC    OTRSV(L'OTRSV),OTRSV             CLEAR RESERVE DATA
          MVC   OTMSG(L'OTMSG),DCINMSG           MOVE IN MSG
          MVC   OTLITDT(L'OTLITDT),DCDATE        MOVE IN DATE
          MVC   OTLITIME(L'OTLITIME),DCTIME      MOVE IN TIME
          UNPK  OTDATE,CDATE                     MAKE TIME & DATE
          OI    OTDATE+7,X'F0'                    EBCDIC
          UNPK  OTTIME,CTIME
          OI    OTTIME+7,X'F0'
          XR    R9,R9                             GET READY
          L     R9,INPUTMSN                       INPUT COUNT
          CVD   R9,DLBWORK                        INPUT COUNT
          UNPK  OTINPUTN,DLBWORK                  INPUT COUNT
          OI    OTINPUTN+7,X'F0'                 FIX SIGN
          MVC   OTFILL(L'OTFILL),=28X'40'         FILL CHAR
          MVC   OTLTERM(L'OTLTERM),LTERMN         ADD TERMINAL
*
*
          CALL  ASMTDLI,(ISRTFUNCT,(3),(7),,USER1),VL
*
          XC   IOAREAOT(L'IOAREAOT),IOAREAOT
          BR    R6
*
```

```
ERRRTN    DS    0H                      SOME WRONG HERE
*
          L     R13,4(R13)
          RETURN (14,12),RC=8           RELOAD DL/I REGS & RETURN
*                                       ERROR
GOBACK    DS    0H                      RETURN TO IMS
*
          L     R13,4(R13)
          RETURN (14,12),RC=0           RELOAD DL/I REGS & RETURN
*
         DS    0D
PSBS     DS    3F
         SPACE 1
BASE     EQU   12
RC       EQU   15
R0       EQU   0
R1       EQU   1
R2       EQU   2
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
         SPACE 1
*
          DS    0F
SAVEAREA  DC    18F'0'
*
GUFUNCT   DC    CL4'GU  '              GET UNIQUE CALL
GNFUNCT   DC    CL4'GN  '              GET NEXT
PURGFUNCT DC    CL4'PURG'              PURGE CALL
ISRTFUNCT DC    CL4'ISRT'              INSERT CALL
BADCALL   DC    CL8'BAD CALL'          BAD LIT
ERROPT    DC    F'0'                   1=nodump 0=dump
*
DCINMSG   DC    CL26' INPUT MESSAGE SUCESSFUL '
DCDATE    DC    CL6' DATE '
DCTIME    DC    CL6' TIME '
USER1     DC    CL8'USER1   '
USER2     DC    CL8'USER2   '
WTOR      DC    CL8'WTOR    '
*
INITFUNC  DC    CL16'INITAPI'
TAKEFUNC  DC    CL16'TAKESOCKET'
SENDFUNC  DC    CL16'SEND'
RECVFUNC  DC    CL16'RECV'
CLOSFUNC  DC    CL16'CLOSE'
TERMFUNC  DC    CL16'TERMAPI'
SELEFUNC  DC    CL16'SELECT'
*
WORKTCPIP DC    CL27'TCPIP WORK DATA BEGINS HERE'
APITYPE   DC    AL2(2)
MAXSOC    DC    AL2(MAX)
MAX       EQU   50
MAXSNO    DS    F'00'
*
IDENT     DS    0CL16
TCPNAME   DS    CL8
ASDNAME   DS    CL8
*
CLIENT    DS    0CL38
DOMAIN    DC    F'2'
NAME      DS    CL8
TASK      DS    CL8
RESERVED  DS    20B'0'
*
SUBTASK   DS    CL8
ERRNO     DS    F
RETCODE   DS    F
FLAGS     DC    F'0'
NBYTE     DC    F'50'
BUF       DS    CL(LENG)
LENG      EQU   50
LENGTH    DC    AL4(LENG)
```

```
TIMEOUT   DS    0D
SECONDS   DS    F
MILLISEC  DS    F
RSNDMASK   DS    CL(MAX)
WSNDMASK   DS    CL(MAX)
ESNDMASK   DS    CL(MAX)
RRETMASK   DS    CL(MAX)
WRETMASK   DS    CL(MAX)
ERETMASK   DS    CL(MAX)
S          DS    H
*
          DS    0D
DLBWORK   DS    D
          DS    0F
IOAREAIN  DS    0CL56                  I/O AREA INPUT
TIMLEN    DS    H                      Length of trans init msg
TIMRSV    DS    H                      reserved set to zeros
TIMID     DS    CL8                    LISTENER ID set to LISTNR
TIMLAS    DS    CL8                    LISTENER addr space name
TIMLTD    DS    CL8                    LISTENER taskid for takesocket
TIMSAS    DS    CL8                    SERVER addr space name
TIMSTD    DS    CL8                    SERVER TASK ID user in initapi
TIMSD     DS    H                      socket given in LISTENER used in
*                                              tasksocket
TIMTCPAS  DS    CL8                    TCPIP addr space name
TIMDT     DS    H                      Data type of client
*                                      ASCII(0) or EBCDIC(1)
          DS    0F
IOAREAOT  DS    0CL119                 I/O AREA OUTPUT
OTLTH     DS    BL2
OTRSV     DS    BL2
OTLTERM   DS    CL8
OTINPUTN  DS    CL8
OTMSG     DS    CL25
OTLITDT   DS    CL6
OTDATE    DS    CL8
OTLITIME  DS    CL6
OTTIME    DS    CL8
OTFILL    DS    CL28
OTLEN     EQU   (*-IOAREAOT)
*
IOPCB     DSECT                        I/O AREA
LTERMN    DS    CL8                    LOGICAL TERMINAL NAME
          DS    CL2                    RESERVED FOR IMS
STATUS    DS    CL2                    STATUS CODE
CDATE     DS    PL4                    CURRENT DATE YYDDD
CTIME     DS    PL4                    CURRENT TIME HHMMSST
INPUTMSN  DS    BL4                    SEQUENCE NUMBER
MSGOUTDN  DS    CL8                    MESSAGE OUT DESC NAME
USERID    DS    CL8                    USER ID OF SOURCE
*
ALTPCB1   DSECT                        ALTERNATE PCB
ALTERM1   DS    CL8                    DESTINATION NAME
          DS    CL2                    RESERVED FOR IMS
ALSTAT1   DS    CL2                    STATUS CODE
*
ALTPCB2   DSECT                        ALTERNATE PCB
ALTERM2   DS    CL8                    DESTINATION NAME
          DS    CL2                    RESERVED FOR IMS
ALSTAT2   DS    CL2                    STATUS CODE
*
          END
```

Figure 83. Sample assembler IMS server

Sample program implicit-mode

The topic shows an example of an implicit-mode client server program pair. The client program name is EZAIMSC1; you can find it in *hlq*.SEZAINST(EZAIMSC1). The server program name is EZASVAS1; its IMS trancode is DLSI101. The sample program is located in *hlq*.SEZAINST(EZASVAS1). When link editing the sample program, module EZAIMSAS should be included from the SEZALOAD target library.

Sample implicit-mode program flow

The client begins execution and obtains the host name and port number from the startup parameters. It then issues SOCKET and CONNECT calls to establish connectivity to the specified host and port. Upon successful completion of the CONNECT, the client sends the TRM, which tells the Listener to schedule the specified transaction (DLSI101). Because implicit-mode protocol requires that all input data segments be transmitted before the server application is scheduled, the client follows the TRM with 2 segments of application data and an end-of-message (EOM) segment. The Listener schedules DLSI101 and places a TIM on the IMS message queue, followed by the 2 segments of application data. Finally, the Listener issues a GIVESOCKET call and waits for the server to take the socket.

When the requested server (EZASVAS1) begins execution, it issues a GU call to ASMADLI. Behind the scenes, the Assist module issues its own GU and retrieves the TIM from the IMS message queue. Using addressability information from the TIM, it issues INITAPI and takeSOCKET calls, which establish connectivity with the client.

Once connectivity is established, the Assist module issues a GN to the IMS message queue, which returns the first segment of application data sent by the client. This data is returned to the server mainline. (Thus, to the server mainline, the first segment of application data is returned in response to its GU.) In the sample program, the first segment of application data is the data record: `THIS IS FIRST TEXT MESSAGE SEND TO SERVER`. This record is echoed back to the client by means of an IMS ISRT call to ASMADLI. The IMS Assist module intercepts the ISRT and issues a TCP/IP write() to echo the segment back to the client. The server mainline then issues a GN ASMADLI (which the Assist module intercepts and executes another GN ASMTDLI) to receive the second segment of user data. This segment is also echoed back to the client, using an IMS ISRT call, which the Assist module intercepts and replaces with a TCP/IP write() to the client.

After the second client data segment, the message queue contains an EOM segment, denoting the client's end-of-message. When the server has echoed the second input segment to the client, it issues another GN to ASMADLI. ASMADLI receives an end-of-message indication from the message queue and passes a QD status code back to the server mainline.

At this point, the server mainline has completed processing that message and issues a GU to see whether another message has arrived for that trancode. This GU triggers the Assist module to send a final CSMOKY message to the client, indicating successful completion. It then issues another GU to the IMS message queue to determine whether another message for that trancode has been queued. If so, the server program repeats itself; if not, the server issues a GOBACK and ends.

Sample implicit-mode client program (C language)

```
/*
 * Include Files.
 */
/*  #define RESOLVE_VIA_LOOKUP */
#pragma runopts(NOSPIE NOSTAE)
#define lim 119
#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         */
    struct sktmsg
           {
              short msglen;
              short msgrsv;
              char  msgtrn??(8??);
              char  msgdat??(lim??);
           }  msgbuff;
    struct datmsg
           {
              short datlen;
```

```
            short datrsv;
            char  datdat??(lim??);
         }  datbuff;

    char buf ??(lim??);        /* send receive buffer                 */

    struct hostent *hostnm;    /* server host name information        */
    struct sockaddr_in server; /* server address                      */
    int s;                     /* client socket                       */
    int len;                   /* length for send                     */

    /*
     * Check Arguments Passed. Should be hostname and port.
     */
    if (argc != 3)
    {
        printf("Invalid parameter count\n");
        exit(1);
    }

    printf("Usage: %s program name\n",argv??(0??));

    /*
     * The host name is the first argument. Get the server address.
     */

    printf("Usage: %s host name\n",argv??(1??));

    hostnm = gethostbyname(argv[1]);
    if (hostnm == (struct hostent *) 0)
    {
         printf("Gethostbyname failed\n");
        exit(2);
    }

    /*
     * The port is the second argument.
     */

    printf("Usage: %s port name\n",argv??(2??));

    port = (unsigned short) atoi(argv[2]);

    /*
     * 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);
    }
    /*
     * Put a message into the buffer.
     */

   msgbuff.msgdat??(0??)='\0';
   msgbuff.msgrsv = 0;
   msgbuff.msglen = 20;
   strncat(msgbuff.msgtrn,"*TRNREQ*",
           lim-strlen(msgbuff.msgdat)-1);
   strncat(msgbuff.msgdat,"DLSI101 ",
           lim-strlen(msgbuff.msgdat)-1);
   len=20;

    if (send(s, (char *)&msgbuff, len, 0) < 0)
    {
        tcperror("Send()");
        exit(5);
    }

    printf("\n");
    printf(msgbuff.msgdat);
    printf("send one complete\n");

    /*
     * Put a text message into the buffer.
```

```
     */
    datbuff.datdat??(0??)='\0';
    datbuff.datlen = 46;
    datbuff.datrsv = 0;
    strncat(datbuff.datdat,"THIS IS FIRST TEXT MESSAGE SEND TO SERVER ",
            lim-strlen(datbuff.datdat)-1);
    len=46;

     if (send(s, (char *)&datbuff, len, 0) < 0)
     {
         tcperror("Send()");
         exit(6);
     }

     printf("\n");
     printf(datbuff.datdat);
     printf("\n");
     printf("send for first text message complete\n");

     /*
      * Put a text message into the buffer.
      */

    datbuff.datdat??(0??)='\0';
    datbuff.datlen = 47;
    strncat(datbuff.datdat,"THIS IS 2ND TEXT MESSAGE SENDING TO SERVER",
            lim-strlen(datbuff.datdat)-1);
    len=47;

     if (send(s, (char *)&datbuff, len, 0) < 0)
     {
         tcperror("Send()");
         exit(7);
     }

     printf("\n");
     printf(datbuff.datdat);
     printf("\n");
     printf("send for 2nd test message complete\n");

     /*
      * Put a end message into the buffer.
      */

    datbuff.datdat??(0??)='\0';
    datbuff.datlen = 4;
    strncpy(datbuff.datdat," ",lim);
     len=4;

     if (send(s, (char *)&datbuff, len, 0) < 0)
     {
         tcperror("Send()");
         exit(8);
     }

     printf("\n");
     printf(datbuff.datdat);
     printf("\n");
     printf("send for end message complete\n");

     /*
      * The server sends back the same message. Receive it into the
      * buffer.
      */

     strncpy(datbuff.datdat," ",lim);

     if (recv(s,(char *)&datbuff, lim, 0) < 0)
     {
         tcperror("Recv()");
         exit(9);
     }

     printf("receive one text complete\n");
     printf(datbuff.datdat);
     printf("\n");

     /*
      * The server sends back the same message. Receive it into the
      * buffer.
      */

     strncpy(datbuff.datdat," ",lim);

     if (recv(s,(char *)&datbuff, lim, 0) < 0)
     {
         tcperror("Recv()");
         exit(10);
     }

     printf("receive two text complete\n");
     printf(datbuff.datdat);
     printf("\n");
```

```
    /*
     * The server sends eof message. Receive it into the
     * buffer.
     */

    strncpy(datbuff.datdat," ",lim);

    if (recv(s,(char *)&datbuff, 4, 0) < 0)
    {
        tcperror("Recv()");
        exit(11);
    }

    printf("receive eof complete\n");
    printf("\n");
    printf(datbuff.datdat);
    printf("\n");

    strncpy(datbuff.datdat," ",lim);

    if (recv(s,(char *)&datbuff, 12, 0) < 0)
    {
        tcperror("Recv()");
        exit(12);
    }

    printf("receive CSMOKY complete\n");
    printf("\n");
    printf(datbuff.datdat);
    printf("\n");

    /*
     * Close the socket.
     */
    close(s);

    printf("Client Ended Successfully\n");
    exit(0);

}
```

Figure 84. Sample C client to drive IMS Listener

Sample implicit-mode server program (Assembly language)

```
EZASVAS1  CSECT                        ENTRY POINT
          USING EZASVAS1,BASE          ADDRESSABILITY
          SAVE  (14,12)                SAVE DL/I REGS
          LR    BASE,15
          ST    R13,SAVEAREA+4         SAVE AREA CHAINING
          LA    R13,SAVEAREA           NEW SAVE AREA
          MVC   PSBS(L'PSBS*3),0(1)    SAVE PCB LIST
*
* REG 1 CONTAINS PTR TO PCB ADDR LIST
* REG 13 CONTAINS PTR TO DL/I SAVE AREA
* REG 14 CONTAINS PTR DL/I RETURN ADDRESS
* REG 15 CONTAINS PROGRAMS ENTRY POINT
*
          L     R2,0(R0,R1)             LOAD ADDR OF I/O PCB
*
          USING IOPCB,R2                ADDRESSABILITY
*
          L     R3,4(R0,R1)             LOAD ADDR OF ALT PCB
*
          USING ALTPCB1,R3              ADDRESSABILITY
*
          L     R4,8(R0,R1)             LOAD ADDR OF ALT PCB
          LA    R4,0(R0,R4)             REMOVE HIGH ORDER BIT
*
          USING ALTPCB2,R4              ADDRESSABILITY
*
          LA    R5,IOAREAIN
          LA    R7,IOAREAOT                      POINT TO OUTPUT AREA
*
GUCALL    DS    0H                      GET UNIQUE CALL
*
*
          CALL  ASMADLI,(GUFUNCT,(2),(5)),VL
*
          CLC   STATUS(L'STATUS),=CL2'QC'    IF NO MESSAGES
          BE    GOBACK                       RETURN TO IMS
*                                            ELSE NEXT INSTR
          CLC   STATUS(L'STATUS),=CL2'  '    IF BLANK OK
          BNE   ERRRTN                       SOME WRONG HERE
*                                            ELSE NEXT INSTR
*
          XR  R6,R6                          CLEAR REG
          LA  R6,GNCALL                      SET RETURN ADDRESS
```

```
          BAL R6,ISRTCALL                    GO INSERT SEGMENT
*
GNCALL    DS    0H                      GET NEXT CALL
*
*
          CALL  ASMADLI,(GNFUNCT,(2),(5)),VL
*
          CLC   STATUS(L'STATUS),=CL2'QD'    IF NO MORE SEGMENTS
          BE    GUCALL                       RETURN TO IMS
          CLC   STATUS(L'STATUS),=CL2'  '    IF NO MORE SEGMENTS
          BNE   ERRRTN                       SOME WRONG HERE
*
          XR  R6,R6                          CLEAR REG
          LA  R6,GNLOOP                      SET RETURN ADDRESS
          BAL R6,ISRTCALL                    GO INSERT SEGMENT
*
GNLOOP    B     GNCALL
*
ISRTCALL  DS    0H                      INSERT - WRITE TO TERMINAL
*                                                AND ALTERNATE
*                                                SUCESSFUL MSG
          XR    R9,R9                            CLEAR REG
          LA    R9,OTLEN                         LOAD LENGTH
          STH   R9,OTLTH                         STORE LEN THERE
          XC    OTRSV(L'OTRSV),OTRSV             CLEAR RESERVE DATA
          MVC   OTMSG(L'OTMSG),DCINMSG           MOVE IN MSG
          MVC   OTLITDT(L'OTLITDT),DCDATE         "    " DATE
          MVC   OTLITIME(L'OTLITIME),DCTIME       "    " TIME
          UNPK  OTDATE,CDATE                      MAKE TIME & DATE
          OI    OTDATE+7,X'F0'                    EBCDIC
          UNPK  OTTIME,CTIME
          OI    OTTIME+7,X'F0'
          XR    R9,R9                             GET READY
          L     R9,INPUTMSN                       INPUT COUNT
          CVD   R9,DLBWORK                        INPUT COUNT
          UNPK  OTINPUTN,DLBWORK                  INPUT COUNT
          OI    OTINPUTN+7,X'F0'                 FIX SIGN
          MVC   OTFILL(L'OTFILL),=28X'40'         FILL CHAR
          MVC   OTLTERM(L'OTLTERM),LTERMN         ADD TERMINAL
*
* For LTERM USER1....
*
          CALL  ASMADLI,(ISRTFUNCT,(2),(7)),VL
*
* For LTERM USER2....
*
          XC   IOAREAOT(L'IOAREAOT),IOAREAOT
          BR   R6
*
ERRRTN    DS    0H                      SOME WRONG HERE
*
          L     R13,4(R13)
          RETURN (14,12),RC=8           RELOAD DL/I REGS & RETURN
*                                       ERROR
*
GOBACK    DS    0H                      RETURN TO IMS
*
          L     R13,4(R13)
          RETURN (14,12),RC=0           RELOAD DL/I REGS & RETURN
*
         DS    0D
PSBS     DS    3F
         SPACE 1
BASE     EQU   12
RC       EQU   15
R0       EQU   0
R1       EQU   1
R2       EQU   2
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
         SPACE 1
*
          DS    0F
SAVEAREA  DC    18F'0'
GUFUNCT   DC    CL4'GU  '              GET UNIQUE CALL
GNFUNCT   DC    CL4'GN  '              GET NEXT
PURGFUNCT DC    CL4'PURG'              PURGE CALL
ISRTFUNCT DC    CL4'ISRT'              INSERT CALL
BADCALL   DC    CL8'BAD CALL'          BAD LIT
ERROPT    DC    F'1'                   1=NODUMP 2=DUMP
DCINMSG   DC    CL26' INPUT MESSAGE SUCESSFUL '
DCDATE    DC    CL6' DATE '
```

```
DCTIME    DC    CL6' TIME '
USER1     DC    CL8'USER1   '
USER2     DC    CL8'USER2   '
WTOR      DC    CL8'WTOR    '
*
          DS    0D
DLBWORK   DS    D
          DS    0F
IOAREAIN  DS    CL119                  I/O AREA INPUT
          DS    0F
IOAREAOT  DS    0CL119                 I/O AREA OUTPUT
OTLTH     DS    BL2
OTRSV     DS    BL2
OTLTERM   DS    CL8
OTINPUTN  DS    CL8
OTMSG     DS    CL25
OTLITDT   DS    CL6
OTDATE    DS    CL8
OTLITIME  DS    CL6
OTTIME    DS    CL8
OTFILL    DS    CL46
OTLEN     EQU   (*-IOAREAOT)
*
IOPCB     DSECT                        I/O AREA
LTERMN    DS    CL8                    LOGICAL TERMINAL NAME
          DS    CL2                    RESERVED FOR IMS
STATUS    DS    CL2                    STATUS CODE
CDATE     DS    PL4                    CURRENT DATE YYDDD
CTIME     DS    PL4                    CURRENT TIME HHMMSST
INPUTMSN  DS    BL4                    SEQUENCE NUMBER
MSGOUTDN  DS    CL8                    MESSAGE OUT DESC NAME
USERID    DS    CL8                    USER ID OF SOURCE
*
ALTPCB1   DSECT                        ALTERNATE PCB
ALTERM1   DS    CL8                    DESTINATION NAME
          DS    CL2                    RESERVED FOR IMS
ALSTAT1   DS    CL2                    STATUS CODE
*
ALTPCB2   DSECT                        ALTERNATE PCB
ALTERM2   DS    CL8                    DESTINATION NAME
          DS    CL2                    RESERVED FOR IMS
ALSTAT2   DS    CL2                    STATUS CODE
*
*
          END
```

Figure 85. Sample assembler IMS server

Sample program - IMS MPP client

This information assumes that the IMS system is the server; however, some applications require that the server be a TCP/IP host. The following information shows an example of a program in which the *client* is an IMS MPP, and the *server* is a TCP/IP host.

For simplicity, we have coded both client and server to execute on an MVS host. The client (EZAIMSC3) is initiated by a 3270-driven IMS MPP; the server (EZASVAS3) is a TSO job which is already running when the client starts.

The samples are located in *hlq*.SEZAINST(EZAIMSC3) and *hlq*.SEZAINST(EZASVAS3).

Sample IMS MPP client program flow

A TSO Submit command is used to start the server. Once started, it executes the TCP/IP connection sequence for an iterative server (INITAPI, SOCKET, BIND, LISTEN, SELECT, and ACCEPT) and then waits for the client to request connection.

Note that the BIND call returns a socket descriptor which is then used to listen for a connection request. The ACCEPT call also returns a socket descriptor, which is used for the application data connection. Meanwhile, the original listener socket is available to receive additional connection requests.

The client is started by calling an IMS transaction which, in turn, executes the TCP/IP connection sequence for a client (INITAPI, SOCKET, and CONNECT).

Upon receiving the connection request from the client, the server issues a READ and waits for the client to WRITE the initial message. The server contains a READ/WRITE loop which echoes client transmissions until an "END" message is received. When this message is received, it sets a 'last record' switch, echoes the end message to the client, and terminates.

Note that in order for the server to terminate, it must close two sockets: one -- the socket on which it listens for connection requests; the other -- the socket on which the data transfers took place.

The client and server both include Write To Operator macros, which allow you to monitor progress through the application logic flow. At the end of this appendix you will find a sample of the WTO output from the client and the server.

Sample client program for non-IMS server

```
EZAIMSC3 CSECT
EZAIMSC3 AMODE ANY
EZAIMSC3 RMODE ANY
         GBLB  &TRACE  ASSEMBLER VARIABLE TO CONTROL TRACE GENERATION
&TRACE   SETB  1       1=TRACE ON  0=TRACE OFF
         GBLB  &SUBTR  ASSEMBLER VARIABLE TO CONTROL SUBTRACE
&SUBTR   SETB  0       1=SUBTRACE ON  0=SUBTRACE OFF
*--------------------------------------------------------------------*
*                                                                    *
* MODULE NAME:  EZAIMSC3                                             *
*                                                                    *
* Copyright:    Licensed Materials - Property of IBM                 *
*                                                                    *
*               "Restricted Materials of IBM"                        *
*                                                                    *
*               5694-A01                                             *
*                                                                    *
*               Copyright IBM Corp. 2009                             *
*                                                                    *
*               US Government Users Restricted Rights -              *
*               Use, duplication or disclosure restricted by         *
*               GSA ADP Schedule Contract with IBM Corp.             *
*                                                                    *
* Status:       CSV1R11                                              *
*                                                                    *
* MODULE FUNCTION: Sample program of an IMS MPP TCP client. This     *
*                  module connects with a TCP/IP server and          *
*                  exchanges msgs with it. The number of msgs        *
*                  exchanged is determined by a constant and         *
*                  the length of the messages is also determined     *
*                  by a constant.                                    *
*                  Note: If an error occurs during processing, this  *
*                  module will send an error message to the system   *
*                  console and then Abends0c1.                       *
*                                                                    *
* LANGUAGE:  Assembler                                               *
*                                                                    *
* ATTRIBUTES: Reusable                                               *
*                                                                    *
* INPUT: None                                                        *
*                                                                    *
* Change History:                                                    *
*                                                                    *
* Flag Reason   Release  Date   Origin    Description                *
* ---- -------- -------- ------ --------  -------------------------- *
* $Q1= D316.15  CSV1R5   020604 BKELSEY : Support 64K sockets        *
* $F1= RBBASE   CSV1R11  080612 Herr    : Cleaned up >72 lines       *
*                                                                    *
*--------------------------------------------------------------------*
SOC0000  DS    0H
         USING *,R15              Tell assembler to use reg 15
         B     SOC00100           Branch to startup address
         DC    CL16'IMSTCPCLEYECATCH'
BUFLEN   EQU   1000               Set length of I/O buffers
R4BASE   DC    A(SOC0000+4096)
*--------------------------------------------------------------------*
*        Control Variables for this program                          *
*--------------------------------------------------------------------*
SOCMSGN  DC    F'005'             Number of messages to be exchanged
SOCMSGL  DC    F'200'             Length of messages to be exchanged
SERVPORT DC    H'5000'            Port Address of Server
SOCTASK  DC    F'0'               Task number for this client
SERVLEN  DC    H'0'               Length of server's name
SERVNAME DC    CL24' '            Internet name of server
SENDINT  DC    CL8'00000010'      Delay interval between sends
*--------------------------------------------------------------------*
*        Constants used for call functions                           *
*--------------------------------------------------------------------*
INITAPI  DC    CL16'INITAPI'
GETHSTID DC    CL16'GETHOSTID'
SOCKET   DC    CL16'SOCKET'
GHBN     DC    CL16'GETHOSTBYNAME'
CONNECT  DC    CL16'CONNECT'
READ     DC    CL16'READ'
WRITE    DC    CL16'WRITE'
CLOSE    DC    CL16'CLOSE'
TERMAPI  DC    CL16'TERMAPI'
*--------------------------------------------------------------------*
```

```
*        Beginning of program execution statements                   *
*--------------------------------------------------------------------*
SOC00100 DS    0H                  Beginning of program
         STM   R14,R12,12(R13)     Save callers registers
         LR    R3,R15              Move base reg to R3
         L     R4,R4BASE           Add R4 as second base reg
         DROP  R15                 Tell assembler to drop R15 as base
         USING SOC0000,R3,R4       Tell assembler to use R3 and R4 as   X
                                   base registers
         LR    R7,R13              Save address of previous save area
         LA    R12,SOCSTG          Move address of program stg to R12
         LA    R13,SOCSTGL         Move length of program stge to R13
         SR    R14,R14             Clear R14
         SR    R15,R15             Clear R15
         MVCL  R12,R14             Clear program storage
         LA    R13,SOCSTG          Move address of program stg to R13
         USING SOCSTG,R13          Tell Assembler about storage
         ST    R7,SOCSAVEL         Save address of lower save area
         ST    R13,8(R7)           Complete save area chain
SOC00200 DS    0H
*
*   Build message for console
*
         MVC   MSG1D,MSG1C         Initialize first part of message
         L     R0,SOCTASK          Get task number
         CVD   R0,DWORK            Convert task number to decimal
         UNPK  MSGTD,DWORK+5(3)    Convert decimal to character
         OI    MSGTD+4,X'F0'       Clear sign
         MVC   MSG2D,MSG2CS        Move 'Started' to message
         LA    R6,MSG              Put text address in R6
         MVC   MSGLEN,=AL2(MSGTL)  Put length of text in msg hdr.
         MVC   WTOLIST,WTOPROT     Move prototype WTO to list form
         WTO   TEXT=(R6),          Write message to operator            X
               MF=(E,WTOLIST)
*
*        Issue INITAPI Call to connect to interface
*
         MVC   SOCTASKC(3),=CL3'SOC'  Build Task Identifier
         MVC   SOCTASKC+3(5),MSGTD
         MVC   MSG2D,MSG2C1        Move 'INITAPI'to message
         MVC   MAXSOC,=AL2(50)     Initialize MAXSOC field
         MVC   ASTCPNAM,=CL8'TCPV3   '  Initialize TCP Name
         MVC   ASCLNAME,=CL8'TCPCLINT'  Initialize AS Name
*
         CALL  EZASOKET,                                                X
               (INITAPI,MAXSOC,ASIDENT,SOCTASKC,HISOC,ERRNO,            X
               RETCODE),                                                X
               VL                  Specify variable parameter list
*
         L     R6,RETCODE          Check for sucessful call
         C     R6,=F'0'            Is it less than zero
         BL    SOCERR              Yes, go display error and terminat
         AIF   (NOT &TRACE).TRACE01
*  TRACE ENTRY FOR INITAPI  TRACE TYPE = 1
         LA    R6,MSG              Put text address in R6
         MVC   MSGLEN,=AL2(MSGTL)  Put length of text in msg hdr.
         WTO   TEXT=(R6),          Write message to operator            X
               MF=(E,WTOLIST)
.TRACE01 ANOP
*
*        Issue GETHOSTID Call  to obtain internet address of host
*
         MVC   MSG2D,MSG2C8        Move 'GTHSTID'to message
*
         CALL  EZASOKET,           Issue GETHOSTID Call                 X
               (GETHSTID,SERVIADD),                                     X
               VL                  Specify Variable parameter list
*
         AIF   (NOT &TRACE).TRACE08
*  TRACE ENTRY FOR GETHOSTID  TRACE TYPE = 8
         LA    R6,MSG              Put text address in R6
         MVC   MSGLEN,=AL2(MSGTL)  Put length of text in msg hdr.
         WTO   TEXT=(R6),          Write message to operator            X
               MF=(E,WTOLIST)
.TRACE08 ANOP
*
*        Issue SOCKET Call to obtain a socket descriptor
*
         MVC   MSG2D,MSG2C2        Move 'SOCKET' to message
         MVC   AF,=F'2'            Address Family = Internet
         MVC   SOCTYPE,=F'1'       Type = Stream Sockets
         XC    PROTO,PROTO         Clear protocol field
*
         CALL  EZASOKET,           Issue SOCKET Call                    X
               (SOCKET,AF,SOCTYPE,PROTO,ERRNO,RETCODE),                 X
               VL                  Specify variable parameter list
*
         L     R6,RETCODE          Check for sucessful call
         C     R6,=F'0'            Is it less than zero
         BL    SOCERR              Yes, go display error and terminat
         AIF   (NOT &TRACE).TRACE02
*  TRACE ENTRY FOR SOCKET  TRACE TYPE = 2
         LA    R6,MSG              Put text address in R6
```

```
         MVC   MSGLEN,=AL2(MSGTL) Put length of text in msg hdr.
         WTO   TEXT=(R6),         Write message to operator            X
               MF=(E,WTOLIST)
.TRACE02 ANOP
*
*        Get socket descriptor number
*
         L     R6,RETCODE         Descriptor number returned
         STH   R6,SOCDESC         Save it
*
*        Issue CONNECT Command to Connect to Server
*
         MVC   SSOCAF,=H'2'       Set AF=INET
         MVC   SSOCPORT,SERVPORT  Move Port Number
         MVC   SSOCINET,SERVIADD  Move Internet Address of Server
         MVC   MSG2D,MSG2C4       Move 'CONNECT' to message
*
         CALL  EZASOKET,          Issue CONNECT Call                   X
               (CONNECT,SOCDESC,SERVSOC,ERRNO,RETCODE),                X
               VL                 Specify variable parameter list
*
         L     R6,RETCODE         Check for sucessful call
         C     R6,=F'0'           Is it less than zero
         BL    SOCERR             Yes, go display error and terminat
         AIF   (NOT &TRACE).TRACE04
*  TRACE ENTRY FOR CONNECT  TRACE TYPE = 4
         LA    R6,MSG             Put text address in R6
         MVC   MSGLEN,=AL2(MSGTL) Put length of text in msg hdr.
         WTO   TEXT=(R6),         Write message to operator            X
               MF=(E,WTOLIST)
.TRACE04 ANOP
*
*        Send initial message to server
*
         MVC   BUFFER(L'MSG1),MSG1  Move Message to Buffer
         LA    R6,L'MSG1          Get length of message
         ST    R6,DATALEN         Put length in data field
         MVC   MSG2D,MSG2C5       Move 'WRITE' to message
*
         CALL  EZASOKET,          Issue WRITE Call                     X
               (WRITE,SOCDESC,DATALEN,BUFFER,ERRNO,RETCODE),           X
               VL
*
         L     R6,RETCODE         Check for sucessful call
         C     R6,=F'0'           Is it less than zero
         BL    SOCERR             Yes, go display error and terminat
         AIF   (NOT &TRACE).TRACE05
*  TRACE ENTRY FOR WRITE  TRACE TYPE = 5
         MVC   MSGLEN,=AL2(MSGTL+18) Put length of text in msg hdr.
         MVC   MSG3D,ERR3C        ' RETCODE= '
         MVI   MSG3S,C'+'         Move sign
         L     R6,RETCODE         Get return code value
         CVD   R6,DWORK           Convert it to decimal
         UNPK  MSG4D,DWORK+4(4)   Unpack it
         OI    MSG4D+6,X'F0'      Correct the sign
         LA    R6,MSG             Put text address in R6
         WTO   TEXT=(R6),         Write message to operator            X
               MF=(E,WTOLIST)
.TRACE05 ANOP
*
*        Read response to initial message
*
         MVC   MSG2D,MSG2C6       Move 'READ' to message
         LA    R6,L'BUFFER        Get length of buffer
         ST    R6,DATALEN         Put length in data field
*
         CALL  EZASOKET,          Issue READ Call                      X
               (READ,SOCDESC,DATALEN,BUFFER,ERRNO,RETCODE),            X
               VL                 Specify variable parameter list
*
         L     R6,RETCODE         Check for sucessful call
         C     R6,=F'0'           Is it less than zero
         BL    SOCERR             Yes, go display error and terminat
         AIF   (NOT &TRACE).TRACE06
*  TRACE ENTRY FOR READ  TRACE TYPE = 6
         MVC   MSGLEN,=AL2(MSGTL+18) Put length of text in msg hdr.
         MVC   MSG3D,ERR3C        ' RETCODE= '
         MVI   MSG3S,C'+'         Move sign
         L     R6,RETCODE         Get return code value
         CVD   R6,DWORK           Convert it to decimal
         UNPK  MSG4D,DWORK+4(4)   Unpack it
         OI    MSG4D+6,X'F0'      Correct the sign
         LA    R6,MSG             Put text address in R6
         WTO   TEXT=(R6),         Write message to operator            X
               MF=(E,WTOLIST)
.TRACE06 ANOP
*
*        Send second message to server
*
         MVC   BUFFER(L'MSG2),MSG2  Move Message to Buffer
         LA    R6,L'MSG2          Get length of message
         ST    R6,DATALEN         Put length in data field
         MVC   MSG2D,MSG2C5       Move 'WRITE' to message
```

```
*
         CALL  EZASOKET,          Issue WRITE Call                    X
               (WRITE,SOCDESC,DATALEN,BUFFER,ERRNO,RETCODE),          X
               VL
*
         L     R6,RETCODE         Check for sucessful call
         C     R6,=F'0'           Is it less than zero
         BL    SOCERR             Yes, go display error and terminat
         AIF   (NOT &TRACE).TRACE15
*  TRACE ENTRY FOR WRITE  TRACE TYPE = 5
         MVC   MSGLEN,=AL2(MSGTL+18) Put length of text in msg hdr.
         MVC   MSG3D,ERR3C        ' RETCODE= '
         MVI   MSG3S,C'+'         Move sign
         L     R6,RETCODE         Get return code value
         CVD   R6,DWORK           Convert it to decimal
         UNPK  MSG4D,DWORK+4(4)   Unpack it
         OI    MSG4D+6,X'F0'      Correct the sign
         LA    R6,MSG             Put text address in R6
         WTO   TEXT=(R6),         Write message to operator           X
               MF=(E,WTOLIST)
.TRACE15 ANOP
         L     R6,RETCODE         Check for sucessful call
         C     R6,=F'0'           Is it less than zero
         BL    SOCERR             Yes, go display error and terminat
*
*        Read response to second message
*
         MVC   MSG2D,MSG2C6       Move 'READ' to message
*
         CALL  EZASOKET,          Issue READ Call                     X
               (READ,SOCDESC,SOCMSGL,BUFFER,ERRNO,RETCODE),           X
               VL                 Specify variable parameter list
*
         L     R6,RETCODE         Check for sucessful call
         C     R6,=F'0'           Is it less than zero
         BL    SOCERR             Yes, go display error and terminat
*
         AIF   (NOT &TRACE).TRACE16
*  TRACE ENTRY FOR READ  TRACE TYPE = 6
         MVC   MSGLEN,=AL2(MSGTL+18) Put length of text in msg hdr.
         MVC   MSG3D,ERR3C        ' RETCODE= '
         MVI   MSG3S,C'+'         Move sign
         L     R6,RETCODE         Get return code value
         CVD   R6,DWORK           Convert it to decimal
         UNPK  MSG4D,DWORK+4(4)   Unpack it
         OI    MSG4D+6,X'F0'      Correct the sign
         LA    R6,MSG             Put text address in R6
         WTO   TEXT=(R6),         Write message to operator           X
               MF=(E,WTOLIST)
.TRACE16 ANOP
*
*        Send End message to server
*
         MVC   BUFFER(L'ENDMSG),ENDMSG  Move end message to buffer
         LA    R6,L'ENDMSG        Get length of message
         ST    R6,SOCMSGL         Put length in length field
         MVC   MSG2D,MSG2C5       Move 'WRITE' to message
*
         CALL  EZASOKET,          Issue WRITE Call                    X
               (WRITE,SOCDESC,SOCMSGL,BUFFER,ERRNO,RETCODE),          X
               VL
*
         L     R6,RETCODE         Check for sucessful call
         C     R6,=F'0'           Is it less than zero
         BL    SOCERR             Yes, go display error and terminat
         AIF   (NOT &TRACE).TRACE25
*  TRACE ENTRY FOR WRITE  TRACE TYPE = 5
         MVC   MSGLEN,=AL2(MSGTL+18) Put length of text in msg hdr.
         MVC   MSG3D,ERR3C        ' RETCODE= '
         MVI   MSG3S,C'+'         Move sign
         L     R6,RETCODE         Get return code value
         CVD   R6,DWORK           Convert it to decimal
         UNPK  MSG4D,DWORK+4(4)   Unpack it
         OI    MSG4D+6,X'F0'      Correct the sign
         LA    R6,MSG             Put text address in R6
         WTO   TEXT=(R6),         Write message to operator           X
               MF=(E,WTOLIST)
.TRACE25 ANOP
*
*        Read response to end message
*
         MVC   MSG2D,MSG2C6       Move 'READ' to message
*
         CALL  EZASOKET,          Issue READ Call                     X
               (READ,SOCDESC,SOCMSGL,BUFFER,ERRNO,RETCODE),           X
               VL                 Specify variable parameter list
*
         L     R6,RETCODE         Check for sucessful call
         C     R6,=F'0'           Is it less than zero
         BL    SOCERR             Yes, go display error and terminat
         AIF   (NOT &TRACE).TRACE26
*  TRACE ENTRY FOR READ  TRACE TYPE = 6
         MVC   MSGLEN,=AL2(MSGTL+18) Put length of text in msg hdr.
```

```
         MVC   MSG3D,ERR3C        ' RETCODE= '
         MVI   MSG3S,C'+'         Move sign
         L     R6,RETCODE         Get return code value
         CVD   R6,DWORK           Convert it to decimal
         UNPK  MSG4D,DWORK+4(4)   Unpack it
         OI    MSG4D+6,X'F0'      Correct the sign
         LA    R6,MSG             Put text address in R6
         WTO   TEXT=(R6),         Write message to operator            X
               MF=(E,WTOLIST)
.TRACE26 ANOP
*
*        Close socket
*
         MVC   MSG2D,MSG2C7       Move 'CLOSE' to message
*
         CALL  EZASOKET,          Issue CLOSE Call                     X
               (CLOSE,SOCDESC,ERRNO,RETCODE),                          X
               VL                 Specify variable parameter list
*
         L     R6,RETCODE         Check for sucessful call
         C     R6,=F'0'           Is it less than zero
         BL    SOCERR             Yes, go display error and terminat
         AIF   (NOT &TRACE).TRACE07
*  TRACE ENTRY FOR CLOSE TRACE TYPE = 7
         LA    R6,MSG             Put text address in R6
         MVC   MSGLEN,=AL2(MSGTL) Put length of text in msg hdr.
         WTO   TEXT=(R6),         Write message to operator            X
               MF=(E,WTOLIST)
.TRACE07 ANOP
*
*        Terminate Connection to API
*
         CALL  EZASOKET,          Issue TERMAPI Call                   X
               (TERMAPI),                                              X
               VL                 Specify variable parameter list
*
*        Issue console message for task termination
*
         MVC   MSG2D,MSG2CE       Move 'Ended' to message
         LA    R6,MSG             Put text address in R6
         MVC   MSGLEN,=AL2(MSGTL) Put length of text in msg hdr.
         WTO   TEXT=(R6),         Write message to operator            X
               MF=(E,WTOLIST)
*
*        Return to Caller
*
         L     R13,SOCSAVEL
         LM    R14,R12,12(R13)
         BR    R14
*
*        Write error message to operator and ABENDS0C1
*
SOCERR   DS    0H                 Write error message to operator
         MVC   ERR1D,MSG1D        'IMSTCPCL, TASK #'
         MVC   ERRTD,MSGTD        Move task number to message
         MVC   ERR2D,MSG2D        Call Type
         MVC   ERR3D,ERR3C        ' RETCODE= '
         MVI   ERR3S,C'-'         Move sign which is always minus
         MVC   ERR5D,ERR5C        ' ERRNO= '
         L     R6,RETCODE         Get return code value
         CVD   R6,DWORK           Convert it to decimal
         UNPK  ERR4D,DWORK+4(4)   Unpack it
         OI    ERR4D+6,X'F0'      Correct the sign
         L     R6,ERRNO           Get errno value
         CVD   R6,DWORK           Convert it to decimal
         UNPK  ERR6D,DWORK+4(4)   Unpack it
         OI    ERR6D+6,X'F0'      Correct the sign
         LA    R6,ERR             Put text address in R6
         MVC   ERRLEN,=AL2(ERRTL) Put length of text in msg hdr.
         WTO   TEXT=(R6),         Write message to operator            X
               MF=(E,WTOLIST)
ABEND    DS    0H
         DC    H'0'               Force ABEND
WTOPROT  WTO   TEXT=,             List form of WTO Macro               X
               MF=L
WTOPROTL EQU   *-WTOPROT          Length of WTO Prototype
MSG1C    DC    CL17'IMSTCPCL, TASK # '
MSG2CS   DC    CL8' STARTED'
MSG2CE   DC    CL8' ENDED  '
ERR3C    DC    CL10' RETCODE= '
ERR5C    DC    CL8' ERRNO= '
MSG2C1   DC    CL8' INITAPI'
MSG2C2   DC    CL8' SOCKET '
MSG2C4   DC    CL8' CONNECT'
MSG2C5   DC    CL8' WRITE  '
MSG2C6   DC    CL8' READ   '
MSG2C7   DC    CL8' CLOSE  '
MSG2C8   DC    CL8' GTHSTID'
MSG2C35  DC    CL8' SYNC   '
MSG1     DC    CL16'CLIENT MESSAGE 1'     First msg to server
MSG2     DC    CL16'CLIENT MESSAGE 2'     2nd msg to server
ENDMSG   DS    0CL48              End Message for Server
         DC    CL3'END'           End indicator for SRV1
```

```
         DC    CL45' '              Pad with blanks
         DS    0D
SOCSTG   DS    0F                   PROGRAM STORAGE
SOCSAVE  DS    0F                   Save Area
SOCSAVE1 DS    F                    Word for high-level languages
SOCSAVEL DS    F                    Address of previous save area
SOCSAVEH DS    F                    Address of next save area
SOCSAV14 DS    F                    Reg 14
SOCSAV15 DS    F                    Reg 15
SOCSAV0  DS    F                    Reg 0
SOCSAV1  DS    F                    Reg 1
SOCSAV2  DS    F                    Reg 2
SOCSAV3  DS    F                    Reg 3
SOCSAV4  DS    F                    Reg 4
SOCSAV5  DS    F                    Reg 5
SOCSAV6  DS    F                    Reg 6
SOCSAV7  DS    F                    Reg 7
SOCSAV8  DS    F                    Reg 8
SOCSAV9  DS    F                    Reg 9
SOCSAV10 DS    F                    Reg 10
SOCSAV11 DS    F                    Reg 11
SOCSAV12 DS    F                    Reg 12
SOCSAV13 DS    F                    Reg 13
MAXSOC   DS    H                    Maximum number of sockets for this   X
                                            application
SOCTASKC DS    CL8                  Character task identifier
SOCDESC  DS    H                    Socket Descriptor Number
HISOC    DS    F                    Highest socket descriptor available
AF       DS    F                    Address family for socket call
SOCTYPE  DS    F                    Type of socket
NS       DS    F                    New socket number for socket call
SERVAL   DS    12F                  Alias array for server
SERVSOC  DS    0F                   Socket Address of Server
SSOCAF   DS    H                    Address Family of Server = 2
SSOCPORT DS    H                    Port number for Server
SSOCINET DS    F                    Internet address for Server
         DC    D'0'                 Reserved
MSG      DS    0F                   Message area
MSGLEN   DS    H                    Length of message
MSG1D    DS    CL17                 'IMSTCPCL, TASK #'
MSGTD    DS    CL5                  Task Number
MSG2D    DS    CL8                  Last part of message
MSGE     EQU   *                    End of message
MSGTL    EQU   MSGE-MSG1D           Length of message text
MSG3D    DS    CL10                 ' RETCODE = '
MSG3S    DS    C                    Sign which is always -
MSG4D    DS    CL7                  Return code
ERR      DS    0F                   Error message area
ERRLEN   DS    H                    Length of message
ERR1D    DS    CL17                 'IMSTCPCL, TASK #'
ERRTD    DS    CL5                  Task Number
ERR2D    DS    CL8                  Last part of message
ERR3D    DS    CL10                 ' RETCODE = '
ERR3S    DS    C                    Sign which is always -
ERR4D    DS    CL7                  Return code
ERR5D    DS    CL8                  ' ERRNO ='
ERR6D    DS    CL7                  Error number
ERRE     EQU   *                    End of message
ERRTL    EQU   ERRE-ERR1D           Length of message text
BUFFER   DS    CL(BUFLEN)           Socket I/O Buffer
DATALEN  DS    F                    Length of buffer data
DWORK    DS    D                    Double word work area
RECNO    DS    PL4                  Record Number
ERRNO    DS    F                    Error number returned from call
RETCODE  DS    F                    Return code from call
PROTO    DS    F                    Protocol field for socket
ASIDENT  DS    0F                   Address space identifier for initapi
ASTCPNAM DS    CL8                  Name of TCP/IP Address Space
SERVIADD DS    F                    Internet address for Server
ASCLNAME DS    CL8                  Our name as known to TCP/IP
WTOLIST  DS    CL(WTOPROTL)         List form of WTO Macro
SOCSTGE  EQU   *                    End of Program Storage
SOCSTGL  EQU   SOCSTGE-SOCSTG       Length of Program Storage
         LTORG
R0       EQU   0
R1       EQU   1
R2       EQU   2
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
```

```
GWABAR   EQU   13
         END
```

Figure 86. Sample of IMS program as a client

Sample server program for IMS MPP client

```
EZASVAS3 CSECT
EZASVAS3 AMODE ANY
EZASVAS3 RMODE ANY
         GBLB  &TRACE  ASSEMBLER VARIABLE TO CONTROL TRACE GENERATION
&TRACE   SETB  1       1=TRACE ON  0=TRACE OFF
         GBLB  &SUBTR  ASSEMBLER VARIABLE TO CONTROL SUBTRACE
&SUBTR   SETB  0       1=SUBTRACE ON  0=SUBTRACE OFF
*--------------------------------------------------------------------*
*                                                                    *
* MODULE NAME:  EZASVAS3                                             *
*                                                                    *
* Copyright:    Licensed Materials - Property of IBM                 *
*                                                                    *
*               "Restricted Materials of IBM"                        *
*                                                                    *
*               5694-A01                                             *
*                                                                    *
*               Copyright IBM Corp. 2009                             *
*                                                                    *
*               US Government Users Restricted Rights -              *
*               Use, duplication or disclosure restricted by         *
*               GSA ADP Schedule Contract with IBM Corp.             *
*                                                                    *
* Status:       CSV1R11                                              *
*                                                                    *
* MODULE FUNCTION: Test module for Extended Sockets.  This module    *
*                  accepts connection request from IMS client        *
*                  program named EZAIMSC3.                           *
*                                                                    *
* LANGUAGE:  Assembler                                               *
*                                                                    *
* ATTRIBUTES: Non-reusable                                           *
*                                                                    *
* Change History:                                                    *
*                                                                    *
* Flag Reason   Release  Date   Origin    Description                *
* ---- -------- -------- ------ --------  -------------------------- *
* $Q1= D316.15  CSV1R5   020604 BKELSEY : Support 64K sockets        *
* $F1= RBBASE   CSV1R11  080612 Herr    : Cleaned up >72 lines       *
*                                                                    *
*--------------------------------------------------------------------*
SOC0000  DS    0H
         USING *,R15              Tell assembler to use reg 15
         B     SOC00100           Branch to startup address
         DC    CL14'SERVEREYECATCH'
ASIDENT  DS    0F                 Address Space Identifier for initapi
ASTCPNAM DC    CL8'TCPV3    '     Name of TCP/IP Address Space
ASCLNAME DC    CL8'CALLSRVER'     Our name as known to TCP/IP
TIMEOUT  DS    0F                 Timeout value for select
TIMESEC  DC    F'180'             Timeout value in seconds
TIMEMSEC DC    F'0'               Timeout value in milliseconds
BUFLEN   EQU   1000               Set length of I/O buffers
R4BASE   DC    A(SOC0000+4096)
SOC00100 DS    0H                 Beginning of program
         STM   R14,R12,12(R13)    Save callers registers
         LR    R3,R15             Move base reg to R3
         L     R4,R4BASE          Add R4 as second base reg
         DROP  R15                Tell assembler to drop R15 as base
         USING SOC0000,R3,R4      Tell assembler to use R3 and R4 as   X
                                  base registers
         LA    R6,SOCSTG          Clear program storage
         LA    R7,SOCSTGL
         SR    R14,R14
         SR    R15,R15
         MVCL  R6,R14
         ST    R13,SOCSAVEH       Save address of higher save area
         LA    R7,SOCSAVE         Complete save area chain
         ST    R7,8(R13)          Tell caller where our save area is
         LA    R13,SOCSAVE        Point R13 at our save area
         MVI   ENDSW,X'00'        Clear end-of-transmission switch
*
*   Build message for console
*
         MVC   MSG1D,MSG1C        Initialize first part of message
         MVC   MSGTD,=CL5'00000'  Move subtask number from clientid
         MVC   MSG2D,MSG2CS       Move 'Started' to message
         LA    R6,MSG             Put text address in R6
         MVC   MSGLEN,=AL2(MSGTL) Put length of text in msg hdr.
         MVC   WTOLIST,WTOPROT    Move prototype WTO to list form
         WTO   TEXT=(R6),         Write message to operator            X
               MF=(E,WTOLIST)
*
```

```
*        Issue INITAPI Call to connect to interface
*
         MVC   SOCTASKC,=CL8'TAS00000' Give subtask a name
         MVC   MSG2D,MSG2C00      Move 'INITAPI'to message
         MVC   MAXSOC,=AL2(50)    Initialize MAXSOC parameter
*
         CALL  EZASOKET,                                             X
               (INITAPI,MAXSOC,ASIDENT,SOCTASKC,HISOC,ERRNO,         X
               RETCODE),                                             X
               VL
*
         L     R6,RETCODE         Check for sucessful call
         C     R6,=F'0'           Is it less than zero
         BL    SOCERR             Yes, go display error and terminat
         AIF   (NOT &TRACE).TRACE00
*  TRACE ENTRY FOR INITAPI  TRACE TYPE = 0
         LA    R6,MSG             Put text address in R6
         MVC   MSGLEN,=AL2(MSGTL) Put length of text in msg hdr.
         WTO   TEXT=(R6),         Write message to operator          X
               MF=(E,WTOLIST)
.TRACE00 ANOP
*
*        Issue SOCKET Call to obtain socket to listen on
*
         MVC   MSG2D,MSG2C25      Move 'SOCKET'to message
         MVC   AF,=F'2'           Initialize AF to '2' (INET)
         MVC   SOCTYPE,=F'1'      Specify stream sockets
         MVC   PROTO,=F'0'        Protocol is ignored for stream
*
         CALL  EZASOKET,          Issue SOCKET CALL                  X
               (SOCKET,AF,SOCTYPE,PROTO,ERRNO,RETCODE),              X
               VL
*
         L     R6,RETCODE         Check for sucessful call
         C     R6,=F'0'           Is it less than zero
         BL    SOCERR             Yes, go display error and terminate
         AIF   (NOT &TRACE).TRACE25
*  TRACE ENTRY FOR SOCKET TRACE TYPE = 25
         LA    R6,MSG             Put text address in R6
         MVC   MSGLEN,=AL2(MSGTL) Put length of text in msg hdr.
         WTO   TEXT=(R6),         Write message to operator          X
               MF=(E,WTOLIST)
.TRACE25 ANOP
         L     R0,RETCODE         Get descriptor number of socket
         STH   R0,LISTSOC         Save it
*
*        Issue GETHOSTID call to determine our internet address
*
         MVC   MSG2D,MSG2C07      Move 'GETHSTID'to message
*
         CALL  EZASOKET,          Issue GETHOSTID Call               X
               (GETHSTID,RETCODE),VL
*
         AIF   (NOT &TRACE).TRACE07
*  TRACE ENTRY FOR SOCKET TRACE TYPE = 07
         LA    R6,MSG             Put text address in R6
         MVC   MSGLEN,=AL2(MSGTL) Put length of text in msg hdr.
         WTO   TEXT=(R6),         Write message to operator          X
               MF=(E,WTOLIST)
.TRACE07 ANOP
         L     R0,RETCODE         Get internet address of host
         ST    R0,SINETADR        Save it
*
*        Issue BIND call to establish port
*
         MVC   MSG2D,MSG2C02      Move 'BIND' to message
         MVC   SPORT,=H'5000'     Move port number to structure
         MVC   SAF,=H'2'          Move AF (INET) to structure
*
         CALL  EZASOKET,          Issue BIND Call                    X
               (BIND,LISTSOC,SOCKNAME,ERRNO,RETCODE),                X
               VL
         L     R6,RETCODE         Check for sucessful call
         C     R6,=F'0'           Is it less than zero
         BL    SOCERR             Yes, go display error and terminat
*
         AIF   (NOT &TRACE).TRACE02
*  TRACE ENTRY FOR BIND TRACE TYPE = 02
         LA    R6,MSG             Put text address in R6
         MVC   MSGLEN,=AL2(MSGTL) Put length of text in msg hdr.
         WTO   TEXT=(R6),         Write message to operator          X
               MF=(E,WTOLIST)
.TRACE02 ANOP
*
*
*        Issue LISTEN call to establish backlog of connection requests
*
         MVC   MSG2D,MSG2C13      Move 'LISTEN' to message
         MVC   BACKLOG,=F'5'      Set backlog to 5
*
         CALL  EZASOKET,          Issue LISTEN Call                  X
               (LISTEN,LISTSOC,BACKLOG,ERRNO,RETCODE),VL
         L     R6,RETCODE         Check for sucessful call
```

```
         C     R6,=F'0'           Is it less than zero
         BL    SOCERR             Yes, go display error and terminate
*
         AIF   (NOT &TRACE).TRACE13
*  TRACE ENTRY FOR LISTEN TRACE TYPE = 13
         LA    R6,MSG             Put text address in R6
         MVC   MSGLEN,=AL2(MSGTL) Put length of text in msg hdr.
         WTO   TEXT=(R6),         Write message to operator            X
               MF=(E,WTOLIST)
.TRACE13 ANOP
*
*        Issue SELECT call to wait on connection request
*
         MVC   MSG2D,MSG2C19      Move 'SELECT' to message
         MVC   SELSOC,=F'31'      Maximum number of sockets
         MVC   WSNDMASK,=F'0'     Not checking for writes
         MVC   ESNDMASK,=F'0'     Not checking for exceptions
         LA    R0,1               Put 1 in rightmost position of R0
         LH    R1,LISTSOC         Put listener socket number in R1
         SLL   R0,0(R1)           Create mask for read
         ST    R0,RSNDMASK        Put value in mask field
*
         CALL  EZASOKET,          Issue SELECT Call                    X
               (SELECT,SELSOC,TIMEOUT,RSNDMASK,WSNDMASK,ESNDMASK,      X
               RRETMASK,WRETMASK,ERETMASK,ERRNO,RETCODE),              X
               VL
         L     R6,RETCODE         Check for sucessful call
         C     R6,=F'0'           Is it less than zero
         BL    SOCERR             Yes, go display error and terminat
*
         AIF   (NOT &TRACE).TRACE19
*  TRACE ENTRY FOR SELECT TRACE TYPE = 19
         LA    R6,MSG             Put text address in R6
         MVC   MSGLEN,=AL2(MSGTL) Put length of text in msg hdr.
         WTO   TEXT=(R6),         Write message to operator            X
               MF=(E,WTOLIST)
.TRACE19 ANOP
*
*        Issue ACCEPT call to accept a new connection
*
         MVC   MSG2D,MSG2C01      Move 'ACCEPT' to message
         MVC   NS,=F'4'           Use socket 4 for connection socket
*
         CALL  EZASOKET,          Issue ACCEPT Call                    X
               (ACCEPT,LISTSOC,SOCKNAME,ERRNO,RETCODE),                X
               VL
         L     R6,RETCODE         Check for sucessful call
         C     R6,=F'0'           Is it less than zero
         BL    SOCERR             Yes, go display error and terminat
*
         AIF   (NOT &TRACE).TRACE01
*  TRACE ENTRY FOR ACCEPT TRACE TYPE = 01
         LA    R6,MSG             Put text address in R6
         MVC   MSGLEN,=AL2(MSGTL) Put length of text in msg hdr.
         WTO   TEXT=(R6),         Write message to operator            X
               MF=(E,WTOLIST)
.TRACE01 ANOP
         L    R0,RETCODE          Get descriptor number of new socket
         STH  R0,CONNSOC          Save it for future use
*
*        Issue READ call to get first message from client
*
         LA    R6,L'BUFFER        Get length of buffer
         ST    R6,DATALEN         Put length in data field
         MVC   MSG2D,MSG2C14      Move 'READ' to message
         XC    FLAGS,FLAGS        Clear the FLAGS field
*
         CALL  EZASOKET,          Issue READ Call                      X
               (READ,CONNSOC,DATALEN,BUFFER,ERRNO,RETCODE),VL
         L     R6,RETCODE         Check for sucessful call
         C     R6,=F'0'           Is it less than zero
         BL    SOCERR             Yes, go display error and terminat
*
         AIF   (NOT &TRACE).TRAC14A
*  TRACE ENTRY FOR READ TRACE TYPE = 14
         LA    R6,MSG             Put text address in R6
         MVC   MSGLEN,=AL2(MSGTL) Put length of text in msg hdr.
         WTO   TEXT=(R6),         Write message to operator            X
               MF=(E,WTOLIST)
.TRAC14A ANOP
*
*        Send Initial Message to client to continue transaction
*
         MVC   BUFFER(L'RESPMSG),RESPMSG  Move Message to Buffer
         LA    R6,L'RESPMSG       Get length of message
         ST    R6,DATALEN         Put length in data field
         XC    FLAGS,FLAGS        Clear FLAGS field
         MVC   MSG2D,MSG2C26      Move 'WRITE' to message
*
         CALL  EZASOKET,          Issue WRITE call                     X
               (WRITE,CONNSOC,DATALEN,BUFFER,ERRNO,RETCODE),VL
*
         L     R6,RETCODE         Check for sucessful call
```

```
         C     R6,=F'0'           Is it less than zero
         BL    SOCERR             Yes, go display error and terminat
         AIF   (NOT &TRACE).TRAC26A
*  TRACE ENTRY FOR WRITE TRACE TYPE = 22
         LA    R6,MSG             Put text address in R6
         MVC   MSGLEN,=AL2(MSGTL) Put length of text in msg hdr.
         WTO   TEXT=(R6),         Write message to operator            X
               MF=(E,WTOLIST)
.TRAC26A ANOP
SOC0300  DS    0H
*
*        Read Message from Client
*
         MVC   MSG2D,MSG2C14      Move 'READ' to message
         LA    R0,L'BUFFER        Get length of buffer
         ST    R0,DATALEN         Use it for data length
         XC    FLAGS,FLAGS        Clear FLAGS field
*
         CALL  EZASOKET,                                               X
               (READ,CONNSOC,DATALEN,BUFFER,ERRNO,RETCODE),VL
*
         L     R6,RETCODE         Check for sucessful call
         C     R6,=F'0'           Is it less than zero
         BNH   SOCERR             Yes, go display error and terminat
         AIF   (NOT &TRACE).TRAC14B
*  TRACE ENTRY FOR RECV  TRACE TYPE = 14
         LA    R6,MSG             Put text address in R6
         MVC   MSGLEN,=AL2(MSGTL) Put length of text in msg hdr.
         WTO   TEXT=(R6),         Write message to operator            X
               MF=(E,WTOLIST)
.TRAC14B ANOP
         CLC   BUFFER(3),=CL3'END' Was this last record
         BNE   SOC0350            No
         MVI   ENDSW,C'E'         Yes, set end-of-transmission switch
SOC0350  DS    0H
*
*        Send Response to Client
*
         MVC   MSG2D,MSG2C26      Move 'WRITE' to message
         MVC   DATALEN,RETCODE    Get message length from previous call
         XC    FLAGS,FLAGS        Clear FLAGS field
*
         CALL  EZASOKET,                                               X
               (WRITE,CONNSOC,DATALEN,BUFFER,ERRNO,RETCODE),VL
*
         L     R6,RETCODE         Check for sucessful call
         C     R6,=F'0'           Is it less than zero
         BNH   SOCERR             Yes, go display error and terminat
         AIF   (NOT &TRACE).TRAC26B
*  TRACE ENTRY FOR SEND   TRACE TYPE = 26
         LA    R6,MSG             Put text address in R6
         MVC   MSGLEN,=AL2(MSGTL) Put length of text in msg hdr.
         WTO   TEXT=(R6),         Write message to operator            X
               MF=(E,WTOLIST)
.TRAC26B ANOP
*
         CLI   ENDSW,C'E'         Have we received last record
         BNE   SOC0300            No, so go back and do another
*
*        Close sockets
*
         MVC   MSG2D,MSG2C03      Move 'CLOSE1' to message
*
         CALL  EZASOKET,          Issue CLOSE call for connection skt  X
               (CLOSE,CONNSOC,ERRNO,RETCODE),VL
*
         L     R6,RETCODE         Check for sucessful call
         C     R6,=F'0'           Is it less than zero
         BL    SOCERR             Yes, go display error and terminat
         AIF   (NOT &TRACE).TRACE03
*  TRACE ENTRY FOR CLOSE TRACE TYPE = 3
         LA    R6,MSG             Put text address in R6
         MVC   MSGLEN,=AL2(MSGTL) Put length of text in msg hdr.
         WTO   TEXT=(R6),         Write message to operator            X
               MF=(E,WTOLIST)
.TRACE03 ANOP
*
         MVC   MSG2D,MSG2C03A     Move 'CLOSE2' to message
*
         CALL  EZASOKET,          Issue CLOSE call for listen socket   X
               (CLOSE,LISTSOC,ERRNO,RETCODE),VL
*
         L     R6,RETCODE         Check for sucessful call
         C     R6,=F'0'           Is it less than zero
         BL    SOCERR             Yes, go display error and terminat
         AIF   (NOT &TRACE).TRAC103
*  TRACE ENTRY FOR CLOSE TRACE TYPE = 3
         LA    R6,MSG             Put text address in R6
         MVC   MSGLEN,=AL2(MSGTL) Put length of text in msg hdr.
         WTO   TEXT=(R6),         Write message to operator            X
               MF=(E,WTOLIST)
.TRAC103 ANOP
*
```

```
*        Terminate Connection to API
*
         CALL  EZASOKET,                                               X
               (TERMAPI),VL
*
*        Issue console message for task termination
*
         MVC   MSG2D,MSG2CE       Move 'Ended' to message
         LA    R6,MSG             Put text address in R6
         MVC   MSGLEN,=AL2(MSGTL) Put length of text in msg hdr.
         WTO   TEXT=(R6),         Write message to operator            X
               MF=(E,WTOLIST)
*
*        Return to Caller
*
         L     R13,SOCSAVEH
         LM    R14,R12,12(R13)
         BR    R14
*
*        Write error message to operator
*
SOCERR   DS    0H                 Write error message to operator
         MVC   ERR1D,MSG1D        'SERVER, TASK #'
         MVC   ERRTD,MSGTD        Move task number to message
         MVC   ERR2D,MSG2D        Call Type
         MVC   ERR3D,ERR3C        ' RETCODE= '
         MVI   ERR3S,C'-'         Move sign which is always minus
         MVC   ERR5D,ERR5C        ' ERRNO= '
         L     R6,RETCODE         Get return code value
         CVD   R6,DWORK           Convert it to decimal
         UNPK  ERR4D,DWORK+4(4)   Unpack it
         OI    ERR4D+6,X'F0'      Correct the sign
         L     R6,ERRNO           Get errno value
         CVD   R6,DWORK           Convert it to decimal
         UNPK  ERR6D,DWORK+4(4)   Unpack it
         OI    ERR6D+6,X'F0'      Correct the sign
         LA    R6,ERR             Put text address in R6
         MVC   ERRLEN,=AL2(ERRTL) Put length of text in msg hdr.
         WTO   TEXT=(R6),         Write message to operator            X
               MF=(E,WTOLIST)
*
*        Return to Caller
*
*        L     R13,SOCSAVEH
*        LM    R14,R12,12(R13)
*        BR    R14
ABEND    DS    0H
         DC    H'0'               Force ABEND
*---------------------------------------------------------------------*
*        Constants                                                    *
*---------------------------------------------------------------------*
WTOPROT  WTO   TEXT=,             List form of WTO Macro               X
               MF=L
WTOPROTL EQU   *-WTOPROT          Length of WTO Prototype
MSG1C    DC    CL17'SERVER,   TASK # '
MSG2CS   DC    CL8' STARTED'
MSG2CE   DC    CL8' ENDED  '
ERR3C    DC    CL10' RETCODE= '
ERR5C    DC    CL8' ERRNO= '
MSG2C00  DC    CL8' INITAPI'
MSG2C01  DC    CL8' ACCEPT '
MSG2C02  DC    CL8' BIND   '
MSG2C03  DC    CL8' CLOSE  '
MSG2C03A DC    CL8' CLOSE2 '
MSG2C07  DC    CL8' GTHSTID'
MSG2C13  DC    CL8' LISTEN '
MSG2C14  DC    CL8' READ   '
MSG2C19  DC    CL8' SELECT '
MSG2C25  DC    CL8' SOCKET '
MSG2C26  DC    CL8' WRITE  '
MSG2C32  DC    CL8' TAKESKT'
RESPMSG  DC    CL50'FIRST RESPONSE FROM SERVER  '
*---------------------------------------------------------------------*
*        Constants used for call types                                *
*---------------------------------------------------------------------*
INITAPI  DC    CL16'INITAPI'
BIND     DC    CL16'BIND'
LISTEN   DC    CL16'LISTEN'
ACCEPT   DC    CL16'ACCEPT'
READ     DC    CL16'READ'
SELECT   DC    CL16'SELECT'
WRITE    DC    CL16'WRITE'
SOCKET   DC    CL16'SOCKET'
CLOSE    DC    CL16'CLOSE'
GETHSTID DC    CL16'GETHOSTID'
TERMAPI  DC    CL16'TERMAPI'
*---------------------------------------------------------------------*
*        Program Storage Area                                         *
*---------------------------------------------------------------------*
SOCSTG   DS    0F                 PROGRAM STORAGE
SOCSAVE  DS    0F                 Save Area
SOCSAVE1 DS    F                  Word for high-level languages
SOCSAVEH DS    F                  Address of previous save area
```

```
SOCSAVEL DS    F                  Address of next save area
SOCSAV14 DS    F                  Reg 14
SOCSAV15 DS    F                  Reg 15
SOCSAV0  DS    F                  Reg 0
SOCSAV1  DS    F                  Reg 1
SOCSAV2  DS    F                  Reg 2
SOCSAV3  DS    F                  Reg 3
SOCSAV4  DS    F                  Reg 4
SOCSAV5  DS    F                  Reg 5
SOCSAV6  DS    F                  Reg 6
SOCSAV7  DS    F                  Reg 7
SOCSAV8  DS    F                  Reg 8
SOCSAV9  DS    F                  Reg 9
SOCSAV10 DS    F                  Reg 10
SOCSAV11 DS    F                  Reg 11
SOCSAV12 DS    F                  Reg 12
SOCSAV13 DS    F                  Reg 13
PARMADDR DS    F                  Address of parameter list
GWAADDR  DS    F                  Address of Global Work Area
TIEADDR  DS    F                  Address of Task Information Element
LISTSOC  DS    H                  Socket number used for listen
CONNSOC  DS    H                  Socket number created by accept
SOCMSGN  DS    F                  Number of messages to be exchanged
SOCMSGL  DS    F                  Length of messages to be exchanged
SOCTASKC DS    CL8                Character task identifier
HISOC    DS    F                  Highest socket descriptor available
SERVLEN  DS    H
SERVSOC  DS    0F                 Socket Address of Server
SERVAF   DS    H                  Address Family of Server = 2
SERVPORT DS    H                  Port Address of Server
SERVIADD DS    F                  Internet Address of Server
ENDSW    DS    C                  End of transmission switch
MSG      DS    0F                 Message area
MSGLEN   DS    H                  Length of message
MSG1D    DS    CL17               'SERVER,   TASK #'
MSGTD    DS    CL5                Task Number
MSG2D    DS    CL8                Last part of message
MSGE     EQU   *                  End of message
MSGTL    EQU   MSGE-MSG1D         Length of message text
ERR      DS    0F                 Error message area
ERRLEN   DS    H                  Length of message
ERR1D    DS    CL17               'SERVER,   TASK #'
ERRTD    DS    CL5                Task Number
ERR2D    DS    CL8                Last part of message
ERR3D    DS    CL10               ' RETCODE = '
ERR3S    DS    C                  Sign which is always -
ERR4D    DS    CL7                Return code
ERR5D    DS    CL8                ' ERRNO ='
ERR6D    DS    CL7                Error number
ERRE     EQU   *                  End of message
ERRTL    EQU   ERRE-ERR1D         Length of message text
*---------------------------------------------------------------------*
*     Name structure used by bind                                     *
*---------------------------------------------------------------------*
SOCKNAME DS    0F                 Socket Name structure
SAF      DS    H                  The address family of the socket
SPORT    DS    H                  The port number of this socket
SINETADR DS    F                  The internet address of this socket
         DS    D                  Reserved
SOCKNAML EQU   *-SOCKNAME         Length of SOCKNAME Structure
CLIENTID DS    0F                 Client Id structure
CDOMAIN  DS    F                  The domain of this client (2)
CNAME    DS    CL8                The major name of this client
CSUBTASK DS    CL8                The minor (subtask) name of this     X
                                  client
         DS    D                  Reserved
CLIENTL  EQU   *-CLIENTID
BUFFER   DS    CL(BUFLEN)         Socket I/O Buffer
DATALEN  DS    F                  Length of buffer data
DWORK    DS    D                  Double word work area
SENDINT  DS    D                  Time interval for send
RECNO    DS    PL4                Record Number
AF       DS    F                  Address family for socket call
NS       DS    F                  New socket number for socket call
SOCTYPE  DS    F                  Socket type for socket call
PROTO    DS    F                  Protocol for socket call
ERRNO    DS    F                  Error number returned from call
RETCODE  DS    F                  Return code from call
CINADDR  DS    F                  Internet address of client
CPORT    DS    F                  Port number of client
MAXSOC   DS    H                  Maximum # sockets for INITAPI
SELSOC   DS    F                  Maximum # sockets for SELECT
BACKLOG  DS    F                  Backlog value for LISTEN
FLAGS    DS    F                  FLAGS field for RECV and RECVFROM
RSNDMASK DS    F                  Read send mask for select
WSNDMASK DS    F                  Write send mask for select
ESNDMASK DS    F                  Exception send mask for select
RRETMASK DS    F                  Read return mask for select
WRETMASK DS    F                  Write return mask for select
ERETMASK DS    F                  Exception return mask for select
WTOLIST  DS    CL(WTOPROTL)       List form of WTO Macro
EZASMTI  EZASMI TYPE=TASK,                                             X
               STORAGE=CSECT      Generate task storage for interface
```

```
EZASMGW  EZASMI TYPE=GLOBAL,      Storage definition for GWA           X
               STORAGE=CSECT
SOCSTGE  EQU   *                  End of Program Storage
SOCSTGL  EQU   SOCSTGE-SOCSTG     Length of Program Storage
         LTORG
R0       EQU   0
R1       EQU   1
R2       EQU   2
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
GWABAR   EQU   13
         END
```

Figure 87. Sample of IMS program as a server

WTO output from sample program

Client Output

```
13.29.18 JOB00084  IEF403I SOCCALLS - STARTED - TIME=13.29.18
13.29.18 JOB00084  +SERVER,   TASK # 00000 STARTED
13.29.19 JOB00084  +SERVER,   TASK # 00000 INITAPI
13.29.19 JOB00084  +SERVER,   TASK # 00000 SOCKET
13.29.19 JOB00084  +SERVER,   TASK # 00000 GTHSTID
13.29.19 JOB00084  +SERVER,   TASK # 00000 BIND
13.29.20 JOB00084  +SERVER,   TASK # 00000 LISTEN
13.29.41 JOB00084  +SERVER,   TASK # 00000 SELECT
13.29.41 JOB00084  +SERVER,   TASK # 00000 ACCEPT
13.29.41 JOB00084  +SERVER,   TASK # 00000 READ
13.29.41 JOB00084  +SERVER,   TASK # 00000 WRITE
13.29.41 JOB00084  +SERVER,   TASK # 00000 READ
13.29.41 JOB00084  +SERVER,   TASK # 00000 WRITE
13.29.41 JOB00084  +SERVER,   TASK # 00000 READ
13.29.42 JOB00084  +SERVER,   TASK # 00000 WRITE
13.29.42 JOB00084  +SERVER,   TASK # 00000 CLOSE
13.29.42 JOB00084  +SERVER,   TASK # 00000 CLOSE2
13.29.42 JOB00084  +SERVER,   TASK # 00000 ENDED
```

Server Output

```
13.27.45 JOB00082  IEF403I MESSAGE - STARTED - TIME=13.27.45
13.29.40 JOB00082  +IMSTCPCL, TASK # 00000 STARTED
13.29.41 JOB00082  +IMSTCPCL, TASK # 00000 INITAPI
13.29.41 JOB00082  +IMSTCPCL, TASK # 00000 GTHSTID
13.29.41 JOB00082  +IMSTCPCL, TASK # 00000 SOCKET
13.29.41 JOB00082  +IMSTCPCL, TASK # 00000 CONNECT
13.29.41 JOB00082  +IMSTCPCL, TASK # 00000 WRITE   RETCODE= +0000016
13.29.41 JOB00082  +IMSTCPCL, TASK # 00000 READ    RETCODE= +0000050
13.29.41 JOB00082  +IMSTCPCL, TASK # 00000 WRITE   RETCODE= +0000016
13.29.41 JOB00082  +IMSTCPCL, TASK # 00000 READ    RETCODE= +0000016
13.29.41 JOB00082  +IMSTCPCL, TASK # 00000 WRITE   RETCODE= +0000048
13.29.42 JOB00082  +IMSTCPCL, TASK # 00000 READ    RETCODE= +0000048
13.29.42 JOB00082  +IMSTCPCL, TASK # 00000 CLOSE
13.29.42 JOB00082  +IMSTCPCL, TASK # 00000 ENDED
```

Appendix A. Return codes

This appendix covers the following return codes and error messages

- Error numbers from MVS TCP/IP
- Error codes from the Sockets Extended interface

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.

Table 49. 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 TCP/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.
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.

Table 49. Sockets ERRNOs (continued)

Error number	Message name	Socket API type	Error description	Programmer's response
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.
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.
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.

Table 49. Sockets ERRNOs (continued)

Error number	Message name	Socket API type	Error description	Programmer's response
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.
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().
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.

Table 49. Sockets ERRNOs (continued)

Error number	Message name	Socket API type	Error description	Programmer's response
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.
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.	Call Setibmopt() only 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.
41	EPROTOTYPE	IOCTL (SIOCGPARTNERINFO, SIOCSAPPLDATA, SIOCSPARTNERINFO, SIOCTTLSCTL)	Socket is not a TCP socket.	Issue the IOCTL on TCP sockets only.

Table 49. Sockets ERRNOs (continued)

Error number	Message name	Socket API type	Error description	Programmer's response
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() supports only a socket type of SOCK_STREAM.
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, Connect	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.	To reuse the same address, use Setsockopt() with SO_REUSEADDR. See 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 49. 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.
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.

Error number	Message name	Socket API type	Error description	Programmer's response
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.
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.
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.

Table 49. Sockets ERRNOs (continued)

Table 49. Sockets ERRNOs (continued)

Error number	Message name	Socket API type	Error description	Programmer's response
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.
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_STOP_CONNECTION was requested on a connection that has outstanding application data. For unread application data, the errno junior is JrTTLSStopReadDataPending. For unwritten application data, the errno junior is JrTTLSStopWriteDataPending. • 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 before requesting TTLS_RESET_SESSION or TTLS_RESET_CIPHER. • Request TTLS_STOP_CONNECTION after all application data is cleared from the connection. For JrTTLSStopReadDataPending, read all available application data. For JrTTLSStopWriteDataPending, wait for all the outstanding application data to be written. • 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.
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.

Table 49. Sockets ERRNOs (continued)

Error number	Message name	Socket API type	Error description	Programmer's response
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.
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, Accept, Takesocket	A new socket cannot be created because the MAXSOC value, which is specified on the INITAPI call, has been reached.	Take either one of the following actions: • Verify whether all open sockets are intended to be in use. • Increase the MAXSOC value to a value that is appropriate for the current workload. If the default value is currently being used, you might be required to add the INITAPI call.
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.
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.

Table 49. Sockets ERRNOs (continued)

Error number	Message name	Socket API type	Error description	Programmer's response
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	EIBMINVTCPCONNECTIO N	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.
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	ESUBTASKALREADYACTIV E	REXX	The subtask is already active.	Issue the INITIALIZE call only 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	EDOMAINSERVERFAILUR E	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

Error number	Message name	Socket API type	Error description	Programmer's response
2021	EOPTNAMEMISMATCH	REXX	The caller specified an OPTNAME that is invalid for the LEVEL that it specified.	Correct either the OPTNAME or the LEVEL.
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 an object that does not exist.	
3513	EOUTOFSTATE		Protocol engine has received a command that is not acceptable in its current state.	

Appendix B. 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.

RFCs are available at http://www.rfc-editor.org/rfc.html.

Draft RFCs that have been implemented in this and previous Communications Server releases are listed at the end of this topic.

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

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 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 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

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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

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Requirements for Internet gateways R. Braden, J. Postel

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Official Internet protocols J. Reynolds, J. Postel

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X Window System Protocol, version 11: Alpha update April 1987 R. Scheifler

RFC 1014
XDR: External Data Representation standard Sun Microsystems

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Using ARP to implement transparent subnet gateways S. Carl-Mitchell, J. Quarterman

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Domain administrators guide M. Stahl

RFC 1033
Domain administrators operations guide M. Lottor

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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

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Telnet Data Entry Terminal option: DODIIS implementation A. Yasuda, T. Thompson

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Internet Protocol on Network System's HYPERchannel: Protocol specification K. Hardwick, J. Lekashman

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Nonstandard for transmission of IP datagrams over serial lines: SLIP J. Romkey

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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

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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

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Requirements for Internet Hosts—Communication Layers R. Braden, Ed.

RFC 1123
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RFC 1155
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RFC 1156
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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

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Internet drafts

Internet drafts are working documents of the Internet Engineering Task Force (IETF), its areas, and its working groups. Other groups can also distribute working documents as Internet drafts. You can see Internet drafts at http://www.ietf.org/ID.html.

Appendix C. 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 can view the information through the z/OS Internet Library website http://www.ibm.com/systems/z/os/zos/library/bkserv/ or IBM Knowledge Center http://www.ibm.com/support/knowledgecenter/. If you continue to experience problems, send a message to Contact z/OS web page (www.ibm.com/systems/z/os/zos/webqs.html) or write to:

IBM Corporation
Attention: MHVRCFS Reader Comments
Department H6MA, Building 707
2455 South Road
Poughkeepsie, NY 12601-5400
USA

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. See 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

One exception is command syntax that is published in railroad track format, which is accessible using screen readers with IBM Knowledge Center, as described in #accessibility/ddsd.

Dotted decimal syntax diagrams

Syntax diagrams are provided in dotted decimal format for users accessing IBM Knowledge Center using a screen reader. In dotted decimal format, each syntax element is written on a separate line. If two or more syntax elements are always present together (or always absent together), they can appear on the same line, because they can be considered as a single compound syntax element.

Each line starts with a dotted decimal number; for example, 3 or 3.1 or 3.1.1. To hear these numbers correctly, make sure that your screen reader is set to read out punctuation. All the syntax elements that have the same dotted decimal number (for example, all the syntax elements that have the number 3.1) are mutually exclusive alternatives. If you hear the lines 3.1 USERID and 3.1 SYSTEMID, you know that your syntax can include either USERID or SYSTEMID, but not both.

The dotted decimal numbering level denotes the level of nesting. For example, if a syntax element with dotted decimal number 3 is followed by a series of syntax elements with dotted decimal number 3.1, all the syntax elements numbered 3.1 are subordinate to the syntax element numbered 3.

Certain words and symbols are used next to the dotted decimal numbers to add information about the syntax elements. Occasionally, these words and symbols might occur at the beginning of the element itself. For ease of identification, if the word or symbol is a part of the syntax element, it is preceded by the backslash (\) character. The * symbol can be used next to a dotted decimal number to indicate that the syntax element repeats. For example, syntax element *FILE with dotted decimal number 3 is given the format 3 * FILE. Format 3* FILE indicates that syntax element FILE repeats. Format 3* * FILE indicates that syntax element * FILE repeats.

Characters such as commas, which are used to separate a string of syntax elements, are shown in the syntax just before the items they separate. These characters can appear on the same line as each item, or on a separate line with the same dotted decimal number as the relevant items. The line can also show another symbol giving information about the syntax elements. For example, the lines 5.1*, 5.1 LASTRUN, and 5.1 DELETE mean that if you use more than one of the LASTRUN and DELETE syntax elements, the elements must be separated by a comma. If no separator is given, assume that you use a blank to separate each syntax element.

If a syntax element is preceded by the % symbol, this indicates a reference that is defined elsewhere. The string following the % symbol is the name of a syntax fragment rather than a literal. For example, the line 2.1 %OP1 means that you should see separate syntax fragment OP1.

The following words and symbols are used next to the dotted decimal numbers:

- A question mark (?) means an optional syntax element. A dotted decimal number followed by the ? symbol indicates that all the syntax elements with a corresponding dotted decimal number, and any subordinate syntax elements, are optional. If there is only one syntax element with a dotted decimal number, the ? symbol is displayed on the same line as the syntax element, (for example 5? NOTIFY). If there is more than one syntax element with a dotted decimal number, the ? symbol is displayed on a line by itself, followed by the syntax elements that are optional. For example, if you hear the lines 5 ?, 5 NOTIFY, and 5 UPDATE, you know that syntax elements NOTIFY and UPDATE are optional; that is, you can choose one or none of them. The ? symbol is equivalent to a bypass line in a railroad diagram.
- An exclamation mark (!) means a default syntax element. A dotted decimal number followed by the ! symbol and a syntax element indicate that the syntax element is the default option for all syntax elements that share the same dotted decimal number. Only one of the syntax elements that share the same dotted decimal number can specify a ! symbol. For example, if you hear the lines 2? FILE, 2.1! (KEEP), and 2.1 (DELETE), you know that (KEEP) is the default option for the FILE keyword. In this example, if you include the FILE keyword but do not specify an option, default option KEEP will be applied. A default option also applies to the next higher dotted decimal number. In this example, if the FILE keyword is omitted, default FILE(KEEP) is used. However, if you hear the lines 2? FILE, 2.1, 2.1.1! (KEEP), and 2.1.1 (DELETE), the default option KEEP applies only to the next higher dotted decimal number, 2.1 (which does not have an associated keyword), and does not apply to 2? FILE. Nothing is used if the keyword FILE is omitted.
- An asterisk (*) means a syntax element that can be repeated 0 or more times. A dotted decimal number followed by the * symbol indicates that this syntax element can be used zero or more times; that is, it is optional and can be repeated. For example, if you hear the line 5.1* data area, you know that you can include one data area, more than one data area, or no data area. If you hear the lines 3*, 3 HOST, and 3 STATE, you know that you can include HOST, STATE, both together, or nothing.

  Notes:

  1. If a dotted decimal number has an asterisk (*) next to it and there is only one item with that dotted decimal number, you can repeat that same item more than once.

2. If a dotted decimal number has an asterisk next to it and several items have that dotted decimal number, you can use more than one item from the list, but you cannot use the items more than once each. In the previous example, you could write HOST STATE, but you could not write HOST HOST.
3. The * symbol is equivalent to a loop-back line in a railroad syntax diagram.

- + means a syntax element that must be included one or more times. A dotted decimal number followed by the + symbol indicates that this syntax element must be included one or more times; that is, it must be included at least once and can be repeated. For example, if you hear the line 6.1+ data area, you must include at least one data area. If you hear the lines 2+, 2 HOST, and 2 STATE, you know that you must include HOST, STATE, or both. Similar to the * symbol, the + symbol can only repeat a particular item if it is the only item with that dotted decimal number. The + symbol, like the * symbol, is equivalent to a loop-back line in a railroad syntax diagram.

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The minimum supported hardware for z/OS releases identified in z/OS announcements can subsequently change when service for particular servers or devices is withdrawn. Likewise, the levels of other software products supported on a particular release of z/OS are subject to the service support lifecycle of those products. Therefore, z/OS and its product publications (for example, panels, samples, messages, and product documentation) can include references to hardware and software that is no longer supported.

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Trademarks

Bibliography

This bibliography contains descriptions of the documents in the z/OS Communications Server library.

z/OS Communications Server documentation is available online at the z/OS Internet Library web page at http://www.ibm.com/systems/z/os/zos/library/bkserv/.

z/OS Communications Server library updates

Updates to documents are also available on RETAIN and in information APARs (info APARs). Go to http://www.software.ibm.com/support to view information APARs.

- z/OS V2R1 Communications Server New Function APAR Summary
- z/OS V2R2 Communications Server New Function APAR Summary
- z/OS V2R3 Communications Server New Function APAR Summary

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	GC27-3664	This document is intended to help you plan for new IP or SNA functions, 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	SC27-3663	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	SC27-3650	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 with the z/OS Communications Server: IP Configuration Reference.

Title	Number	Description
z/OS Communications Server: IP Configuration Reference	SC27-3651	This document presents information for people who want to administer and maintain IP. Use this document 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	SC27-3672	This document presents the major concepts involved in implementing an SNA network. Use this document with the z/OS Communications Server: SNA Resource Definition Reference.
z/OS Communications Server: SNA Resource Definition Reference	SC27-3675	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 with the z/OS Communications Server: SNA Network Implementation Guide.
z/OS Communications Server: SNA Resource Definition Samples	SC27-3676	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	SC27-3658	This document is for systems 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	SC27-3662	This document describes how to use TCP/IP applications. It contains requests with which a user can log on to a remote host using Telnet, transfer data sets using FTP, send electronic mail, print on remote printers, and authenticate network users.
z/OS Communications Server: IP System Administrator's Commands	SC27-3661	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	SC27-3673	This document serves as a reference for programmers and operators requiring detailed information about specific operator commands.
z/OS Communications Server: Quick Reference	SC27-3665	This document contains essential information about SNA and IP commands.

Customization

Title	Number	Description
z/OS Communications Server: SNA Customization	SC27-3666	This document enables you to customize SNA, and includes the following information: • 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	SC27-3660	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	SC27-3649	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	SC27-3653	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	SC27-3659	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	SC27-3674	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	SC27-3669	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.)

Title	Number	Description
z/OS Communications Server: SNA Programmer's LU 6.2 Reference	SC27-3670	This document provides reference material for the SNA LU 6.2 programming interface for host application programs.
z/OS Communications Server: CSM Guide	SC27-3647	This document describes how applications use the communications storage manager.
z/OS Communications Server: CMIP Services and Topology Agent Guide	SC27-3646	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	GC27-3652	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	GC27-3645	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	GC27-3667 GC27-3668	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	SC27-3671	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

Title	Number	Description
z/OS Communications Server: IP Messages Volume 1 (EZA)	SC27-3654	This volume contains TCP/IP messages beginning with EZA.
z/OS Communications Server: IP Messages Volume 2 (EZB, EZD)	SC27-3655	This volume contains TCP/IP messages beginning with EZB or EZD.
z/OS Communications Server: IP Messages Volume 3 (EZY)	SC27-3656	This volume contains TCP/IP messages beginning with EZY.
z/OS Communications Server: IP Messages Volume 4 (EZZ, SNM)	SC27-3657	This volume contains TCP/IP messages beginning with EZZ and SNM.
z/OS Communications Server: IP and SNA Codes	SC27-3648	This document describes codes and other information that appear in z/OS Communications Server messages.

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