z/OS

Language Environment Debugging Guide

GA22-7560-10

z/OS

Language Environment Debugging Guide

GA22-7560-10

Note

Before using this information and the product it supports, be sure to read the general information under “Notices” on page 531.

Eleventh Edition, September 2009

This is a major revision of GA22-7560-09.

This edition applies to Language Environment in z/OS Version 1 Release 11 (5694-A01) and to all subsequent releases and modifications until otherwise indicated in new editions.

IBM welcomes your comments. A form for readers' comments may be provided at the back of this document, or you may address your comments to the following address:

International Business Machines Corporation
MHVRCFS, Mail Station P181
2455 South Road
Poughkeepsie, NY 12601-5400
United States of America

FAX (United States & Canada): 1+845+432-9405
FAX (Other Countries):
Your International Access Code +1+845+432-9405

IBMLink (United States customers only): IBMUSM10(MHVRCFS)
Internet e-mail: mhvrcfs@us.ibm.com
World Wide Web: http://www.ibm.com/systems/z/os/zos/webqs.html

If you would like a reply, be sure to include your name, address, telephone number, or FAX number.

Make sure to include the following in your comment or note:

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

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

© Copyright International Business Machines Corporation 1991, 2009.
US Government Users Restricted Rights – Use, duplication or disclosure restricted by GSA ADP Schedule Contract with IBM Corp.

Contents

Figures xi

Tables xv

About this document xvii
Using your documentation xvii
How to read syntax diagrams xix
Symbols xix
Syntax items xix
Syntax examples xx
This debugging guide xxi
Where to find more information xxi
Information updates on the web xxi
The z/OS Basic Skills Information Center xxi

Summary of Changes xxiii

Part 1. Introduction to debugging in Language Environment 1

Chapter 1. Preparing your routine for debugging 3
Setting compiler options 3
XL C and XL C++ compiler options 3
COBOL compiler options 5
Fortran compiler options 5
PL/I compiler options 6
Enterprise PL/I for z/OS compiler options 7
Using Language Environment run-time options 8
Determining run-time options in effect 9
Using the CLER CICS transaction to display and set run-time options 11
Controlling storage allocation 11
Stack storage statistics 17
Heap storage statistics 18
HEAPPOOLS storage statistics 19
Modifying condition handling behavior 20
Language Environment callable services 20
Language Environment run-time options 20
Customizing condition handlers 22
Invoking the assembler user exit 23
Establishing enclave termination behavior for unhandled conditions 24
Using messages in your routine 24
C/C++ 25
COBOL 25
Fortran 25
PL/I 25
Using condition information 25
Using the feedback code parameter 25
Using the symbolic feedback code 27

Chapter 2. Classifying errors 29
Identifying problems in routines 29
Language Environment module names 29
Common errors in routines 29
Interpreting run-time messages 30

© Copyright IBM Corp. 1991, 2009

Message prefix . . . 31
Message number . . . 31
Severity code . . . 31
Message text . . . 32
Understanding abend codes . . . 32
User abends . . . 32
System abends . . . 32
Using edcmtext to obtain information about errno2 values . . . 33
Format . . . 33
Description . . . 33
Usage notes . . . 33
Message returns . . . 33
Examples . . . 34
Exit Values . . . 34

Chapter 3. Using Language Environment debugging facilities . . . 35
Debug tools . . . 35
Language Environment dump service, CEE3DMP . . . 35
Generating a Language Environment dump with CEE3DMP . . . 35
Generating a Language Environment dump with TERMTHDACT . . . 39
Generating a Language Environment dump with language-specific functions 43
Understanding the Language Environment dump . . . 43
Debugging with specific sections of the Language Environment dump. . . . 62
Using the DLL failure control block . . . 78
Multiple enclave dumps. . . . 79
Generating a system dump . . . 81
Steps for generating a system dump in a batch run-time environment. . . . 82
Steps for generating a system dump in an IMS run-time environment. . . . 82
Steps for generating a system dump in a CICS run-time environment. . . . 82
Steps for generating a Language Environment U4039 abend . . . 83
Steps for generating a system dump in a z/OS UNIX shell . . . 83
Formatting and analyzing system dumps . . . 84
Preparing to use the Language Environment support for IPCS . . . 85
Language Environment IPCS Verbexit – LEDATA . . . 85
Format . . . 86
Parameters . . . 86
Understanding the Language Environment IPCS Verbexit LEDATA output 89
Understanding the HEAP LEDATA output. . . . 107
Understanding the heappool LEDATA output . . . 113
Understanding the HEAPPOOLS trace LEDATA output. . . . 118
Understanding the C/C++-specific LEDATA output . . . 123
C/C++-specific sections of the LEDATA output . . . 145
Understanding the COBOL-specific LEDATA output . . . 147
COBOL-specific sections of the LEDATA Output . . . 149
Formatting individual control blocks . . . 150
Requesting a Language Environment trace for debugging . . . 152
Locating the trace dump . . . 153
Using the Language Environment trace table format in a dump report . . . 154
Understanding the trace table entry (TTE) . . . 154
Sample dump for the trace table entry . . . 161
Requesting a UNIX System Services syscall trace for debugging . . . 163

Part 2. Debugging language-specific routines . . . 165

Chapter 4. Debugging C/C++ routines . . . 167
Debugging C/C++ programs . . . 167

Using the __amrc and __amrc2 structures to debug input/output 167
Using file I/O tracing to debug C/C++ file I/O problems 174
Displaying an error message with the perror() function 174
Using __errno2() to diagnose application problems 174
Diagnosing DLL problems 176
Using C/C++ listings 176
Finding variables 177
Generating a Language Environment dump of a C/C++ routine 185
cdump() 185
csnap() 186
ctrace() 186
Sample C routine that calls cdump() 186
Sample C++ routine that generates a Language Environment dump 188
Sample Language Environment dump with C/C++-specific information 190
Finding C/C++ information in a Language Environment dump 196
Sample Language Environment dump with XPLINK-specific information 201
Finding XPLINK information in a Language Environment dump 206
C/C++ contents of the Language Environment trace tables 207
Debugging examples of C/C++ routines 214
Divide-by-zero error 214
Calling a nonexistent non-XPLINK function 218
Calling a nonexistent XPLINK function 221
Handling dumps written to the z/OS UNIX file system 224
Multithreading consideration 225
Understanding C/C++ heap information in storage reports 226
Language Environment storage report with HEAPPOOLS statistics 226
C function __uheapreport() storage report 227
MEMCHECK VHM memory leak analysis tool 229
Invoking MEMCHECK VHM 229
MEMCHECK VHM environment variables 230
MEMCHECK VHM report sample scenario 231
MEMCHECK VHM report examples 232

Chapter 5. Debugging COBOL programs 237
Determining the source of error 237
Tracing program logic 237
Finding input/output errors 238
Handling input/output errors 238
Validating data (class test) 238
Assessing switch problems 238
Generating information about procedures 239
Using COBOL listings 241
Generating a Language Environment dump of a COBOL program 241
COBOL program that calls another COBOL program 241
COBOL program that calls the Language Environment CEE3DMP callable service 242
Sample Language Environment dump with COBOL-specific information 243
Finding COBOL information in a dump 245
Debugging example COBOL programs 250
Subscript range error 250
Calling a nonexistent subroutine 253
Divide-by-zero error 256

Chapter 6. Debugging Fortran routines 263
Determining the source of errors in Fortran routines 263
Identifying run-time errors 263

Using Fortran compiler listings 265
Generating a Language Environment dump of a Fortran routine 265
DUMP/PDUMP subroutines 266
CDUMP/CPDUMP subroutines 267
SDUMP subroutine 268
Finding Fortran information in a Language Environment dump 271
Understanding the Language Environment traceback table 272
Examples of debugging Fortran routines 273
Calling a nonexistent routine 273
Divide-by-zero error. 275

Chapter 7. Debugging PL/I for MVS & VM routines 279
Determining the source of errors in PL/I for MVS & VM routines 279
Logic errors in the source routine. 279
Invalid use of PL/I for MVS & VM 279
Unforeseen errors 280
Invalid input data. 280
Compiler or run-time routine malfunction 280
System malfunction. 280
Unidentified routine malfunction 280
Storage overlay problems 281
Using PL/I for MVS & VM compiler listings 282
Generating PL/I for MVS & VM listings and maps. 282
Finding information in PL/I for MVS & VM listings. 283
Generating a Language Environment dump of a PL/I for MVS & VM routine 289
PLIDUMP syntax and options 289
PLIDUMP usage notes 290
Finding PL/I for MVS & VM information in a dump 291
Traceback 291
Control blocks for active routines. 294
Control blocks associated with the thread. 298
PL/I for MVS & VM contents of the Language Environment trace table 300
Debugging example of PL/I for MVS & VM routines 301
Subscript range error 301
Calling a nonexistent subroutine 305
Divide-by-zero error. 307

Chapter 8. Debugging Enterprise PL/I routines 315
Determining the source of errors in Enterprise PL/I routines 315
Logic errors in the source routine. 315
Invalid use of Enterprise PL/I 315
Unforeseen errors 316
Invalid input data. 316
Compiler or run-time routine malfunction 316
System malfunction. 316
Unidentified routine malfunction 316
Storage overlay problems 317
Using Enterprise PL/I compiler listings 318
Generating Enterprise PL/I listings and maps 318
Finding information in Enterprise PL/I listings 319
Generating a Language Environment dump of an Enterprise PL/I routine 324
PLIDUMP syntax and options 325
PLIDUMP usage notes 326
Finding Enterprise PL/I information in a dump 327
Traceback 327
Control blocks for active routines. 329

Control blocks associated with the thread. 331
Enterprise PL/I contents of the Language Environment trace table 334
Debugging example of Enterprise PL/I routines 334
Subscript range error 334
Calling a nonexistent subroutine 338
Divide-by-zero error. 342

Chapter 9. Debugging under CICS 347
Accessing debugging information. 347
Locating Language Environment run-time messages 347
Locating the Language Environment traceback. 347
Locating the Language Environment dump 348
Using CICS transaction dump 349
Using CICS register and program status word contents 349
Using Language Environment abend and reason codes 349
Using Language Environment return codes to CICS 350
Activating Language Environment feature trace records under CICS 350
Ensuring transaction rollback 353
Finding data when Language Environment returns a nonzero return code 353
Finding data when Language Environment abends internally 353
Finding data when Language Environment abends from an EXEC CICS command 354
Displaying and modifying run-time options with the CLER transaction 354

Part 3. Debugging Language Environment AMODE 64 applications 357

Chapter 10. Preparing your AMODE 64 application for debugging 359
Setting compiler options 359
XL C and XL C++ compiler options for AMODE 64 applications 359
Using Language Environment run-time options. 359
Determining run-time options in effect 360
Controlling storage allocation 361
Storage statistics for AMODE 64 applications 365
Modifying exception handling behavior. 367
Language Environment application program interfaces (API). 367
Language Environment run-time options 367
Customizing exception handlers 368
Using condition information 368
Using the feedback code parameter. 368
Using the symbolic feedback code 370

Chapter 11. Classifying AMODE 64 application errors 371
Identifying problems in routines 371
Language Environment module names 371
Common errors in routines 371
Interpreting run-time messages 372
Message prefix 373
Message number 373
Severity code 373
Message text 373
Understanding abend codes 373
User abends 374
System abends 374

Chapter 12. Using Language Environment AMODE 64 debugging facilities 375
Debugging tools 375

Language Environment dumps 375
Generating a Language Environment dump with TERMTHDACT 375
Generating a Language Environment dump with language-specific functions 377
Understanding the Language Environment dump 377
Generating a system dump 394
Steps for generating a system dump in a batch run-time environment . . . 395
Steps for generating a system dump in a z/OS UNIX shell 396
Formatting and analyzing system dumps 397
Preparing to use the Language Environment support for IPCS 397
Language Environment IPCS Verbexit – LEDATA 397
Format 398
Parameters 398
Understanding the Language Environment IPCS Verbexit LEDATA output 401
Understanding the HEAP LEDATA output 418
Understanding the heappool LEDATA output 429
Understanding the heap pools trace LEDATA output 435
Understanding the C/C++-specific LEDATA output 442
C/C++-specific sections of the LEDATA output 454
Understanding the AUTH LEDATA output 456
Sections of the AUTH LEDATA Verbexit formatted output 461
Formatting individual control blocks 462
Requesting a Language Environment trace for debugging 464
Locating the trace dump 465
Using the Language Environment trace table format in a dump report . . . 466
Understanding the trace table entry (TTE) 466
Sample dump for the trace table entry 472
Requesting a UNIX System Services syscall trace for debugging 473

Chapter 13. Debugging AMODE 64 C/C++ routines 475
Debugging C/C++ programs 475
Using the __amrc and __amrc2 structures to debug input/output 475
Using file I/O tracing to debug C/C++ file I/O problems 482
Displaying an error message with the perror() function 483
Using __errno2() to diagnose application problems 483
Using C/C++ listings 485
Finding variables 485
Generating a Language Environment dump of a C/C++ routine 488
cdump() 488
csnap() 489
ctrace() 489
Sample C routine that calls cdump() 489
Sample C++ routine that generates a Language Environment dump 491
Sample Language Environment dump with C/C++-specific information 492
C/C++ contents of the Language Environment trace tables 498
Debugging examples of C/C++ routines 500
Divide-by-zero error 500
Calling a nonexistent function 507
Handling dumps written to the z/OS UNIX file system 514
Multithreading consideration 515
Understanding C/C++ heap information in storage reports 515
Language Environment storage report with heap pools statistics 516
C function __uheapreport() storage report 518

Appendix A. Diagnosing problems with Language Environment 521
Diagnosis checklist 521
Locating the name of the failing routine for a non-XPLINK application . . . 522

Searching the IBM Software Support Database 525
Preparing documentation for an Authorized Program Analysis Report (APAR) 525

Appendix B. Accessibility 529
Using assistive technologies 529
Keyboard navigation of the user interface. 529
z/OS information 529

Notices 531
Policy for unsupported hardware 533
Programming Interface Information 533
Trademarks. 533

Bibliography 535
Language Products Publications 535
Related Publications 536

Index 539

Figures

1. Options report example produced by run-time option RPTOPTS(ON). . . . 10
2. Storage report produced by run-time option RPTSTG(ON) . . . 12
3. Storage report produced by RPTSTG(ON) with XPLINK . . . 14
4. Language Environment condition token . . . 27
5. The C program CELSAMP . . . 44
6. The C DLL CELDLL. . . . 47
7. Example dump using CEE3DMP . . . 48
8. Upward-growing (non-XPLINK) stack frame format . . . 64
9. Downward-growing (XPLINK) stack frame format . . . 65
10. Common anchor area . . . 66
11. Condition information block . . . 75
12. Machine state information block . . . 78
13. Language Environment dump of multiple enclaves . . . 80
14. Example of formatted output from LEDATA Verbexit . . . 90
15. Example of formatted PTBL output from LEDATA Verbexit . . . 106
16. Example formatted detailed heap segment report from LEDATA Verbexit . . . 108
17. Example formatted detailed heappool report from LEDATA Verbexit . . . 114
18. Example formatted detailed HEAPPOOLS trace report from LEDATA Verbexit . . . 119
19. Example formatted C/C++ output from LEDATA Verbexit . . . 124
20. Example formatted COBOL output from LEDATA Verbexit . . . 148
21. The CAA formatted by the CBFORMAT IPCS command . . . 151
22. Format of the trace table entry . . . 154
23. Trace table in dump output. . . . 162
24. __amrc structure . . . 168
25. __amrc2 structure . . . 169
26. Example of a routine using perror() . . . 174
27. Example of a routine using __errno2() . . . 175
28. Sample output of a routine using __errno2() . . . 175
29. Example of a routine using _EDC_ADD_ERRNO2 . . . 175
30. Sample output of a routine using _EDC_ADD_ERRNO2 . . . 175
31. Example of a routine using __err2ad() in combination with __errno2() . . . 176
32. Sample output of routine using __err2ad() in combination with __errno2() . . . 176
33. Writable static map produced by prelinker . . . 179
34. Location of RENT static variable in storage. . . . 180
35. Writable static map produced by prelinker . . . 180
36. Location of NORENT static variable in storage . . . 181
37. Example code for parameter variable . . . 182
38. Example code for parameter variable . . . 182
39. Partial storage offset listing . . . 183
40. Example code for structure variable . . . 183
41. Example of aggregate map . . . 184
42. Writable static map produced by prelinker . . . 184
43. Example C routine using cdump() to generate a dump . . . 187
44. Fetched module for C routine. . . . 188
45. Example C++ routine with protection exception generating a dump . . . 189
46. Template file STACK.C . . . 189
47. Header file STACK.H . . . 190
48. Example dump from sample C routine . . . 191
49. Memory file control block . . . 199
50. Registers on entry to CEE3DMP . . . 200
51. Parameters, registers, and variables for active routines . . . 200
52. Condition information for active routines . . . 201
53. Sample XPLINK-compiled program (tranmain) which calls a NOXPLINK-compiled program 202

© Copyright IBM Corp. 1991, 2009

54. Sample NOXPLINK-compiled program (trandll) which calls an XPLINK-compiled program 203
55. Example dump of calling between XPLINK and non-XPLINK programs 204
56. Trace table with C/C++ trace table entry types 1 thru 4 209
57. Trace table with XPLINK trace table entries 5 and 6. 211
58. Trace table with trace table entry types 7 and 8 212
59. C routine with a divide-by-zero error 214
60. Sections of the dump from example C/C++ routine 215
61. Pseudo assembly listing. 216
62. C/C++ CAA information in dump. 217
63. Writable static map 217
64. Enclave storage section of dump 218
65. C/C++ example of calling a nonexistent subroutine 218
66. Sections of the dump from example C routine. 219
67. Pseudo assembly listing. 220
68. Writable static map 220
69. Enclave control blocks and storage sections in dump 221
70. C/C++ example of calling a nonexistent subroutine 221
71. Sections of the dump from example C routine. 222
72. Pseudo assembly listing. 223
73. Writable static map 224
74. Enclave control blocks and storage sections in dump 224
75. IPCS panel for entering data set information 225
76. Storage report generated by __uheapreport() 229
77. Trace report generated by MEMCHECK VHM. 233
78. Heap Leak Report generated by MEMCHECK VHM 235
79. Example of using the WITH DEBUGGING MODE clause 240
80. COBOL program COBDUMP1 calling COBDUMP2 242
81. COBOL program COBDUMP2 calling the Language Environment dump service CEE3DMP 243
82. Sections of the Language Environment dump called from COBDUMP2 244
83. Control block information for active COBOL routines 246
84. Storage for active COBOL programs 247
85. Enclave-level data for COBOL programs. 249
86. Process-level control blocks for COBOL programs 250
87. COBOL example of moving a value outside an array range. 251
88. Sections of Language Environment dump for COBOLX 252
89. COBOL listing for COBOLX 253
90. COBOL example of calling a nonexistent subroutine 253
91. Sections of Language Environment dump for COBOLY 254
92. COBOL Listing for COBOLY 255
93. Parameters, registers, and variables for active routines section of dump for COBOLY 256
94. Main COBOL program, COBOL subroutine, and assembler routine 257
95. Sections of Language Environment dump for program COBOLZ1 258
96. COBOL listing for COBOLZ2 259
97. Listing for ASSEMZ3 260
98. Variables section of Language Environment dump for COBOLZ2. 260
99. Listing for COBOLZ2 261
100. Variables section of Language Environment dump for COBOLZ1. 261
101. Example program that calls SDUMP 270
102. Language Environment dump generated using SDUMP 271
103. Sections of the Language Environment dump 272
104. Example of calling a nonexistent routine. 273
105. Sections of the Language Environment dump resulting from a call to a nonexistent routine 274
106. Fortran routine with a divide-by-zero error 275
107. Language Environment dump from divide-by-zero Fortran example 276
108. PL/I for MVS & VM routine compiled with LIST and MAP 283
109. Compiler-generated listings from example PL/I for MVS & VM routine 284

110. Traceback section of dump 292
111. Task traceback section 293
112. Control blocks for active routines section of the dump 295
113. Control blocks associated with the thread section of the dump 299
114. Example of moving a value outside an array range 302
115. Sections of the Language Environment dump 303
116. Example of calling a nonexistent subroutine 305
117. Sections of the Language Environment dump 306
118. PL/I for MVS & VM routine with a divide-by-zero error 308
119. Variables from routine SAMPLE 308
120. Object code listing from example PL/I for MVS & VM routine 309
121. Language Environment dump from example PL/I for MVS & VM routine 310
122. Enterprise PL/I routine compiled with LIST, MAP, and SOURCE 319
123. Compiler-generated listings from example Enterprise PL/I routine 320
124. Traceback section of dump 328
125. Control blocks for active routines section of the dump 330
126. Control blocks associated with the thread section of the dump 332
127. Example of moving a value outside an array range 335
128. Sections of the Language Environment dump 336
129. Example of calling a nonexistent subroutine 339
130. Sections of the Language Environment dump 340
131. Enterprise PL/I routine with a divide-by-zero error 342
132. Variables from routine SAMPLE 342
133. Object code listing from example Enterprise PL/I routine 343
134. Language Environment dump from example Enterprise PL/I routine 344
135. Language Environment traceback written to the transient data queue 348
136. CICS trace output in the ABBREV format. 351
137. CICS trace output in the FULL format. 352
138. 64–bit options report 361
139. 64–bit storage report 362
140. Language Environment condition token 369
141. The C program CELQSAMP 379
142. The C DLL CELQDLL 381
143. Example dump using CEE3DMP 381
144. Example of formatted output from LEDATA Verbexit 403
145. Example of formatted PTBL output from LEDATA Verbexit 417
146. Example formatted detailed heap segment report from LEDATA Verbexit 419
| 147. Example formatted detailed heappool report from LEDATA Verbexit 430
148. Example formatted detailed HEAPPOOLS trace report from LEDATA Verbexit 436
149. Example formatted C/C++ output from LEDATA Verbexit 443
150. Example of formatted AUTH output from LEDATA Verbexit 457
151. The CAA formatted by the CBFORMAT IPCS command 463
152. Format of the trace table entry 466
153. Trace table in dump output. 473
154. __amrc structure 477
155. __amrc2 structure 477
156. Example of a routine using perror() 483
157. Example of a routine using __errno2() 484
158. Sample output of routine using __errno2() 484
159. Example of a routine using _EDC_ADD_ERRNO2 484
160. Sample output of a routine using _EDC_ADD_ERRNO2 484
161. Example of a routine using __err2ad() in combination with __errno2() 485
162. Sample output of routine using __err2ad() in combination with __errno2() 485
163. Example code for structure variables 488
164. Example of aggregate map 488
165. Example C routine using cdump() to generate a dump 490

166. Fetched module for C routine 491
167. Example C++ routine with protection exception generating a dump 491
168. Template file STACK.C 492
169. Header file STACK.H 492
170. Example dump from sample C routine 493
171. Trace table with XPLINK trace table entries 5 and 6. 499
172. C routine with a divide-by-zero error 501
173. Sections of the dump from example C/C++ routine 502
174. Pseudo assembly listing. 504
175. C/C++ CAA information in dump. 506
176. Writable static map 507
177. IPCS storage display of the writeable static area. 507
178. C/C++ example of calling a nonexistent subroutine 508
179. Sections of the dump from example C routine. 509
180. Pseudo assembly listing. 512
181. Writable static map 514
182. IPCS storage display of the writeable static area. 514
183. IPCS panel for entering data set information 515
184. Storage report generated by __uheapreport() 520
185. C PPA1 524
186. Nonconforming entry point type with sample dump 524

Tables

1. How to Use z/OS Language Environment Publications xviii
2. Syntax examples xx
3. Common error symptoms, possible causes, and programmer responses 30
4. CEE3DMP options 36
5. TERMTHDACT suboptions, level of information, and destinations 39
6. Condition handling of 0Cx abends 42
7. List of CAA fields 67
8. Language Environment Control blocks that can be individually formatted 151
9. LE=1 entry records 155
10. LE=2 entry records 156
11. Format of the mutex/CV/latch records 160
12. LE=8 entry records 161
13. LE=20 entry records 161
14. __last_op values and diagnosis information 170
15. Finding the WSA base address 177
16. Compiler-generated COBOL listings and their contents 241
17. Compiler-generated Fortran listings and their contents 265
18. Compiler-generated PL/I for MVS & VM listings and their contents 282
19. Typical comments in a PL/I for MVS & VM static storage listing 285
20. Comments in a PL/I for MVS & VM object code listing 287
21. PL/I for MVS & VM mnemonics 288
22. Compiler-generated PL/I listings and their contents 318
23. Finding data when Language Environment returns a nonzero return code 353
24. Finding data when Language Environment abends internally 353
25. Finding data when Language Environment abends from an EXEC CICS command 354
26. Common error symptoms, possible causes, and programmer responses 372
27. TERMTHDACT suboptions, level of information, and destinations 375
28. Language Environment control blocks which can be individually formatted 463
29. Preinitalized Environments for Authorized Programs control blocks which can be individually formatted 464
30. LE=1 entry records 467
31. LE=2 entry records 467
32. Format of the mutex/CV/latch records 471
33. LE=8 entry records 472
34. __last_op values and diagnosis information 479
35. Problem resolution documentation requirements 526

© Copyright IBM Corp. 1991, 2009

About this document

This document supports z/OS (5694–A01).

IBM® z/OS Language Environment (also called Language Environment) provides common services and language-specific routines in a single run-time environment for C, C++, COBOL, Fortran (z/OS only; no support for z/OS UNIX System Services or CICS®), PL/I, and assembler applications. It offers consistent and predictable results for language applications, independent of the language in which they are written.

Language Environment is the prerequisite run-time environment for applications generated with the following IBM compiler products:

- z/OS XL C/C++ (feature of z/OS)
- z/OS C/C++
- OS/390 C/C++
- C/C++ for MVS/ESA™
- C/C++ for z/VM
- XL C/C++ for z/VM
- AD/Cycle® C/370™
- VisualAge for Java, Enterprise Edition for OS/390
- Enterprise COBOL for z/OS
- Enterprise COBOL for z/OS and OS/390
- COBOL for OS/390 & VM
- COBOL for MVS & VM (formerly COBOL/370)
- Enterprise PL/I for z/OS
- Enterprise PL/I for z/OS and OS/390
- VisualAge PL/I
- PL/I for MVS & VM (formerly PL/I MVS™ & VM)
- VS FORTRAN and FORTRAN IV (in compatibility mode)

Although not all compilers listed are currently supported, Language Environment supports the compiled objects that they created.

Language Environment supports, but is not required for, an interactive debug tool for debugging applications in your native z/OS environment.

Debug Tool is also available as a standalone product. Debug Tool Utilities and Advanced Functions is also available. For more information, see http://www.ibm.com/software/awdtools/debugtool/.

Language Environment supports, but is not required for, VS FORTRAN Version 2 compiled code (z/OS only).

Language Environment consists of the common execution library (CEL) and the run-time libraries for C/C++, COBOL, Fortran, and PL/I.

For more information on VisualAge for Java, Enterprise Edition for OS/390, program number 5655-JAV, see the product documentation.

Using your documentation

The publications provided with Language Environment are designed to help you:

© Copyright IBM Corp. 1991, 2009

- Manage the run-time environment for applications generated with a Language Environment-conforming compiler.
- Write applications that use the Language Environment callable services.
- Develop interlanguage communication applications.
- Customize Language Environment.
- Debug problems in applications that run with Language Environment.
- Migrate your high-level language applications to Language Environment.

Language programming information is provided in the supported high-level language programming manuals, which provide language definition, library function syntax and semantics, and programming guidance information.

Each publication helps you perform different tasks, some of which are listed in Table 1. All books are available in printable (PDF) and BookManager softcopy formats. For a complete list of publications that you may need, see "Bibliography" on page 535.

Table 1. How to Use z/OS Language Environment Publications

To ...	**Use ...**
Evaluate Language Environment	*z/OS Language Environment Concepts Guide*
Plan for Language Environment	*z/OS Language Environment Concepts Guide* *z/OS Language Environment Run-Time Application Migration Guide*
Install Language Environment	*z/OS Program Directory*
Customize Language Environment	*z/OS Language Environment Customization*
Understand Language Environment program models and concepts	*z/OS Language Environment Concepts Guide* *z/OS Language Environment Programming Guide* *z/OS Language Environment Programming Guide for 64-bit Virtual Addressing Mode*
Find syntax for Language Environment run-time options and callable services	*z/OS Language Environment Programming Reference*
Develop applications that run with Language Environment	*z/OS Language Environment Programming Guide* and your language programming guide
Debug applications that run with Language Environment, diagnose problems with Language Environment	*z/OS Language Environment Debugging Guide*
Get details on run-time messages	*z/OS Language Environment Run-Time Messages*
Develop interlanguage communication (ILC) applications	*z/OS Language Environment Writing Interlanguage Communication Applications* and your language programming guide
Migrate applications to Language Environment	*z/OS Language Environment Run-Time Application Migration Guide* and the migration guide for each Language Environment-enabled language

How to read syntax diagrams

This section describes how to read syntax diagrams. It defines syntax diagram symbols, items that may be contained within the diagrams (keywords, variables, delimiters, operators, fragment references, operands) and provides syntax examples that contain these items.

Syntax diagrams pictorially display the order and parts (options and arguments) that comprise a command statement. They are read from left to right and from top to bottom, following the main path of the horizontal line.

Symbols

The following symbols may be displayed in syntax diagrams:

Symbol	Definition
▸▸—	Indicates the beginning of the syntax diagram.
—▸	Indicates that the syntax diagram is continued to the next line.
▸—	Indicates that the syntax is continued from the previous line.
—▸◂	Indicates the end of the syntax diagram.

Syntax items

Syntax diagrams contain many different items. Syntax items include:

- Keywords - a command name or any other literal information.
- Variables - variables are italicized, appear in lowercase, and represent the name of values you can supply.
- Delimiters - delimiters indicate the start or end of keywords, variables, or operators. For example, a left parenthesis is a delimiter.
- Operators - operators include add (+), subtract (-), multiply (*), divide (/), equal (=), and other mathematical operations that may need to be performed.
- Fragment references - a part of a syntax diagram, separated from the diagram to show greater detail.
- Separators - a separator separates keywords, variables or operators. For example, a comma (,) is a separator.

Note: If a syntax diagram shows a character that is not alphanumeric (for example, parentheses, periods, commas, equal signs, a blank space), enter the character as part of the syntax.

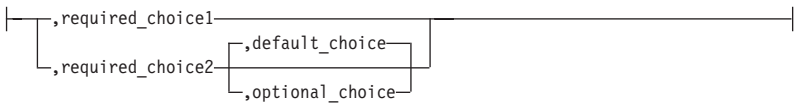
Keywords, variables, and operators may be displayed as required, optional, or default. Fragments, separators, and delimiters may be displayed as required or optional.

Item type	Definition
Required	Required items are displayed on the main path of the horizontal line.
Optional	Optional items are displayed below the main path of the horizontal line.
Default	Default items are displayed above the main path of the horizontal line.

Syntax examples

The following table provides syntax examples.

Table 2. Syntax examples

Item	Syntax example
Required item. Required items appear on the main path of the horizontal line. You must specify these items.	
Required choice. A required choice (two or more items) appears in a vertical stack on the main path of the horizontal line. You must choose one of the items in the stack.	
Optional item. Optional items appear below the main path of the horizontal line.	
Optional choice. An optional choice (two or more items) appears in a vertical stack below the main path of the horizontal line. You may choose one of the items in the stack.	
Default. Default items appear above the main path of the horizontal line. The remaining items (required or optional) appear on (required) or below (optional) the main path of the horizontal line. The following example displays a default with optional items.	
Variable. Variables appear in lowercase italics. They represent names or values.	
Repeatable item. An arrow returning to the left above the main path of the horizontal line indicates an item that can be repeated. A character within the arrow means you must separate repeated items with that character. An arrow returning to the left above a group of repeatable items indicates that one of the items can be selected,or a single item can be repeated.	
Fragment. The fragment symbol indicates that a labeled group is described below the main syntax diagram. Syntax is occasionally broken into fragments if the inclusion of the fragment would overly complicate the main syntax diagram.	 **fragment:** 

This debugging guide

z/OS Language Environment Debugging Guide provides assistance with detecting and locating programming errors that occur during run time under Language Environment. It can help you establish a debugging process to analyze data and narrow the scope and location of where an error might have occurred. You can read about how to prepare a routine for debugging, how to classify errors, and how to use the debugging facilities Language Environment provides. Also included are chapters on debugging HLL-specific routines and routines that run under CICS. Debugging for AMODE 64 applications is covered in separate chapters, corresponding to the topics and contents provided above.

This book is for application programmers interested in techniques for debugging run-time programs. To use this book, you should be familiar with:

- Language Environment
- Appropriate languages that use the compilers listed above
- Program storage concepts

Where to find more information

Please see *z/OS Information Roadmap* for an overview of the documentation associated with z/OS.

Information updates on the web

For the latest information updates that have been provided in PTF cover letters and Documentation APARs for z/OS®, see the online document at: http://publibz.boulder.ibm.com/cgi-bin/bookmgr_OS390/Shelves/ZDOCAPAR

This document is updated weekly and lists documentation changes before they are incorporated into z/OS publications.

The z/OS Basic Skills Information Center

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

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

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

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

Summary of Changes

Summary of Changes
for GA22-7560-10
z/OS Version 1 Release 11

This document contains information previously presented in *z/OS Language Environment Debugging Guide*, GA22-7560-09, which supported z/OS Version 1 Release 10.

The following summarizes the changes to that information.

New Information

- "Understanding the heappool LEDATA output" on page 113 has been added in Chapter 3, "Using Language Environment debugging facilities," on page 35.
- "Understanding the heappool LEDATA output" on page 429 has been added in Chapter 12, "Using Language Environment AMODE 64 debugging facilities," on page 375.
- "Requesting a UNIX System Services syscall trace for debugging" on page 163 has been added in Chapter 3, "Using Language Environment debugging facilities," on page 35.
- "Requesting a UNIX System Services syscall trace for debugging" on page 473 has been added in Chapter 12, "Using Language Environment AMODE 64 debugging facilities," on page 375.
- "Using file I/O tracing to debug C/C++ file I/O problems" on page 174 has been added in Chapter 4, "Debugging C/C++ routines," on page 167.
- "Using file I/O tracing to debug C/C++ file I/O problems" on page 482 has been added in Chapter 13, "Debugging AMODE 64 C/C++ routines," on page 475.

Changed Information

- Figure 1 on page 10 has been updated in "Determining run-time options in effect" on page 9.
- Figure 12 on page 78 has been updated in "Using the machine state information block" on page 77.
- Figure 14 on page 90 has been updated in "Understanding the Language Environment IPCS Verbexit LEDATA output" on page 89.
- Figure 138 on page 361 has been updated in "Determining run-time options in effect" on page 360.
- Condition information for active routine has been updated in "Sections of the Language Environment dump" on page 56.
- CAA field, CEECAA_CICS_EXT_REG, has been updated in Table 7 on page 67.
- In "Language Environment IPCS Verbexit – LEDATA" on page 85, the Condition Management Control Blocks section in Chapter 3, "Using Language Environment debugging facilities," on page 35 has been updated.
- In "Language Environment IPCS Verbexit – LEDATA" on page 397, the Condition Management Control Blocks section in Chapter 12, "Using Language Environment AMODE 64 debugging facilities," on page 375 has been updated.

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

© Copyright IBM Corp. 1991, 2009

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

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

Summary of Changes
for GA22-7560-09
z/OS Version 1 Release 10

This document contains information previously presented in *z/OS Language Environment Debugging Guide*, GA22-7560-08, which supported z/OS Version 1 Release 9.

The following summarizes the changes to that information.

New Information

- "HEAPPOOLS storage statistics" on page 517 has been added to "Language Environment storage report with heap pools statistics" on page 516.

Changed Information

- A usage note has been added to "Language Environment IPCS Verbexit – LEDATA" on page 85 and "Language Environment IPCS Verbexit – LEDATA" on page 397
- In "Understanding the C/C++-specific LEDATA output" on page 123, Figure 19 on page 124 has been updated with changed and new sections.
- In "Understanding the C/C++-specific LEDATA output" on page 442, Figure 149 on page 443 has been updated with changed and new sections.
- A new parameter has been added to "Language Environment IPCS Verbexit – LEDATA" on page 85.
- In "Determining run-time options in effect" on page 360, the figure of 64–bit options report has been updated.
- In "Controlling storage allocation" on page 11, Figure 3 on page 14 has been replaced.
- In "HEAPPOOLS storage statistics" on page 226, HEAPPOOLS statistics has been updated.
- In "HEAPPOOLS64 storage statistics" on page 516, HEAPPOOLS64 statistics and HEAPPOOLS64 summary has been updated.
- In "Understanding the HEAPPOOLS trace LEDATA output" on page 118, Figure 18 on page 119 has been updated.
- In "Understanding the heap pools trace LEDATA output" on page 435, Figure 148 on page 436 has been updated.
- "Storage statistics for AMODE 64 applications" on page 365 has been moved from Appendix C in *z/OS Language Environment Programming Reference* to "Controlling storage allocation" on page 361.

This document contains terminology, maintenance, and editorial changes, including changes to improve consistency and retrievability.

Summary of Changes
for GA22-7560-08
z/OS Version 1 Release 9

This document contains information previously presented in *z/OS Language Environment Debugging Guide*, GA22-7560-07, which supported z/OS Version 1 Release 8.

The following summarizes the changes to that information.

New Information

- A new chapter, Chapter 8, "Debugging Enterprise PL/I routines," on page 315, has been added to provide information about debugging Enterprise PL/I routines.
- Language Environment® improves DLL error diagnostics so that you can more easily debug DLL application problems. For more information, see "Diagnosing DLL problems" on page 176 and "Using the DLL failure control block" on page 78.
- A new section, "Using edcmtext to obtain information about errno2 values" on page 33, has been added to provide the edcmtext utility (similar to bpxmtext), which allows faster error resolution when an errno2 is encountered in Language Environment.

Changed Information

- In Chapter 3, "Using Language Environment debugging facilities," on page 35, the following sections have been updated:
  - "Debug tools" on page 35
  - "Understanding the Language Environment dump" on page 43
  - "The Common Anchor Area" on page 65
  - "Formatting and analyzing system dumps" on page 84
- In Chapter 4, "Debugging C/C++ routines," on page 167, the following sections have been updated:
  - "Using __errno2() to diagnose application problems" on page 174
  - "Sample Language Environment dump with C/C++-specific information" on page 190
  - "Sample Language Environment dump with XPLINK-specific information" on page 201
  - "Debugging examples of C/C++ routines" on page 214
  - "Understanding C/C++ heap information in storage reports" on page 226, example storage reports and the description of the HeapPools storage statistics section of the storage report are updated.
- In Chapter 5, "Debugging COBOL programs," on page 237, figures have been updated in the following sections:
  - "Sample Language Environment dump with COBOL-specific information" on page 243
  - "Finding COBOL information in a dump" on page 245
  - "Debugging example COBOL programs" on page 250
- In Chapter 7, "Debugging PL/I for MVS & VM routines," on page 279, the following sections have been updated:
  - "Finding PL/I for MVS & VM information in a dump" on page 291
  - "Debugging example of PL/I for MVS & VM routines" on page 301

- In Chapter 9, “Debugging under CICS,” on page 347, the Locating the Language Environment traceback section has been updated; enhancements are made in the CICS CLER transaction for displaying and modifying Language Environment run-time options. For more information, see “Displaying and modifying run-time options with the CLER transaction” on page 354.
- In Chapter 10, “Preparing your AMODE 64 application for debugging,” on page 359, Figure 138 on page 361 and Figure 139 on page 362 have been updated.
- In Chapter 12, “Using Language Environment AMODE 64 debugging facilities,” on page 375, the following sections have been updated:
  - “Understanding the Language Environment dump” on page 377
  - “Language Environment IPCS Verbexit – LEDATA” on page 397
  - “Understanding the Language Environment IPCS Verbexit LEDATA output” on page 401
  - “Understanding the HEAP LEDATA output” on page 418
  - “Formatting individual control blocks” on page 462
- In Chapter 13, “Debugging AMODE 64 C/C++ routines,” on page 475, the following sections have been updated:
  - “Using __errno2() to diagnose application problems” on page 483
  - “Calling a nonexistent function” on page 507
  - “Understanding C/C++ heap information in storage reports” on page 515

This document contains terminology, maintenance, and editorial changes, including changes to improve consistency and retrievability.

Part 1. Introduction to debugging in Language Environment

This part provides information about options and features you can use to prepare your routine for debugging. It describes some common errors that occur in routines and provides methods of generating dumps to help you get the information you need to debug your routine.

© Copyright IBM Corp. 1991, 2009

Chapter 1. Preparing your routine for debugging

This chapter describes options and features that you can use to prepare your routine for debugging. The following topics are covered:

- Compiler options for C, C++, COBOL, Fortran, and PL/I
- Language Environment run-time options
- Use of storage in routines
- Options for modifying condition handling
- Assembler user exits
- Enclave termination behavior
- User-created messages
- Language Environment feedback codes and condition tokens

Setting compiler options

The following sections discuss language-specific compiler options important to debugging routines in Language Environment. These sections cover only the compiler options that are important to debugging. For a complete list of compiler options, see the appropriate HLL publications.

The use of some compiler options (such as TEST) can affect the performance of your routine. You must set these options before you compile. In some cases, you might need to remove the option and recompile your routine before delivering your application.

XL C and XL C++ compiler options

When using XL C, set the TEST(ALL) suboption, which is equivalent to TEST(LINE,BLOCK,PATH,SYM,HOOK). For XL C++, the option TEST is equivalent to TEST(HOOK). Following is a list of TEST suboptions that you can use to simplify run-time debugging.

ALL Sets all of the TEST suboptions.

BLOCK Generates symbol information for nested blocks.

HOOK Generates all possible hooks. For details on this suboption, see *z/OS XL C/C++ User's Guide*.

LINE Generates line number hooks and allows a debugging tool to generate a symbolic dump.

PATH Generates hooks at all path points; for example, hooks are inserted at if-then-else points before a function call and after a function call.

SYM Generates symbol table information and enables Language Environment to generate a dump at run time.

When you specify SYM, you also get the value and type of variables displayed in the Local Variables section of the dump. For example, if in block 4 the variable x is a signed integer of 12, and in block 2 the variable x is a signed integer of 1, the following output appears in the Local Variables section of the dump:

```
%BLOCK4:>x   signed int         12
%BLOCK2:>x   signed int          1
```

If a nonzero optimization level is used, variables do not appear in the dump.

© Copyright IBM Corp. 1991, 2009

You can use these C/C++ compiler options to make run-time debugging easier:

AGGREGATE (C)	Specifies that a layout for `struct` and `union` type variables appear in the listing.
ATTRIBUTE (C++)	For XL C++ compile, cross reference listing with attribute information. If XREF is specified, the listing also contains reference, definition and modification information.
CHECKOUT (C)	Provides informational messages indicating possible programming errors.
EVENTS	Produces an events file that contains error information and source file statistics.
EXPMAC	Macro expansions with the original source.
FLAG	Specifies the minimum severity level that is tolerated.
GONUMBER	Generates line number tables corresponding to the input source file. This option is turned on when the TEST option is used. This option is needed to show statement numbers in dump output.
INFO (C++)	Indication of possible programming errors.
INLINE	Inline Summary and Detailed Call Structure Reports. (Specify with the REPORT sub-option).
INLRPT	Generates a report on status of functions that were inlined. The OPTIMIZE option must also be specified.
LIST	Listing of the pseudo-assembly listing produced by the compiler.
OFFSET	Displays the offset addresses relative to the entry point of each function.
PHASEID	Causes each compiler module (phase) to issue an informational message which identifies the compiler phase module name, product identifier, and build level.
PPONLY	Completely expanded z/OS XL C, or z/OS XL C++ source code, by activating the preprocessor (PP) only. The output shows, for example, all the ″#include″ and ″#define″ directives.
SERVICE	Places a string in the object module, which is displayed in the traceback if the application fails abnormally.
SHOWINC	All included text in the listing.
SOURCE	Includes source input statements and diagnostic messages in the listing.
TERMINAL	Directs all error messages from the compiler to the terminal. If not specified, this is the default.
TEST	Generates information for debugging interface. This also generates symbol tables needed for symbolic variables in the dump.
XPLINK (BACKCHAIN)	Generates a prolog that saves redundant information in the calling function's stack frame.
XPLINK (STOREARGS)	Generates code to store arguments that are normally passed in registers, into the argument area.
XREF	For XL C compile, cross reference listing with reference, definition, and modification information. For XL C++ compile, cross reference listing with reference, definition, and modification information. If you specify ATTRIBUTE, the listing also contains attribute information.

For a detailed explanation of these options, see *z/OS XL C/C++ User's Guide*.

See the Inter-procedural Analysis chapter in the *z/OS XL C/C++ Programming Guide* for an overview and more details about Inter-procedural Analysis.

COBOL compiler options

When using COBOL, set the SYM suboption of the TEST compiler option. The SYM suboption of TEST causes the compiler to add debugging information into the object program to resolve user names in the routine and to generate a symbolic dump of the DATA DIVISION. With this suboption specified, statement numbers will also be used in the dump output along with offset values.

To simplify debugging, use the NOOPTIMIZE compiler option. Program optimization can change the location of parameters and instructions in the dump output.

You can use the following COBOL compiler options to prepare your program for run-time debugging:

LIST	Produces a listing of the assembler expansion of your source code and global tables, literal pools, information about working storage, and size of routine's working storage.
MAP	Produces lists of items in data division including a data division map, global tables, literal pools, a nested program structure map, and attributes.
OFFSET	Produces a condensed PROCEDURE DIVISION listing containing line numbers, statement references, and location of the first instruction generated for each statement.
OUTDD	Specifies the destination of DISPLAY statement messages.
SOURCE	Produces a listing of your source program with any statements embedded by PROCESS, COPY, or BASIS statements.
TEST	Produces object code that can run with a debugging tool, or adds information to the object program to produce formatted dumps. With or without any suboptions, this option forces the OBJECT option. When specified with any of the hook-location suboption values except NONE, this option forces the NOOPTIMIZE option. SYM suboption includes statement numbers in the Language Environment dump and produces a symbolic dump.
VBREF	Produces a cross-reference of all verb types used in the source program and a summary of how many times each verb is used.
XREF	Creates a sorted cross-reference listing.

For more detail on these options and functions, see the following documents:

- *Enterprise COBOL for z/OS Programming Guide*, SC23-8529
- *Enterprise COBOL for z/OS Programming Guide*, SC27-1412
- *COBOL for OS/390 & VM Programming Guide*

Fortran compiler options

You can use these Fortran compiler options to prepare your program for run-time debugging:

FIPS	Specifies whether standard language flagging is to be performed. This is valuable if you want to write a program conforming to Fortran 77.
FLAG	Specifies the level of diagnostic messages to be written. **I** (Information), **E** (Error), **W** (Warning), or **S** (Severe). You can also use FLAG to suppress messages that are below a specified level. This is useful if you want to suppress information messages, for example.
GOSTMT	Specifies that statement numbers are included in the run-time messages and in the Language Environment dump.

ICA	Specifies whether intercompilation analysis is to be performed, specifies the files containing intercompilation analysis information to be used or updated, and controls output from intercompilation analysis. Specify ICA when you have a group of programs and subprograms that you want to process together and you need to know if there are any conflicting external references, mismatched commons, and so on.
LIST	Specifies whether the object module list is to be written. The LIST option lets you see the pseudo-assembly language code that is similar to what is actually generated.
MAP	Specifies whether a table of source program variable names, named constants, and statement labels and their displacements is to be produced.
OPTIMIZE	Specifies the optimizing level to be used during compilation. If you are debugging your program, it is advisable to use NOOPTIMIZE.
SDUMP	Specifies whether dump information is to be generated.
SOURCE	Specifies whether a source listing is to be produced.
SRCFLG	Controls insertion of error messages in the source listing. SRCFLG allows you to view error messages after the initial line of each source statement that caused the error, rather than at the end of the listing.
SXM	Formats SREF or MAP listing output to a 72-character width.
SYM	Invokes the production of SYM cards in the object text file. SYM cards contain location information for variables within a Fortran program.
TERMINAL	Specifies whether error messages and compiler diagnostics are to be written on the SYSTERM data set and whether a summary of messages for all the compilations is to be written at the end of the listing.
TEST	Specifies whether to override any optimization level above OPTIMIZE(0). This option adds run-time overhead.
TRMFLG	Specifies whether to display the initial line of source statements in error and their associated error messages at the terminal.
XREF	Creates a cross-reference listing.
VECTOR	Specifies whether to invoke the vectorization process. A vectorization report provides detailed information about the vectorization process.

For more detail on these options and functions, see *VS FORTRAN Version 2 Programming Guide for CMS and MVS* or *VS FORTRAN Version 2 Language and Library Reference.*

PL/I compiler options

When using PL/I, specify the TEST compiler option to control the level of testing capability that are generated as part of the object code. Suboptions of the TEST option such as SYM, BLOCK, STMT, and PATH control the location of test hooks and specify whether or not a symbol table is generated. For more information about TEST, its suboptions, and the placement of test hooks, see *PL/I for MVS & VM Programming Guide*.

To simplify debugging and decrease compile time, set optimization to NOOPTIMIZE or OPTIMIZE(0). Higher optimization levels can change the location where parameters and instructions appear in the dump output.

You can use these compiler options to prepare PL/I routines for debugging:

AGGREGATE	Specifies that a layout for arrays and major structures appears in the listing.
ESD	Includes the external symbol dictionary in the listing.
GONUMBER / GOSTMT	Tells the compiler to produce additional information specifying that line numbers from the source routine can be included in run-time messages and in the Language Environment dump.

INTERRUPT	Specifies that users can establish an ATTENTION ON-unit that gains control when an attention interrupt occurs.
LIST	Produces a listing of the assembler expansion of source code and global tables, literal pools, information about working storage, and size of routine's working storage.
LMESSAGE	Tells the compiler to produce run-time messages in a long form. If the cause of a run-time malfunction is a programmer's understanding of language semantics, specifying LMESSAGE could better explain warnings or other information generated by the compiler.
MAP	Tells the compiler to produce tables showing how the variables are mapped in the static internal control section and in the stack frames, thus enabling static internal and automatic variables to be found in the Language Environment dump. If LIST is also specified, the MAP option also produces tables showing constants, control blocks, and INITIAL variable values.
OFFSET	Specifies that the compiler prints a table of statement or line numbers for each procedure with their offset addresses relative to the primary entry point of the procedure.
SOURCE	Specifies that the compiler includes a listing of the source routine in the listing.
STORAGE	Includes a table of the main storage requirements for the object module in the listing.
TERMINAL	Specifies what parts of the compiler listing produced during compilation are directed to the terminal.
TEST	Specifies the level of testing capability that is generated as part of the object code. TEST also controls the location of test hooks and whether or not the symbol table is generated. Because the TEST option increases the size of the object code and can affect performance, limit the number and placement of hooks.
XREF and ATTRIBUTES	Creates a sorted cross-reference listing with attributes.

For more detail on PL/I compiler options, see *PL/I for MVS & VM Programming Guide*.

Enterprise PL/I for z/OS compiler options

The following Enterprise PL/I for z/OS compiler options can be specified when preparing your Enterprise PL/I for z/OS routines for debugging:

AGGREGATE	Specifies that a layout for arrays and major structures appears in the listing.
GONUMBER / GOSTMT	Tells the compiler to produce additional information specifying that line numbers from the source routine can be included in run-time messages and in the Language Environment dump.
INTERRUPT	Specifies that users can establish an ATTENTION ON-unit that gains control when an attention interrupt occurs.
LIST	Produces a listing of the assembler expansion of source code and global tables, literal pools, information about working storage, and size of routine's working storage.
OFFSET	Displays the offset addresses relative to the entry point of each function.
SOURCE	Specifies that the compiler includes a listing of the source routine in the listing.
STORAGE	Includes a table of the main storage requirements for the object module in the listing.

TEST	Specifies the level of testing capability that is generated as part of the object code. TEST also controls the location of test hooks and whether or not the symbol table is generated. Because the TEST option increases the size of the object code and can affect performance, limit the number and placement of hooks.
XREF and ATTRIBUTES	Creates a sorted cross-reference listing with attributes.

For further details on the Enterprise PL/I for z/OS compiler options, see *Enterprise PL/I for z/OS Programming Guide*.

Using Language Environment run-time options

There are several run-time options that affect debugging in Language Environment. The TEST run-time option, for example, can be used with a debugging tool to specify the level of control the debugging tool has when the routine being initialized is started. The ABPERC, CHECK, DEPTHCONDLMT, DYNDUMP, ERRCOUNT, HEAPCHK, INTERRUPT, TERMTHDACT, TRACE, TRAP, and USRHDLR options affect condition handling. The ABTERMENC option affects how an application ends (that is, with an abend or with a return code and reason code) when an unhandled condition of severity 2 or greater occurs.

The following Language Environment run-time options affect debugging:

ABPERC	Specifies that the indicated abend code bypasses the condition handler.
ABTERMENC	Specifies enclave termination behavior for an enclave ending with an unhandled condition of severity 2 or greater.
CEEDUMP	Specifies options to control the processing of the Language Environment dump report.
CHECK	Determines whether run-time checking is performed.
NODEBUG	Controls the COBOL USE FOR DEBUGGING declarative.
DEPTHCONDLMT	Specifies the limit for the depth of nested synchronous conditions in user-written condition handlers. (Asynchronous signals do not affect DEPTHCONDLMT.)
DYNDUMP	Provides a way to obtain IPCS-readable dumps of user applications that would ordinarily be lost due to the absence of a SYSMDUMP, SYSUDUMP, or SYSABEND DD statement
ERRCOUNT	Specifies the number of synchronous conditions of severity 2 or greater tolerated. (Asynchronous signals do not affect ERRCOUNT.)
HEAPCHK	Determines whether additional heap check tests are performed.
INFOMSGFILTER	Filters user specified informational messages from the MSGFILE. **Note:** Affects only those messages generated by Language Environment and any routine that calls CEEMSG. Other routines that write to the message file, such as CEEMOUT, do not have a filtering option.
INTERRUPT	Causes Language Environment to recognize attention interrupts.
MSGFILE	Specifies the ddname of the Language Environment message file.
MSGQ	Specifies the number of instance specific information (ISI) blocks that are allocated on a per-thread basis for use by an application. Located within the Language Environment condition token is an ISI token. The ISI contains information used by the condition manager to identify and react to a specific occurrence of a condition.

PROFILE	Controls the use of an optional profiler tool, which collects performance data for the running application. When this option is in effect, the profiler is loaded and the debugger cannot be loaded. If the TEST option is in effect when PROFILE is specified, the profiler tool will not be loaded.
RPTOPTS	Causes a report to be produced which contains the run-time options in effect. See “Determining run-time options in effect” below.
RPTSTG	Generates a report of the storage used by an enclave. See “Controlling storage allocation” on page 11.
STORAGE	Specifies that Language Environment initializes all heap and stack storage to a user-specified value.
TERMTHDACT	Controls response when an enclave terminates due to an unhandled condition of severity 2 or greater.
TEST	Specifies the conditions under which a debugging tool assumes control.
TRACE	Activates Language Environment run-time library tracing and controls the size of the trace table, the type of trace, and whether the trace table should be dumped unconditionally upon termination of the application.
TRAP	When TRAP is set to ON, Language Environment traps routine interrupts and abends, and optionally prints trace information or invokes a user-written condition handling routine. With TRAP set to OFF, the operating system handles all interrupts and abends. You should generally set TRAP to ON, or your run-time results can be unpredictable.
USRHDLR	Specifies the behavior of two user-written condition handlers. The first handler specified will be registered at stack frame 0. The second handler specified will be registered before any other user-written condition handlers, once the handler is enabled by a condition.
XUFLOW	Specifies whether or not an exponent underflow causes a routine interrupt.

For a more detailed discussion of these run-time options, see *z/OS Language Environment Programming Reference* .

Determining run-time options in effect

The run-time options in effect at the time the routine is run can affect routine behavior. Use RPTOPTS(ON) to generate an options report in the Language Environment message file when your routine terminates. The options report lists run-time options, and indicates where they were set.

Figure 1 on page 10 shows a sample options report.

```
Options Report for Enclave main 12/07/08 6:25:56 PM
Language Environment V01 R11.00

LAST WHERE SET                OPTION
------------------------------------------------------------------------------
Installation default            ABPERC(NONE)
Installation default            ABTERMENC(ABEND)
Installation default          NOAIXBLD
Installation default            ALL31(ON)
Installation default            ANYHEAP(16384,8192,ANYWHERE,FREE)
Installation default          NOAUTOTASK
Installation default            BELOWHEAP(8192,4096,FREE)
Installation default            CBLOPTS(ON)
Installation default            CBLPSHPOP(ON)
Installation default            CBLQDA(OFF)
Installation default            CEEDUMP(60,SYSOUT=*,FREE=END,SPIN=UNALLOC)
Installation default            CHECK(ON)
Installation default            COUNTRY(US)
Installation default          NODEBUG
Installation default            DEPTHCONDLMT(10)
Installation default            DYNDUMP(*USERID,NODYNAMIC,TDUMP)
Installation default            ENVAR("")
Installation default            ERRCOUNT(0)
Installation default            ERRUNIT(6)
Installation default            FILEHIST
Installation default            FILETAG(NOAUTOCVT,NOAUTOTAG)
Default setting               NOFLOW
PARMLIB(CEEPRMPV)               HEAP(4194304,5242880,ANYWHERE,KEEP,8192,4096)
Installation default            HEAPCHK(OFF,1,0,0,0,1024,0,1024,0)
Installation default            HEAPPOOLS(OFF,8,10,32,10,128,10,
                                256,10,1024,10,2048,10,0,10,0,10,
                                0,10,0,10,0,10,0,10)
Installation default            INFOMSGFILTER(OFF,,,,)
Installation default            INQPCOPN
Installation default            INTERRUPT(OFF)
Installation default            LIBSTACK(4096,4096,FREE)
Installation default            MSGFILE(SYSOUT,FBA,121,0,NOENQ)
Installation default            MSGQ(15)
Installation default            NATLANG(ENU)
Ignored                       NONONIPTSTACK(See THREADSTACK)
Installation default            OCSTATUS
Installation default          NOPC
Installation default            PLITASKCOUNT(20)
Installation default            POSIX(OFF)
Installation default            PROFILE(OFF,"")
Installation default            PRTUNIT(6)
Installation default            PUNUNIT(7)
Installation default            RDRUNIT(5)
Installation default            RECPAD(OFF)
Invocation command              RPTOPTS(ON)
SETCEE command                  RPTSTG(ON)
Installation default          NORTEREUS
Installation default          NOSIMVRD
Installation default            STACK(131072,131072,ANYWHERE,KEEP,524288,131072)
Installation default            STORAGE(NONE,NONE,NONE,0)
Installation default            TERMTHDACT(TRACE,,96)
Installation default          NOTEST(ALL,"*","PROMPT","INSPPREF")
Installation default            THREADHEAP(4096,4096,ANYWHERE,KEEP)
Installation default            THREADSTACK(OFF,4096,4096,ANYWHERE,KEEP,131072,
                                           ,131072)
Installation default            TRACE(OFF,4096,DUMP,LE=0)
Installation default            TRAP(ON,SPIE)
Installation default            UPSI(00000000)
Installation default          NOUSRHDLR(,)
Installation default            VCTRSAVE(OFF)
Installation default            XPLINK(OFF)
Installation default            XUFLOW(AUTO)
```

Figure 1. Options report example produced by run-time option RPTOPTS(ON)

Using the CLER CICS transaction to display and set run-time options

The CICS transaction (CLER) allows you to display all the current Language Environment run-time options for a region, and to also have the capability to modify a subset of these options.

For more information about the CICS CLER transaction, see “Displaying and modifying run-time options with the CLER transaction” on page 354.

Controlling storage allocation

The following run-time options control storage allocation:

- STACK
- THREADSTACK
- LIBSTACK
- THREADHEAP
- HEAP
- ANYHEAP
- BELOWHEAP
- STORAGE
- HEAPPOOLS

z/OS Language Environment Programming Guide provides useful tips to assist with the tuning process. Appropriate tuning is necessary to avoid performance problems.

To generate a report of the storage a routine (or more specifically, an enclave) used during its run, specify the RPTSTG(ON) run-time option. The storage report, generated during enclave termination provides statistics that can help you understand how space is being consumed as the enclave runs. If storage management tuning is desired, the statistics can help you set the corresponding storage-related run-time options for future runs. The output is written to the Language Environment message file.

Neither the storage report nor the corresponding run-time options include the storage that Language Environment acquires during early initialization, before run-time options processing, and before the start of space management monitoring. In addition, Language Environment does not report alternative Vendor Heap Manager activity.

Figure 2 on page 12 and Figure 3 on page 14 show sample storage reports. The sections that follow these reports describe the contents of the reports.

```
Storage Report for Enclave main 12/18/08 5:17:20 PM
Language Environment V01 R11.00

    STACK statistics:
      Initial size:                                      4096
      Increment size:                                    4096
      Maximum used by all concurrent threads:            7488
      Largest used by any thread:                        7488
      Number of segments allocated:                         2
      Number of segments freed:                             0
    THREADSTACK statistics:
      Initial size:                                      4096
      Increment size:                                    4096
      Maximum used by all concurrent threads:            3352
      Largest used by any thread:                        3352
      Number of segments allocated:                         6
      Number of segments freed:                             0
    LIBSTACK statistics:
      Initial size:                                      4096
      Increment size:                                    4096
      Maximum used by all concurrent threads:               0
      Largest used by any thread:                           0
      Number of segments allocated:                         0
      Number of segments freed:                             0
    THREADHEAP statistics:
      Initial size:                                      4096
      Increment size:                                    4096
      Maximum used by all concurrent threads:               0
      Largest used by any thread:                           0
      Successful Get Heap requests:                         0
      Successful Free Heap requests:                        0
      Number of segments allocated:                         0
      Number of segments freed:                             0
    HEAP statistics:
      Initial size:                                     49152
      Increment size:                                   16384
      Total heap storage used (sugg. initial size):     29112
      Successful Get Heap requests:                       251
      Successful Free Heap requests:                      218
      Number of segments allocated:                         1
      Number of segments freed:                             0
    HEAP24 statistics:
      Initial size:                                      8192
      Increment size:                                    4096
      Total heap storage used (sugg. initial size):         0
      Successful Get Heap requests:                         0
      Successful Free Heap requests:                        0
      Number of segments allocated:                         0
      Number of segments freed:                             0
    ANYHEAP statistics:
      Initial size:                                     32768
      Increment size:                                   16384
      Total heap storage used (sugg. initial size):    104696
      Successful Get Heap requests:                        28
      Successful Free Heap requests:                       15
      Number of segments allocated:                         6
      Number of segments freed:                             5
```

Figure 2. Storage report produced by run-time option RPTSTG(ON) (Part 1 of 2)

```
    BELOWHEAP statistics:
      Initial size:                                      8192
      Increment size:                                    8192
      Total heap storage used (sugg. initial size):         0
      Successful Get Heap requests:                         0
      Successful Free Heap requests:                        0
      Number of segments allocated:                         0
      Number of segments freed:                             0
    Additional Heap statistics:
      Successful Create Heap requests:                      1
      Successful Discard Heap requests:                     1
      Total heap storage used:                           4912
      Successful Get Heap requests:                         3
      Successful Free Heap requests:                        3
      Number of segments allocated:                         2
      Number of segments freed:                             2
    Largest number of threads concurrently active:          2
End of Storage Report
```

Figure 2. Storage report produced by run-time option RPTSTG(ON) (Part 2 of 2)

```
 Storage Report for Enclave main 12/18/08 4:27:49 PM
Language Environment V01 R11.00

    STACK statistics:
      Initial size:                                      131072
      Increment size:                                    131072
      Maximum used by all concurrent threads:              5416
      Largest used by any thread:                          5416
      Number of segments allocated:                           1
      Number of segments freed:                               0
    THREADSTACK statistics:
      Initial size:                                        4096
      Increment size:                                      4096
      Maximum used by all concurrent threads:             45536
      Largest used by any thread:                          6552
      Number of segments allocated:                          60
      Number of segments freed:                               0
    XPLINK STACK statistics:
      Initial size:                                      524288
      Increment size:                                    131072
      Largest used by any thread:                         20400
      Number of segments allocated:                           1
      Number of segments freed:                               0
    XPLINK THREADSTACK statistics:
      Initial size:                                      131072
      Increment size:                                    131072
      Largest used by any thread:                         22160
      Number of segments allocated:                          30
      Number of segments freed:                               0
    LIBSTACK statistics:
      Initial size:                                        4096
      Increment size:                                      4096
      Maximum used by all concurrent threads:                 0
      Largest used by any thread:                             0
      Number of segments allocated:                           0
      Number of segments freed:                               0
    THREADHEAP statistics:
      Initial size:                                        4096
      Increment size:                                      4096
      Maximum used by all concurrent threads:                 0
      Largest used by any thread:                             0
      Successful Get Heap requests:                           0
      Successful Free Heap requests:                          0
      Number of segments allocated:                           0
      Number of segments freed:                               0
    HEAP statistics:
      Initial size:                                       32768
      Increment size:                                     32768
      Total heap storage used (sugg. initial size):      286576
      Successful Get Heap requests:                          71
      Successful Free Heap requests:                          1
      Number of segments allocated:                          10
      Number of segments freed:                               0
```

Figure 3. Storage report produced by RPTSTG(ON) with XPLINK (Part 1 of 3)

```
HEAP24 statistics:
  Initial size:                                        8192
  Increment size:                                      4096
  Total heap storage used (sugg. initial size):           0
  Successful Get Heap requests:                           0
  Successful Free Heap requests:                          0
  Number of segments allocated:                           0
  Number of segments freed:                               0
ANYHEAP statistics:
  Initial size:                                       16384
  Increment size:                                      8192
  Total heap storage used (sugg. initial size):     1139712
  Successful Get Heap requests:                         487
  Successful Free Heap requests:                        431
  Number of segments allocated:                          50
  Number of segments freed:                              36
BELOWHEAP statistics:
  Initial size:                                        8192
  Increment size:                                      4096
  Total heap storage used (sugg. initial size):           0
  Successful Get Heap requests:                           0
  Successful Free Heap requests:                          0
  Number of segments allocated:                           0
  Number of segments freed:                               0
Additional Heap statistics:
  Successful Create Heap requests:                        0
  Successful Discard Heap requests:                       0
  Total heap storage used:                                0
  Successful Get Heap requests:                           0
  Successful Free Heap requests:                          0
  Number of segments allocated:                           0
  Number of segments freed:                               0
HEAPPOOLS Statistics:
  Pool  1     size:     8 Get Requests:           3
    Successful Get Heap requests:     1-    8               3
  Pool  2     size:    32 Get Requests:         268
    Successful Get Heap requests:     9-   16              36
    Successful Get Heap requests:    17-   24               3
    Successful Get Heap requests:    25-   32             229
  Pool  3     size:   128 Get Requests:         186
    Successful Get Heap requests:    33-   40               3
    Successful Get Heap requests:    41-   48               8
    Successful Get Heap requests:    49-   56             111
    Successful Get Heap requests:    57-   64               4
    Successful Get Heap requests:    65-   72               2
    Successful Get Heap requests:    73-   80               4
    Successful Get Heap requests:    81-   88               6
    Successful Get Heap requests:    89-   96               2
    Successful Get Heap requests:    97-  104               1
    Successful Get Heap requests:   105-  112               5
    Successful Get Heap requests:   113-  120              31
    Successful Get Heap requests:   121-  128               9
```

Figure 3. Storage report produced by RPTSTG(ON) with XPLINK (Part 2 of 3)

```
     Pool  4     size:   256 Get Requests:          38
        Successful Get Heap requests:   137-  144               2
        Successful Get Heap requests:   145-  152               2
        Successful Get Heap requests:   153-  160               2
        Successful Get Heap requests:   161-  168               1
        Successful Get Heap requests:   169-  176               4
        Successful Get Heap requests:   177-  184               4
        Successful Get Heap requests:   185-  192               2
        Successful Get Heap requests:   193-  200               2
        Successful Get Heap requests:   201-  208               3
        Successful Get Heap requests:   209-  216               2
        Successful Get Heap requests:   217-  224               3
        Successful Get Heap requests:   225-  232               3
        Successful Get Heap requests:   233-  240               1
        Successful Get Heap requests:   241-  248               3
        Successful Get Heap requests:   249-  256               4
      Pool  5.1   size:  1024 Get Requests:         230
      Pool  5.2   size:  1024 Get Requests:           3
      Pool  5.3   size:  1024 Get Requests:           5
        Successful Get Heap requests:   257-  264             225
        Successful Get Heap requests:   273-  280               2
        Successful Get Heap requests:   281-  288              10
        Successful Get Heap requests:   841-  848               1
      Pool  6     size:  2048 Get Requests:           2
        Successful Get Heap requests:  1113- 1120               1
        Successful Get Heap requests:  1137- 1144               1
      Requests greater than the largest cell size:            2
    HEAPPOOLS Summary:
      Specified Element   Extent   Cells Per  Extents    Maximum      Cells In
      Cell Size Size      Percent  Extent     Allocated  Cells Used   Use
      ------------------------------------------------------------------------
            8        16     10         204          1           1           0
           32        40     10          81          3         226         225
          128       136     10          24          4          88          77
          256       264     10          12          1           1           0
         1024      1032     10           4         57         228         227
         1024      1032     10           4          1           2           0
         1024      1032     10           4          1           3           0
         2048      2056     10           4          1           2           2
      ------------------------------------------------------------------------
      Suggested Percentages for current Cell Sizes:
        HEAPP(ON,8,1,32,28,128,37,256,1,(1024,3),90,2048,13,0)
      Suggested Cell Sizes:
        HEAPP(ON,
              32,,56,,88,,120,,128,,168,,
              208,,248,,288,,848,,1144,,2080,)
    Largest number of threads concurrently active:           11
End of Storage Report
```

Figure 3. Storage report produced by RPTSTG(ON) with XPLINK (Part 3 of 3)

The statistics for initial and incremental allocations of storage types that have a corresponding run-time option differ from the run-time option settings when their values have been rounded up by the implementation, or when allocations larger than the amounts specified were required during execution. All of the following are rounded up to an integral number of double-words:

- Initial STACK allocations
- Initial allocations of THREADSTACK
- Initial allocations of all types of heap
- Incremental allocations of all types of stack and heap

The run-time options should be tuned appropriately to avoid performance problems. See *z/OS Language Environment Programming Guide* for tips on tuning.

Stack storage statistics

Language Environment stack storage is managed at the thread level—each thread has its own stack-type resources.

STACK, THREADSTACK, LIBSTACK, and IPT STACK statistics for the upward-growing stack

- Initial size — the actual size of the initial segment assigned to each thread. (If a pthread-attributes-table is provided on the invocation of pthread-create, then the stack size specified in the pthread-attributes-table will take precedence over the STACK run-time option.)
- Increment size — the size of each incremental segment acquired, as determined by the increment portion of the corresponding run-time option.
- Maximum used by all concurrent threads — the maximum amount allocated in total at any one time by all concurrently executing threads.
- Largest used by any thread — the largest amount allocated ever by any single thread.
- Number of segments (or increments) allocated — the number of incremental segments allocated by all threads.
- Number of segments freed — the number of incremental segments freed by all threads.

The number of incremental segments freed could be less than the number allocated if any of the segments were not freed individually during the life of the thread, but rather were freed implicitly in the course of thread termination.

XPLINK statistics — XPLINK STACK and XPLINK THREADSTACK statistics for the downward-growing stack

These sections of the storage report only apply if XPLINK is in effect.

- Initial size — the actual size of the initial segment assigned to each thread.
- Increment size — the size of each incremental segment acquired, as determined by the increment portion of the corresponding run-time option.
- Maximum used by all concurrent threads — the maximum amount allocated in total at any one time by all concurrently executing threads.
- Largest used by any thread — the largest amount allocated ever by any single thread.
- Number of segments allocated — the number of incremental segments allocated by all threads.
- Number of segments freed — the number of incremental segments freed by all threads.

The number of incremental segments freed could be less than the number allocated if any of the segments were not freed individually during the life of the thread, but rather were freed implicitly in the course of thread termination.

Determining the applicable threads

If the application is not a multithreading or PL/I multitasking application, then the STACK statistics are for the one and only thread that executed, and the THREADSTACK statistics are all zero.

If the application is a multithreading or PL/I multitasking application, and THREADSTACK(ON) was specified, then the STACK statistics are for the initial thread (the IPT), and the THREADSTACK statistics are for the other threads. However, if THREADSTACK(OFF) was specified, then the STACK statistics are for all of the threads, initial and other.

Allocating stack storage

Another type of stack, called the reserve stack, is allocated for each thread and used to handle out-of-storage conditions. Its size is controlled by the 4th subparameter of the STORAGE run-time option, but its usage is neither tracked nor reported in the storage report.

In a single-threaded environment, Language Environment allocates the initial segments for STACK, LIBSTACK and reserve stack using GETMAIN. The LIBSTACK initial segment allocation is deferred until first use, except when STACK(,,BELOW,,) is in effect. The reserve stack is allocated with STACK. In a multi-threaded POSIX(ON) environment, allocation of stack storage for the initial processing thread (IPT) is the same as the single-threaded environment. For threads other than the IPT, the initial STACK (or THREADSTACK) segment and reserve stack is allocated from ANYHEAP or BELOWHEAP, according to the STACK (or THREADSTACK) location. The initial LIBSTACK segment allocation is again deferred until first use, except when STACK(,,BELOW,,) or THREADSTACK(ON,,,BELOW,,) is in effect. When a STACK, THREADSTACK, or LIBSTACK overflow occurs on any thread, Language Environment obtains the new segment using GETMAIN. The reserve stack does not tolerate overflow.

Heap storage statistics

Language Environment heap storage, other than what is explicitly defined using THREADHEAP, is managed at the enclave level—each enclave has its own heap-type resources, which are shared by the threads that execute within the enclave. Heap storage defined using THREADHEAP is controlled at the thread level.

THREADHEAP statistics

- Initial size—the default initial allocation, as specified by the corresponding run-time option. Please note that for HEAP24, the initial size is the value of the initsz24 of the HEAP option.
- Increment size—the minimum incremental allocation, as specified by the corresponding run-time option. Please note that for HEAP24, the increment size is the value of the incrsz24 of the HEAP option.
- Maximum used by all concurrent threads—the maximum total amount used by all concurrent threads at any one time.
- Largest used by any thread—the largest amount used by any single thread.
- Successful Get Heap requests—the number of Get Heap requests.
- Successful Free Heap requests—the number of Free Heap requests.
- Number of segments allocated—the number of incremental segments allocated.
- Number of segments freed—the number of incremental segments individually freed.

These statistics, in all cases, specify totals for the whole enclave. For THREADHEAP, they indicate the total across all threads in the enclave.

HEAP, HEAP24, ANYHEAP, and BELOWHEAP statistics

- Initial size—the default initial allocation, as specified by the corresponding run-time option. Please note that for HEAP24, the initial size is the value of the initsz24 of the HEAP option.
- Increment size—the minimum incremental allocation, as specified by the corresponding run-time option. Please note that for HEAP24, the increment size is the value of the incrsz24 of the HEAP option.
- Total heap storage used—the largest total amount used by the enclave at any one time.
- Successful Get Heap requests—the number of Get Heap requests.
- Successful Free Heap requests—the number of Free Heap requests.
- Number of segments allocated—the number of incremental segments allocated.
- Number of segments freed—the number of incremental segments individually freed.

The number of Free Heap requests could be less than the number of Get Heap requests if the pieces of heap storage acquired by individual Get Heap requests were not freed individually, but rather were freed implicitly in the course of enclave termination.

The number of incremental segments individually freed could be less than the number allocated if the segments were not freed individually, but rather were freed implicitly in the course of enclave termination.

These statistics, in all cases, specify totals for the whole enclave. For THREADHEAP, they indicate the total across all threads in the enclave.

Additional heap statistics

Besides the fixed types of heap, additional types of heap can be created, each with its own heap ID. You can create and discard these additional types of heap by using the CEECRHP

- Successful Create Heap requests—the number of successful Create Heap requests.
- Successful Discard Heap requests—the number of successful Discard Heap requests.

  The number of Discard Heap requests could be less than the number of Create Heap requests if the special heaps allocated by individual Create Heap requests were not freed individually, but rather were freed implicitly in the course of enclave termination.
- Total heap storage used—the largest total amount used by the enclave at any one time.
- Successful Get Heap requests—the number of Get Heap requests.
- Successful Free Heap requests—the number of Free Heap requests.
- Number of segments allocated—the number of incremental segments allocated.
- Number of segments freed—the number of incremental segments individually freed.

HEAPPOOLS storage statistics

The HEAPPOOLS run-time option (for C/C++ applications only) controls usage of the heap pools storage algorithm at the enclave level. The heap pools algorithm allows for the definition of one to twelve heap pools, each consisting of a number of

storage cells of a specified length. For further details regarding HEAPPOOLS storage statistics in the storage report, see “HEAPPOOLS storage statistics” on page 226.

Modifying condition handling behavior

Setting the condition handling behavior of your routine affects the response that occurs when the routine encounters an error.

You can modify condition handling behavior in the following ways:
- Callable services
- Run-time options
- User-written condition handlers
- POSIX functions (used to specifically set signal actions and signal masks)

Language Environment callable services

You can use these callable services to modify condition handling:

CEE3ABD Terminates an enclave using an abend.

CEE3AB2 Terminate enclave with an abend and reason code.

CEEMRCE Moves the resume cursor to an explicit location where resumption is to occur after a condition has been handled.

CEEMRCR Moves the resume cursor relative to the current position of the handle cursor.

CEE3CIB Returns a pointer to a condition information block (CIB) associated with a given condition token. The CIB contains detailed information about the condition.

CEE3GRO Returns the offset of the location within the most current Language Environment-conforming routine where a condition occurred.

CEE3SPM Specifies the settings of the routine mask. The routine mask controls:
- Fixed overflow
- Decimal overflow
- Exponent underflow
- Significance

You can use CEE3SPM to modify Language Environment hardware conditions. Because such modifications can affect the behavior of your routine, however, you should be careful when doing so.

CEE3SRP Sets a resume point within user application code to resume from a Language Environment user condition handler.

Fortran programs cannot directly call Language Environment callable services. For more information about callable services, see *z/OS Language Environment Programming Reference*.For more information about how to invoke callable services from Fortran, see *Language Environment for MVS & VM Fortran Run-Time Migration Guide*.

Language Environment run-time options

These Language Environment run-time options can affect your routine’s condition handling behavior:

ABPERC Specifies a system- or user-specified abend code that percolates without further action while the Language Environment condition handler is enabled. Normal condition handling activities are performed for everything except the specified abend code. System abends are specified as S**hhh**, where **hhh** is a hexadecimal system abend code.

User abends are specified as U`dddd`, where `dddd` is a decimal user abend code. Any other 4-character EBCDIC string, such as NONE, that is not of the form S**hhh** can also be specified as a user-specified abend code. You can specify only one abend code with this option. This option assumes the use of TRAP(ON). ABPERC is not supported in CICS.

Language Environment ignores ABPERC(0Cx). No abend is percolated and Language Environment condition handling semantics are in effect.

CHECK Specifies that checking errors within an application are detected. The Language Environment-conforming languages can define error checking differently.

DEPTHCONDLMT Limits the extent to which synchronous conditions can be nested in a user-written condition handler. (Asynchronous signals do not affect DEPTHCONDLMT.) For example, if you specify 5, the initial condition and four nested conditions are processed. If the limit is exceeded, the application terminates with abend code 4091 and reason code 21 (X'15').

ERRCOUNT Specifies the number of synchronous conditions of severity 2, 3, and 4 that are tolerated before the enclave terminates abnormally. (Asynchronous signals do not affect ERRCOUNT.) If you specify 0 an unlimited number of conditions is tolerated.

INTERRUPT Causes attentions recognized by the host operating system to be passed to and recognized by Language Environment after the environment has been initialized.

TERMTHDACT Sets the level of information that is produced when a condition of severity 2 or greater remains unhandled within the enclave. There are five possible parameter settings for different levels of information:

- QUIET for no information
- MSG for message only
- TRACE for message and a traceback
- DUMP for message, traceback, and Language Environment dump
- UAONLY for message and a system dump of the user address space
- UATRACE for message, Language Environment dump with traceback information only, and a system dump of the user address space
- UADUMP for message, traceback, Language Environment dump, and system dump
- UAIMM for a system dump of the user address space of the original abend or program interrupt prior to the Language Environment condition manager processing the condition.

TRAP(ON) Fully enables the Language Environment condition handler. This causes the Language Environment condition handler to intercept error conditions and routine interrupts.

When TRAP(ON, NOSPIE) is specified, Language Environment handles all program interrupts and abends through an ESTAE. Use this feature when you do not want Language Environment to issue an ESPIE macro.

During normal operation, you should use TRAP(ON) when running your applications.

TRAP(OFF) Disables the Language Environment condition handler from handling abends and program checks/interrupts. ESPIE is not issued with TRAP(OFF), it is still possible to invoke the condition handler through the CEESGL callable service and pass conditions to registered user-written condition handlers.

Specify TRAP(OFF) when you do not want Language Environment to issue an ESTAE or an ESPIE.

When TRAP(OFF), TRAP(OFF,SPIE), or TRAP(OFF,NOSPIE) is specified and either a program interrupt or abend occurs, the user exit for termination is ignored.

TRAP(OFF) can cause several unexpected side effects. For further information, see the TRAP run-time option in *z/OS Language Environment Programming Reference*.

USRHDLR Specifies the behavior of two user-written condition handlers. The first handler specified will be registered at stack frame 0. The second handler specified will be registered before any other user-written condition handlers, once the handler is enabled by a condition.

When you specify USRHDLR(lastname,supername), lastname gets control at stack frame 0. Supername will get get control first, before any user-written condition handlers but after supername has gone through the enablement phase, when a condition occurs.

XUFLOW Specifies whether an exponent underflow causes a routine interrupt.

Customizing condition handlers

User-written condition handlers permit you to customize condition handling for certain conditions. You can register a user-written condition handler for the current stack frame by using the CEEHDLR callable service. You can use the Language Environment USRHDLR run-time option to register a user-written condition handler for stack frame 0. You can also use USRHDLR to register a user-written condition handler before any other user condition handlers.

When the Language Environment condition manager encounters the condition, it requests that the condition handler associated with the current stack frame handle the condition. If the condition is not handled, the Language Environment condition manager percolates the condition to the next (earlier) stack frame, and so forth to earlier stack frames until the condition has been handled. Conditions that remain unhandled after the first (earliest) stack frame has been reached are presented to the Language Environment condition handler. One of the following Language Environment default actions is then taken, depending on the severity of the condition:

- Resume
- Percolate
- Promote

- Fix-up and resume

For more information about user-written condition handlers and the Language Environment condition manager, see *z/OS Language Environment Programming Guide*.

Invoking the assembler user exit

For debugging purposes, the CEEBXITA assembler user exit can be invoked during:

- Enclave initialization
- Enclave termination
- Process termination

The functions of the CEEBXITA user exit depend on when the user exit is invoked and whether it is application-specific or installation-wide. Application-specific user exits must be linked with the application load module and run only when that application runs. Installation-wide user exits must be linked with the Language Environment initialization/termination library routines and run with all Language Environment library routines. Because an application-specific user exit has priority over any installation-wide user exit, you can customize a user exit for a particular application without affecting the user exit for any other applications.

At enclave initialization, the CEEBXITA user exit runs prior to the enclave establishment. Thus you can modify the environment in which your application runs in the following ways:

- Specify run-time options
- Allocate data sets/files in the user exit
- List abend codes to be passed to the operating system
- Check the values of routine arguments

At enclave termination, the CEEBXITA user exit runs prior to the termination activity. Thus, you can request an abend and perform specified actions based on received return and reason codes. (This does not apply when Language Environment terminates with an abend.)

At process termination, the CEEBXITA user exit runs after the enclave termination activity completes. Thus you can request an abend and deallocate files.

The assembler user exit must have an entry point of CEEBXITA, must be reentrant, and must be capable of running in AMODE(ANY) and RMODE(ANY).

You can use the assembler user exit to establish enclave termination behavior for an enclave ending with an unhandled condition of severity 2 or greater in the following ways:

- If you do not request an abend in the assembler user exit for the enclave termination call, Language Environment honors the setting of the ABTERMENC option to determine how to end the enclave.
- If you request an abend in the assembler user exit for the enclave termination call, Language Environment issues an abend to end the enclave.

For more information on the assembler user exit, see *z/OS Language Environment Programming Guide*.

Establishing enclave termination behavior for unhandled conditions

To establish enclave termination behavior when an unhandled condition of severity 2 or greater occurs, use one of the following methods:

- The assembler user exit (see “Invoking the assembler user exit” on page 23 and *z/OS Language Environment Programming Guide*)
- POSIX signal default action (see *z/OS Language Environment Programming Guide*)
- The ABTERMENC run-time option (discussed below)

The ABTERMENC run-time option sets the enclave termination behavior for an enclave ending with an unhandled condition of severity 2 or greater.

If you specify the IBM-supplied default suboption ABEND, Language Environment issues an abend to end the enclave regardless of the setting of the CEEAUE_ABND flag. Additionally, the assembler user exit can alter the abend code, abend reason code, abend dump attribute, and the abend task/step attribute. For more information on using ABTERMENC, see *z/OS Language Environment Programming Reference*, and for more information on the assembler user exit, see *z/OS Language Environment Programming Guide*.

If you specify the RETCODE suboption, Language Environment uses the CEEAUE_ABND flag value set by the assembler user exit (which is called for enclave termination) to determine whether or not to issue an abend to end the enclave when an unhandled condition of severity 2 or greater occurs.

Using messages in your routine

You can create messages and use them in your routine to indicate the status and progress of the routine during run time, and to display variable values. The process of creating messages and using them requires that you create a message source file, and convert the source file into loadable code for use in your routine.

You can use the Language Environment callable service CEEMOUT to direct user-created message output to the Language Environment message file. To direct the message output to another destination, use the Language Environment MSGFILE run-time option to specify the ddname of the file.

When multiple Language Environment environments are running in the same address space and the same MSGFILE ddname is specified, writing contention can occur. To avoid contention, use the MSGFILE suboption ENQ. ENQ tells Language Environment to perform serialization around writes to the MSGFILE ddname specified which eliminates writing contention. Writing contention can also be eliminated by specifying unique MSGFILE ddnames.

Each Language Environment-conforming language also provides ways to display both user-created and run-time messages. (For an explanation of Language Environment run-time messages, see “Interpreting run-time messages” on page 30.)

The following sections discuss how to create messages in each of the HLLs. For a more detailed explanation of how to create messages and use them in C, C++, COBOL, Fortran, or PL/I routines, see *z/OS Language Environment Programming Guide*.

C/C++

For C/C++ routines, output from the `printf` function is directed to `stdout`, which is associated with `SYSPRINT`. All C/C++ run-time messages and perror() messages are directed to `stderr`. `stderr` corresponds to the ddname associated with the Language Environment MSGFILE run-time option. The destination of the `printf` function output can be changed by using the redirection `1>&2` at routine invocation to redirect `stdout` to the `stderr` destination. Both streams can be controlled by the MSGFILE run-time option.

COBOL

For COBOL programs, you can use the DISPLAY statement to display messages. Output from the DISPLAY statement is directed to SYSOUT. SYSOUT is the IBM-supplied default for the Language Environment message file. The OUTDD compiler option can be used to change the destination of the DISPLAY messages.

Fortran

For Fortran programs, run-time messages, output written to the print unit, and other output (such as output from the SDUMP callable service) are directed to the file specified by the MSGFILE run-time option. If the print unit is different than the error message unit (PRTUNIT and ERRUNIT run-time options have different values), however, output from the PRINT statement won't be directed to the Language Environment message file.

PL/I

Under PL/I, run-time messages are directed to the file specified in the Language Environment MSGFILE run-time option, instead of the PL/I SYSPRINT STREAM PRINT file. User-specified output is still directed to the PL/I SYSPRINT STREAM PRINT file. To direct this output to the Language Environment MSGFILE file, specify the run-time option MSGFILE(SYSPRINT).

Using condition information

If a condition that might require attention occurs while an application is running, Language Environment builds a condition token. The condition token contains 12 bytes (96 bits) of information about the condition that Language Environment or your routines can use to respond appropriately. Each condition is associated with a single Language Environment run-time message.

You can use this condition information in two primary ways:

- To specify the feedback code parameter when calling Language Environment services (see "Using the feedback code parameter").
- To code a symbolic feedback code in a user-written condition handler (see "Using the symbolic feedback code" on page 27).

Using the feedback code parameter

The feedback code is an optional parameter of the Language Environment callable services. (For COBOL/370 programs, you must provide the **fc** parameter in each call to a Language Environment callable service. For C/C++, Enterprise COBOL for z/OS, COBOL for OS/390 & VM, COBOL for MVS & VM, and PL/I routines, this parameter is optional. For more information about **fc** and condition tokens, see *z/OS Language Environment Programming Guide*.)

When you provide the feedback code (**fc**) parameter, the callable service in which the condition occurs sets the feedback code to a specific value called a condition token.

The condition token does not apply to asynchronous signals. For a discussion of the distinctions between synchronous signals and asynchronous signals with POSIX(ON), see *z/OS Language Environment Programming Guide*.

When you do not provide the **fc** parameter, any nonzero condition is signaled and processed by Language Environment condition handling routines. If you have registered a user-written condition handler, Language Environment passes control to the handler, which determines the next action to take. If the condition remains unhandled, Language Environment writes a message to the Language Environment message file. The message is the translation of the condition token into English (or another supported national language).

Language Environment provides callable services that can be used to convert condition tokens to routine variables, messages, or signaled conditions. The following table lists these callable services and their functions.

CEEMSG Transforms the condition token into a message and writes the message to the message file.

CEEMGET Transforms the condition token into a message and stores the message in a buffer.

CEEDCOD Decodes the condition token; that is, separates it into distinct user-supplied variables. Also, if a language does not support structures, CEEDCOD provides direct access to the token.

CEESGL Signals the condition. This passes control to any registered user-written condition handlers. If a user-written condition handler does not exist, or the condition is not handled, Language Environment by default writes the corresponding message to the message file and terminates the routine for severity 2 or higher. For severity 0 and 1, Language Environment continues without writing a message. COBOL, however, issues severity 1 messages before continuing. CEESGL can signal a POSIX condition. For details, see *z/OS Language Environment Programming Guide*.

There are two types of condition tokens. Case 1 condition tokens contain condition information, including the Language Environment message number. All Language Environment callable services and most application routines use case 1 condition tokens. Case 2 condition tokens contain condition information and a user-specified class and cause code. Application routines, user-written condition handlers, assembler user exits, and some operating systems can use case 2 condition tokens.

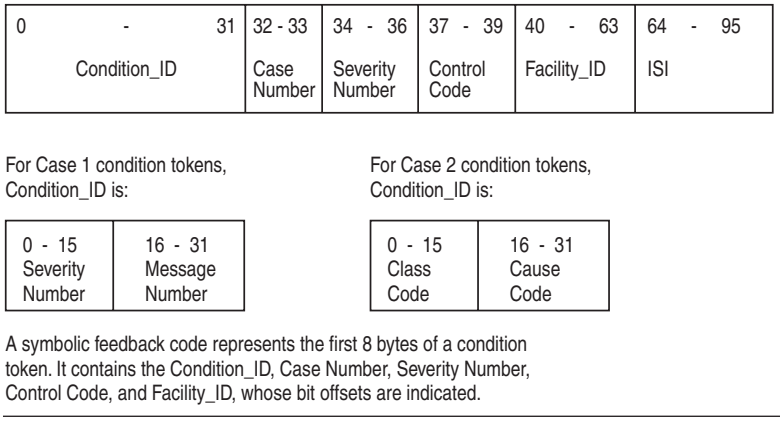


Figure 4. Language Environment condition token

For example, in the condition token: X'0003032D 59C3C5C5 00000000'

- X'0003' is severity.
- X'032D' is message number 813.
- X'59' are hexadecimal flags for case, severity, and control.
- X'C3C5C5' is the CEE facility ID.
- X'00000000' is the ISI. (In this case, no ISI was provided.)

If a Language Environment traceback or dump is generated while a condition token is being processed or when a condition exists, Language Environment writes the run-time message to the condition section of the traceback or dump. If a condition is detected when a callable service is invoked without a feedback code, the condition token is passed to the Language Environment condition manager. The condition manager polls active condition handlers for a response. If a condition of severity 0 or 1 remains unhandled, Language Environment resumes without issuing a message. Language Environment does issue messages, however, for COBOL severity 1 conditions. For unhandled conditions of severity 2 or greater, Language Environment issues a message and terminates. For a list of Language Environment run-time messages and corrective information, see *z/OS Language Environment Run-Time Messages*.

If a second condition is raised while Language Environment is attempting to handle a condition, the message `CEE0374C CONDITION = <message no.>` is displayed using a write-to-operator (WTO). The message number in the CEE0374C message indicates the original condition that was being handled when the second condition was raised. This can happen when a critical error is signaled (for example, when internal control blocks are damaged).

If the output for this error message appears several times in sequence, the conditions appear in order of occurrence. Correcting the earliest condition can cause your application to run successfully.

Using the symbolic feedback code

The symbolic feedback code represents the first 8 bytes of a 12-byte condition token. You can think of the symbolic feedback code as the nickname for a condition. As such, the symbolic feedback code can be used in user-written condition handlers to screen for a given condition, even if it occurs at different locations in an application.

For more details on symbolic feedback codes, see *z/OS Language Environment Programming Guide*.

Chapter 2. Classifying errors

This chapter describes errors that commonly occur in Language Environment routines. It also explains how to use run-time messages and abend codes to obtain information about errors in your routine.

Identifying problems in routines

The following sections describe how you can identify errors in Language Environment routines. Included are common error symptoms and solutions.

Language Environment module names

You can identify Language Environment-supplied module elements by any of the following three-character prefixes:

- CEE (Language Environment)
- CEL (Language Environment and C/C++ run-time library)
- EDC (C/C++)
- FOR (Fortran)
- IBM (PL/I)
- IGZ (COBOL)

Module elements or text files with other prefixes are not part of the Language Environment product.

Common errors in routines

These common errors have simple solutions:

- If you do not have enough virtual storage, increase your region size or decrease your storage usage (stack size) by using the storage-related run-time options and callable services. (See “Controlling storage allocation” on page 11 for information about using storage in routines.)
- If you do not have enough disk space, increase your disk allocation.
- If executable files are not available, check your executable library to ensure that they are defined. For example, check your STEPLIB or JOBLIB definitions.

If your error is not caused by any of the items listed above, examine your routine or routines for changes since the last successful run. If there have been changes, review these changes for errors that might be causing the problem. One way to isolate the problem is to branch around or comment out recent changes and rerun the routine. If the run is successful, the error can be narrowed to the scope of the changes.

Duplicate names shared between Fortran routines and C library routines can produce unexpected results. Language Environment provides several cataloged procedures to properly resolve duplicate names. For more information on how to avoid name conflicts, see *z/OS Language Environment Programming Guide*.

Changes in optimization levels, addressing modes, and input/output file formats can also cause unanticipated problems in your routine.

In most cases, generated condition tokens or run-time messages point to the nature of the error. The run-time messages offer the most efficient corrective action. To

© Copyright IBM Corp. 1991, 2009

help you analyze errors and determine the most useful method to fix the problem, Table 3 lists common error symptoms, possible causes, and programmer responses.

Table 3. Common error symptoms, possible causes, and programmer responses

Error Symptom	Possible Cause	Programmer Response
Numbered run-time message appears	Condition raised in routine	For any messages you receive, read the Programmer Response. For information about message structure, see “Interpreting run-time messages” below.
User abend code < 4000	a) A non-Language Environment abend occurred b) The assembler user exit requested an abend for an unhandled condition of severity ≥2	See the Language Environment abend codes in *z/OS Language Environment Run-Time Messages*. Check for a subsystem-generated abend or a user-specified abend.
User abend code ≥ 4000	a) Language Environment detected an error and could not proceed b) An unhandled software-raised condition occurred and ABTERMENC(ABEND) was in effect c) The assembler user exit requested an abend for an unhandled condition of severity 4	For any abends you receive, read the appropriate explanation listed in the abend codes section of *z/OS Language Environment Run-Time Messages*.
System abend with TRAP(OFF)	Cause depends on type of malfunction	Respond appropriately. See the messages and codes book of the operating system.
System abend with TRAP(ON)	System-detected error	See the messages and codes book of the operating system.
No response (wait/loop)	Application logic failure	Check routine logic. Ensure ERRCOUNT and DEPTHCONDLMT run-time options are set to a nonzero value.
Unexpected message (message received was not from most recent service)	Condition caused by something related to current service	Generate a traceback using CEE3DMP.
Incorrect output	Incorrect file definitions, storage overlay, incorrect routine mask setting, references to uninitialized variables, data input errors, or application routine logic error	Correct the appropriate parameters.
No output	Incorrect ddname, file definitions, or message file setting	Correct the appropriate parameters.
Nonzero return code from enclave	Unhandled condition of severity 2, 3, or 4, or the return code was issued by the application routine	Check the Language Environment message file for run-time message.
Unexpected output	Conflicting library module names	See the name conflict resolution steps outlined in *z/OS Language Environment Programming Guide*.

Interpreting run-time messages

The first step in debugging your routine is to look up any run-time messages. To find run-time messages, check the message file:

- On z/OS, run-time messages are written by default to ddname SYSOUT. If SYSOUT is not specified, then the messages are written to SYSOUT=*.
- On CICS, the run-time messages are written to the CESE transient data QUEUE.

The default message file ddname can be changed by using the MSGFILE run-time option. For information about displaying run-time messages for C/C++, COBOL, Fortran, or PL/I routines, see *z/OS Language Environment Programming Guide*.

Run-time messages provide users with additional information about a condition, and possible solutions for any errors that occurred. They can be issued by Language Environment common routines or language-specific run-time routines and contain a message prefix, message number, severity code, and descriptive text.

In the following example Language Environment message:

```
CEE3206S The system detected a specification exception.
```

- The message prefix is CEE.
- The message number is 3206.
- The severity code is S.
- The message text is “The system detected a specification exception”.

Language Environment messages can appear even though you made no explicit calls to Language Environment services. C/C++, COBOL, and PL/I run-time library routines commonly use the Language Environment services. This is why you can see Language Environment messages even when the application routine does not directly call common run-time services.

Message prefix

The message prefix indicates the Language Environment component that generated the message. The message prefix is the first three characters of the message number and is also the facility ID in the condition token. See the following table for more information about Language Environment run-time messages.

Message Prefix	Language Environment Component
CEE	Common run time
EDC	C/C++ run time
FOR	Fortran run time
IBM	PL/I run time
IGZ	COBOL run time

The messages for the various components can be found in *z/OS Language Environment Run-Time Messages* and in *z/OS MVS Diagnosis: Reference*.

Message number

The message number is the 4-digit number following the message prefix. Leading zeros are inserted if the message number is less than four digits. It identifies the condition raised and references additional condition and programmer response information.

Severity code

The severity code is the letter following the message number and indicates the level of attention called for by the condition. Messages with severity of I are informational messages and do not usually require any corrective action. In general, if more than one run-time message appears, the first noninformational message indicates the

problem. For a complete list of severity codes, severity values, condition information, and default actions, see *z/OS Language Environment Programming Guide*.

Message text

The message text provides a brief explanation of the condition.

Understanding abend codes

Under Language Environment, abnormal terminations generate abend codes. There are two types of abend codes: 1) user (Language Environment and user-specified) abends and 2) system abends. User abends follow the format of U*dddd*, where *dddd* is a decimal user abend code. System abends follow the format of S*hhh*, where *hhh* is a hexadecimal abend code. Language Environment abend codes are usually in the range of 4000 to 4095. However, some subsystem abend codes can also fall in this range. User-specified abends use the range of 0 to 3999.

Example abend codes are:

```
User (Language Environment) abend code:U4041
User-specified abend code:U0005
System abend code:S80A
```

The Language Environment callable service CEE3ABD terminates your application with an abend. You can set the `clean-up` parameter value to determine how the abend is processed and how Language Environment handles the raised condition. For more information about CEE3ABD and `clean-up`, see *z/OS Language Environment Programming Reference*.

You can specify the ABTERMENC run-time option to determine what action is taken when an unhandled condition of severity 2 or greater occurs. For more information on ABTERMENC, see “Establishing enclave termination behavior for unhandled conditions” on page 24, as well as *z/OS Language Environment Programming Reference*.

User abends

If you receive a Language Environment abend code, see *z/OS Language Environment Run-Time Messages* for a list of abend codes, error descriptions, and programmer responses.

System abends

If you receive a system abend code, look up the code and the corresponding information in the publications for the system you are using.

When a system abend occurs, the operating system can generate a system dump. System dumps are written to ddname SYSMDUMP, SYSABEND, or SYSUDUMP. If the DYNDUMP run-time option is used in combination with the TERMTHDACT run-time option, the system dump can be written without the ddname specified. System dumps show the memory state at the time of the condition. See “Generating a system dump” on page 81 for more information about system dumps.

Using edcmtext to obtain information about errno2 values

Language Environment provides the **edcmtext** utility (similar to **bpxmtext**), which allows faster error resolution when an errno2 is encountered in Language Environment. Use the **edcmtext** utility to display errno2 reason code text. This utility produces a description and action for the errno2 value.

The **bpxmtext** utility calls **edcmtext** when the errno2 value is in the range reserved for the C run-time library or **edcmtext** can be invoked directly with the errno2 value as input.

Format

z/OS UNIX® environment:

edcmtext *errno2_value*

TSO/E environment:

EDCMTEXT *errno2_value*

Description

edcmtext displays the description and action text for C/C++ run-time library errno2 values, no other values are supported by this command. This command is intended as an aid for problem determination.

errno2_value is specified as 8 hexadecimal characters.

The user can specify one of the following in place of a errno2 value to view a help dialog: *-h*, *help*, *?*.

The user can specify the **-U** option to display the output in uppercase.

Usage notes

errno2_values are also accepted in mixed case and with hex digits prefixed with the ″0x″.

The range of values for the C/C++ run-time library is 0X'C0000000' through 0X'CFFFFFFF'.

The utility **bpxmtext** displays the description and action text for reason codes returned from the kernel, in addition to *errno2_values* returned from the C/C++ run-time library. The user should use **bpxmtext** when the source of the *errno2_values* is unknown. For further information about **bpxmtext**, see *z/OS UNIX System Services Command Reference*.

Message returns

If the user specifies a *-h*, *help* or *?* in place of the *errno2_value*, the following message is displayed:

```
Usage: edcmtext errno2_value
```

If no text is available for the *errno2_value*, the following message is displayed:

```
errno2_value: No information is currently available for this errno2_value.
```

If the *errno2_value* is not comprised of 1-8 hex digits, the following message is displayed:

```
Usage: edcmtext errno2_value
```

If the *errno2_value* is not in the C/C++ run-time library range, the following message is displayed:

```
Notice: The errn2_value is not in the C/C++ run-time library range.
```

If the environment that *edcmtext* is being run in is not TSO/E or z/OS UNIX the following message is displayed:

```
Error: The environment is not TSO/E or z/OS UNIX.
```

Examples

The command:

```
edcmtext C00B0021
```

produces data displayed in the following format:

```
JrEdc1opsEinval01: The mode argument passed to fopen() or freopen() did not begin
with r, w, or a.

Action: Correct the mode argument.  The first keyword of the mode argument must be
the open mode.  Ensure the open mode is specified first and begins with r, w, or a.

Source: edc1opst.c
```

Exit Values

0	Successful completion
2	Failure due to an argument that is not 1–8 hex digits
8	Bad Input due to an *errno2_value* out of the C/C++ run-time range.
14	Environment not TSO/E or z/OS UNIX
>20	Contact IBM due to Internal Error

Chapter 3. Using Language Environment debugging facilities

This chapter describes methods of debugging routines in Language Environment. Currently, most problems in Language Environment and member language routines can be determined through the use of a debugging tool or through information provided in the Language Environment dump.

Debug tools

Debug tools are designed to help you detect errors early in your routine. IBM offers Debug Tool, a comprehensive compile, edit, and debug product that is provided with the C/C++ for MVS/ESA, COBOL for OS/390 & VM, COBOL for MVS & VM, PL/I for MVS & VM, and VisualAge for Java compiler products. IBM Debug Tool for z/OS is also available as a standalone product for debugging XL C/C++ applications. For more information on Debug Tool, see http://www.ibm.com/software/awdtools/debugtool/.

You can use the IBM Debug Tool to examine, monitor, and control how your routines run, and debug your routines interactively or in batch mode. Debug Tool also provides facilities for setting breakpoints and altering the contents and values of variables. Language Environment run-time options can be used with Debug Tool to debug or analyze your routine. See the Debug Tool publications for a detailed explanation of how to invoke and run Debug Tool. For more information, see http://www.ibm.com/software/awdtools/debugtool/.

You can use IBM WebSphere® Developer Debugger for System z® to get a workstation graphical interface to IBM Debug Tool for z/OS. For more information, see http://www-306.ibm.com/software/awdtools/debugtool/tools/wddsz/.

You can also use **dbx** to debug Language Environment applications, including C/C++ programs. *z/OS UNIX System Services Command Reference* has information on **dbx** subcommands, while *z/OS UNIX System Services Programming Tools* contains usage information.

Language Environment dump service, CEE3DMP

The following sections provide information about using the Language Environment dump service, and describe the contents of the Language Environment dump.

Below is a list of methods to invoke the Language Environment dump service:
- CEE3DMP callable service (non-64-bit only)
- TERMTHDACT run-time option
- HLL-specific functions

Generating a Language Environment dump with CEE3DMP

For non-64-bit, the CEE3DMP callable service generates a dump of the run-time environment for Language Environment and the member language libraries at the point of the CEE3DMP call. You can call CEE3DMP directly from an application routine.

Depending on the CEE3DMP options you specify, the dump can contain information about conditions, tracebacks, variables, control blocks, stack and heap storage, file status and attributes, and language-specific information.

© Copyright IBM Corp. 1991, 2009

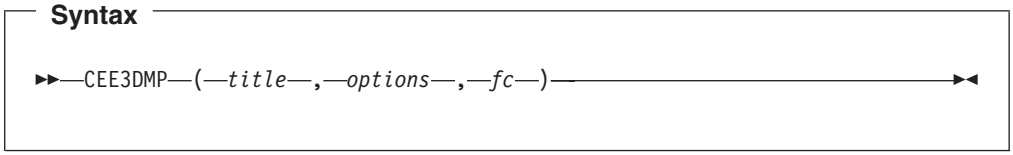
All output from CEE3DMP is written to the default ddname CEEDUMP. CEEDUMP, by default, sends the output to the SDSF output queue. You can direct the output from the CEEDUMP to a specific sysout class by using the environment variable, _CEE_DMPTARG=SYSOUT(x), where x is the output class.

Under z/OS UNIX, if the application is running in an address-space created as a result of a `fork()`, `spawn()`, `spawnp()`, `vfork()`, or one of the exec family of functions, then the CEEDUMP is placed in the HFS in one of the following directories in the specified order:

1. the directory found in environment variable *_CEE_DMPTARG*, if found
2. the current working directory, if this is not the root directory (/), the directory is writable, and the CEEDUMP pathname does not exceed 1024 characters.
3. the directory found in environment variable *TMPDIR* (an environment variable that indicates the location of a temporary directory if it is not /tmp)
4. the **/tmp** directory.

The syntax for CEE3DMP is:

Syntax



title
An 80-byte fixed-length character string that contains a title that is printed at the top of each page of the dump.

options
A 255-byte fixed-length character string that contains options describing the type, format, and destination of dump information. The options are declared as a string of keywords separated by blanks or commas. Some options also have suboptions that follow the option keyword, and are contained in parentheses. The last option declaration is honored if there is a conflict between it and any preceding options.

fc (output)
A 12-byte feedback token code that indicates the result of a call to CEE3DMP. If specified as an argument, feedback information, in the form of a condition token, is returned to the calling routine. If not specified, and the requested operation was not successfully completed, the condition is signaled to the condition manager.

Following is a list of CEE3DMP options and related information:

Table 4. CEE3DMP options

Dump Options	Abbreviation	Action Taken
ENCLAVE(ALL)	ENCL	Dumps all enclaves associated with the current process. (In ILC applications in which a C/C++ routine calls another member language routine, and that routine in turn calls CEE3DMP, traceback information for the C/C++ routine is not provided in the dump.) This is the default setting for ENCLAVE.

Table 4. CEE3DMP options (continued)

Dump Options	Abbreviation	Action Taken
ENCLAVE(CURRENT)	ENCL(CUR)	Dumps the current enclave.
ENCLAVE(n)	ENCL(n)	Dumps a fixed number of enclaves, indicated by *n*.
THREAD(ALL)	THR(ALL)	Dumps all threads in this enclave (including in a PL/I multitasking environment).
THREAD(CURRENT)	THR(CUR)	Dumps the current thread in this enclave.
TRACEBACK	TRACE	Includes a traceback of all active routines. The traceback shows transfer of control from either calls or exceptions. Calls include PL/I transfers of control from BEGIN-END blocks or ON-units.
NOTRACEBACK	NOTRACE	Does not include a traceback of all active routines.
FILES	FILE	Includes attributes of all open files. File control blocks are included when the BLOCKS option is also specified. File buffers are included when the STORAGE option is specified.
NOFILES	NOFILE	Does not include file attributes.
VARIABLES	VAR	Includes a symbolic dump of all variables, arguments, and registers.
NOVARIABLES	NOVAR	Does not include variables, arguments, and registers.
BLOCKS	BLOCK	Dumps control blocks from Language Environment and member language libraries. Global control blocks, as well as control blocks associated with routines on the call chain, are printed. Control blocks are printed for the routine that called CEE3DMP. The dump proceeds up the call chain for the number of routines specified by the STACKFRAME option (see below). Control blocks for files are also dumped if the FILES option was specified. See the FILES option above for more information. If the TRACE run-time option is set to ON, the trace table is dumped if BLOCKS is specified. If the Heap Storage Diagnostics report is requested via the HEAPCHK run-time option, the report is displayed when BLOCKS is specified.
NOBLOCKS	NOBLOCK	Does not include control blocks.
STORAGE	STOR	Dumps the storage used by the routine. The number of routines dumped is controlled by the STACKFRAME option.
NOSTORAGE	NOSTOR	Suppresses storage dumps.

Table 4. CEE3DMP options (continued)

Dump Options	Abbreviation	Action Taken
STACKFRAME(ALL)	SF(ALL)	Dumps all stack frames from the call chain. This is the default setting for STACKFRAME.
STACKFRAME(n)	SF(n)	Dumps a fixed number of stack frames, indicated by *n*, from the call chain. The specific information dumped for each stack frame depends on the VARIABLES, BLOCK, and STORAGE options declarations. The first stack frame dumped is the caller of CEE3DMP, followed by its caller, and proceeding backward up the call chain.
PAGESIZE(n)	PAGE(n)	Specifies the number of lines on each page of the dump.
FNAME(s)	FNAME(s)	Specifies the ddname of the file to which the dump is written.
CONDITION	COND	Dumps condition information for each condition active on the call chain.
NOCONDITION	NOCOND	For each condition active on the call chain, does not dump condition information.
ENTRY	ENT	Includes a description of the program unit that called CEE3DMP and the registers on entry to CEE3DMP.
NOENTRY	NOENT	Does not include a description of the program unit that called CEE3DMP or registers on entry to CEE3DMP.
GENOPTS	GENO	Generate a run-time options report in the dump output. This will be the default if an unhandled condition occurs, and a CEEDUMP is generated due to the setting of the TERMTHDACT run-time option setting.
NOGENOPTS	NOGENO	Do not generate a run-time options report in the dump output. NOGENOPTS is the default for user-called dumps.
REGSTOR(reg_stor_amount)	REGST(reg_ stor_amount)	Controls the amount of storage to be dumped around registers. Default is 96 bytes. Specify REGSTOR(0) if no storage around registers is required.
Note: On CICS, only ENCLAVE(CURRENT) and ENCLAVE(1) settings are supported.		

The IBM-supplied default settings for CEE3DMP are:

```
ENCLAVE(ALL) TRACEBACK
THREAD(CURRENT) FILES VARIABLES NOBLOCKS NOSTORAGE
STACKFRAME(ALL) PAGESIZE(60) FNAME(CEEDUMP)
CONDITION ENTRY NOGENOPTS REGSTOR(96)
```

For additional information about the CEE3DMP callable service and dump options, see *z/OS Language Environment Programming Reference*. For an example of a Language Environment dump, see “Understanding the Language Environment dump” on page 43.

Generating a Language Environment dump with TERMTHDACT

The TERMTHDACT run-time option produces a dump during program checks, abnormal terminations, or calls to the CEESGL service. You must use TERMTHDACT(DUMP) in conjunction with TRAP(ON) to generate a Language Environment dump.

You can use TERMTHDACT to produce a traceback, Language Environment dump, or user address space dump when a thread ends abnormally because of an unhandled condition of severity 2 or greater. If this is the last thread in the process, the enclave goes away. A thread terminating in a non-POSIX environment is analogous to an enclave terminating because Language Environment Version 1 supports only single threads. For information on enclave termination, see *z/OS Language Environment Programming Guide*.

The TERMTHDACT suboptions QUIET, MSG, TRACE, DUMP, UAONLY, UATRACE, UADUMP, and UAIMM control the level of information available. Following are the suboptions, the levels of information produced, and the destination of each.

Table 5. TERMTHDACT suboptions, level of information, and destinations

Suboption	Level of Information	Destination
QUIET	No information	No destination.
MSG	Message	Terminal or ddname specified in MSGFILE run-time option.
TRACE	Message and Language Environment dump containing only a traceback	Message goes to terminal or ddname specified in MSGFILE run-time option. Traceback goes to CEEDUMP file.
DUMP	Message and complete Language Environment dump	Message goes to terminal or ddname specified in MSGFILE run-time option. Language Environment dump goes to CEEDUMP file.
UAONLY	SYSMDUMP, SYSABEND dump, or SYSUDUMP depending on the DD card used in the JCL in z/OS. In CICS, a transaction dump is created. In non-CICS you will get a system dump of your user address space if the appropriate DD statement is used. **Note:** A Language Environment dump is not generated.	Language Environment generates a U4039 abend which allows a system dump of the user address space to be generated. For z/OS, the system dump is written to the ddname specified; for CICS the transaction dump goes to DFHDMPA or the DFHDMPB data set.
UATRACE	Message, Language Environment dump containing only a traceback, and a system dump of the user address space	Message goes to terminal or ddname specified in MSGFILE run-time option. Traceback goes to CEEDUMP file. Language Environment generates a U4039 abend which allows a system dump of the user address space to be generated. For z/OS, the system dump is written to the ddname specified; for CICS the transaction dump goes to DFHDMPA or the DFHDMPB data set.

Table 5. TERMTHDACT suboptions, level of information, and destinations (continued)

Suboption	Level of Information	Destination
UADUMP	Message, Language Environment dump, and SYSMDUMP, SYSABEND dump, or SYSUDUMP depending on the DD card used in the JCL in z/OS. In CICS, a transaction dump is created.	Message goes to terminal or ddname specified in MSGFILE run-time option. Language Environment dump goes to CEEDUMP file. Language Environment generates a U4039 abend which allows a system dump of the user address space to be generated. For z/OS, the system dump is written to the ddname specified; for CICS the transaction dump goes to DFHDMPA or the DFHDMPB data set.
UAIMM	Language Environment generates a system dump of the original abend/program interrupt of the user address space. In CICS, a transaction dump is created. In non-CICS you will get a system dump of your user address space if the appropriate DD statement is used. After the dump is taken by the operating system, Language Environment condition manager continues processing. **Note:** Under CICS, UAIMM yields UAONLY behavior. Under non-CICS, TRAP(ON,NOSPIE) must be in effect. When TRAP(ON,SPIE) is in effect, UAIMM yields UAONLY behavior. For software raised conditions or signals, UAIMM behaves the same as UAONLY.	Message goes to terminal or ddname specified in MSGFILE run-time option. User address space dump goes to ddname specified for z/OS; or a CICS transaction dump goes to the DFHDMPA or DFHDMPB data set.

The TRACE and UATRACE suboptions of TERMTHDACT use these dump options:
- CONDITION
- ENCLAVE(ALL)
- FILES
- FNAME(CEEDUMP)
- GENOPTS
- NOBLOCKS
- NOENTRY
- NOSTORAGE
- STACKFRAME(ALL)
- THREAD(ALL)
- TRACEBACK
- VARIABLES

The DUMP and UADUMP suboptions of TERMTHDACT use these dump options:
- BLOCKS
- CONDITION
- ENCLAVE(ALL)
- FILES
- FNAME(CEEDUMP)
- GENOPTS
- NOENTRY

- STACKFRAME(ALL)
- STORAGE
- THREAD(CURRENT)
- TRACEBACK
- VARIABLES

Although you can modify CEE3DMP options, you cannot change options for a traceback or dump produced by TERMTHDACT.

Considerations for setting TERMTHDACT options

The output of TERMTHDACT may vary depending upon which languages and subsystems are processing the request. This section describes the considerations associated with issuing the TERMTHDACT suboptions.

- COBOL Considerations
  - The following TERMTHDACT suboptions for COBOL are recommended, UAONLY, UATRACE, and UADUMP. A system dump will always be generated when one of these suboptions is specified.
- PL/I Considerations
  - After a normal return from a PL/I ERROR ON-unit, or from a PL/I FINISH ON-unit, Language Environment considers the condition unhandled. If a GOTO is not performed and the resume cursor is not moved, then the thread terminates. The TERMTHDACT setting guides the amount of information that is produced, so the message is not presented twice.
- PL/I MTF Considerations
  - TERMTHDACT applies to a task that terminates abnormally due to an unhandled condition of severity 2 or higher that is percolated beyond the initial routine's stack frame. All active subtasks that were created from the incurring task will terminate abnormally, but the enclave will continue to run.
- z/OS UNIX Considerations
  - The TERMTHDACT option applies when a thread terminates abnormally. Abnormal termination of a single thread causes termination of the entire enclave. If an unhandled condition of severity 2 or higher percolates beyond the first routine's stack frame the enclave terminates abnormally.
  - If an enclave terminates due to a POSIX default signal action, then TERMTHDACT applies to conditions that result from software signals, program checks, or abends.
  - If running under a shell and Language Environment generates a system dump, then a storage dump is generated to a file based on the kernel environment variable, _BPXK_MDUMP.
- CICS Considerations
  - TERMTHDACT output is written either to a transient data queue named CESE, or to the CICS transaction dump, depending on the setting of the CESE|CICSDDS suboption of the TERMTHDACT run-time option. Table 6 on page 42 shows the behavior of CESE|CICSDDS when they are used with the other suboptions of TERMTHDACT.
  - Since Language Environment does not own the ESTAE, the suboption UAIMM will be treated as UAONLY.
  - All associated Language Environment dumps will be suppressed if termination processing is the result of an EXEC CICS ABEND with NODUMP.

Table 6. Condition handling of 0Cx abends

Options	**TERMTHDACT(*X*,CESE,)**	**TERMTHDACT(*X*,CICSDDS,)**
QUIET	• No output.	• No output.
MSG	• Message written to CESE queue or MSGFILE.	• Message written to CESE queue or MSGFILE.
TRACE	• The traceback is written to the CESE queue, followed by U4038 abend with nodump option.	• Language Environment will write traceback, variables, COBOL working storage, C writeable static. The member handlers will be invoked to provide the desired output to the new transaction server queue (which CICS will read and write to CICS transaction dump later). • U4039 abend to force CICS transaction dump followed by U4038 abend with nodump option. • Message to CESE or MSGFILE.
DUMP	• CEEDUMP to CESE queue followed by U4038 abend with nodump option.	• CEEDUMP to new transaction server queue which CICS will read and write to CICS transaction dump later. • U4039 abend to force CICS transaction dump followed by U4038 abend with nodump option. • Message to CESE or MSGFILE.
UATRACE	• U4039 abend with traceback to CESE queue followed by U4038 abend with nodump option.	• Language Environment will write traceback, variables, COBOL working storage, C writeable statics. The member handlers will be invoked to provide the desired output to the new transaction server queue (which CICS will read and write to CICS transaction dump later). • U4039 abend to force CICS transaction dump followed by U4038 abend with nodump option. • Message to CESE or MSGFILE.
UADUMP	• U4039 abend with CEEDUMP to CESE queue followed by U4038 abend with nodump option.	• CEEDUMP to new transaction server queue which CICS will read and write to CICS transaction dump later. • U4039 abend to force CICS transaction dump followed by U4038 abend with nodump option. • Message to CESE or MSGFILE.
UAONLY	• U4039 abend followed by U4038 abend with nodump option.	• U4039 abend followed by U4038 abend with nodump option. • No CEEDUMP information is generated. • Same as CESE.
UAIMM	• U4039 abend followed by U4038 abend with nodump option.	• U4039 abend followed by U4038 abend with nodump option. • No CEEDUMP information is generated. • Same as CESE.

Note: Program checks and other abends will cause CICS to produce a CICS transaction dump.

For more information about the TERMTHDACT run-time option, see *z/OS Language Environment Programming Reference*.

Generating a Language Environment dump with language-specific functions

In addition to the CEE3DMP callable service and the TERMTHDACT run-time option, you can use language-specific routines such as C functions, the Fortran SDUMP service, and the PL/I PLIDUMP service to generate a dump.

C/C++ routines can use the functions `cdump()`, `csnap()`, and `ctrace()` to produce a Language Environment dump. All three functions call the CEE3DMP callable service, and each function includes an options string consisting of different CEE3DMP options that you can use to control the information contained in the dump. For more information on these functions, see “Generating a Language Environment dump of a C/C++ routine” on page 185.

Fortran programs can call SDUMP, DUMP/PDUMP, or CDUMP/CPDUMP to generate a Language Environment dump. CEE3DMP cannot be called directly from a Fortran program. For more information on these functions, see “Generating a Language Environment dump of a Fortran routine” on page 265.

PL/I routines can call PLIDUMP instead of CEE3DMP to produce a dump. PLIDUMP includes options that you can specify to obtain a variety of information in the dump. For a detailed explanation about PLIDUMP, see “Generating a Language Environment dump of a PL/I for MVS & VM routine” on page 289.

Understanding the Language Environment dump

The Language Environment dump service generates output of data and storage from the Language Environment run-time environment on an enclave basis. This output contains the information needed to debug most basic routine errors.

Figure 7 on page 48 illustrates a dump for enclave main. The example assumes full use of the CEE3DMP dump options. Ellipses are used to summarize some sections of the dump and information regarding unhandled conditions may not be present at all. Sections of the dump are numbered to correspond with the descriptions given in “Sections of the Language Environment dump” on page 56.

The CEE3DMP was generated by the C program CELSAMP shown in Figure 5 on page 44. CELSAMP uses the DLL CELDLL shown in Figure 6 on page 47.

```
#pragma options(SERVICE("1.1.d"),NOOPT,TEST(SYM))
#pragma runopts(TERMTHDACT(UADUMP),POSIX(ON),DYNDUMP(,DYNAMIC,))
#pragma runopts(TRACE(ON,1M,NODUMP,LE=1),HEAPCHK(ON,1,0,10,10))
#pragma runopts(RPTSTG(ON),HEAPPOOLS(ON))
#define _OPEN_THREADS
#include <pthread.h>
#include <stdio.h>
#include <stdlib.h>
#include <dll.h>
#include <signal.h>
#include <leawi.h>
#include <ceeedcct.h>

pthread_mutex_t      mut;
pthread_t            thread[2];
int                  threads_joined = 0;
char *               t1 = "Thread 1";
char *               t2 = "Thread 2";
/*********************************************************************/
/*  thread_cleanup: condition handler to clean up threads            */
/*********************************************************************/
void thread_cleanup(_FEEDBACK *cond,_INT4 *input_token,
                    _INT4 *result, _FEEDBACK *new_cond) {

  /* values for handling the conditions */
  #define percolate   20
  printf(">>> Thread_CleanUp: Msg # is %d\n",cond->tok_msgno);
  if (!threads_joined) {
    printf(">>> Thread_CleanUp: Unlocking mutex\n");
    pthread_mutex_unlock(&mut);
    printf(">>> Thread_CleanUp: Joining threads\n");
    if (pthread_join(thread[0],NULL) == -1 )
      perror("Join of Thread #1 failed");
    if (pthread_join(thread[1],NULL) == -1 )
      perror("Join of Thread #2 failed");
    threads_joined = 1;
  }
  *result = percolate;
  printf(">>> Thread_CleanUp: Percolating condition\n");
}
/*********************************************************************/
/*  thread_func: Invoked via pthread_create.                         */
/*********************************************************************/
void *thread_func(void *parm)
{
  printf(">>> Thread_func: %s locking mutex\n",parm);
  pthread_mutex_lock(&mut);
  pthread_mutex_unlock(&mut);
  printf(">>> Thread_func: %s exitting\n",parm);
  pthread_exit(NULL);
}
```

Figure 5. The C program CELSAMP (Part 1 of 3)

```
main()
{
  dllhandle *          handle;
  int                  i = 0;
  FILE*                fp1;
  FILE*                fp2;
  _FEEDBACK            fc;
  _INT4                token;
  _ENTRY               pgmptr;

  printf("Init MUTEX...\n");
  if (pthread_mutex_init(&mut, NULL) == -1) {
    perror("Init of mut failed");
    exit(101);
  }

  printf("Lock Mutex Lock...\n");
  if (pthread_mutex_lock(&mut) == -1) {
    perror("Lock of mut failed");
    exit(102);
  }

  printf("Create 1st thread...\n");
  if (pthread_create(&thread[0],NULL,thread_func,(void *)t1) == -1) {
    perror("Could not create thread #1");
    exit(103);
  }

  printf("Create 2nd thread...\n");
  if (pthread_create(&thread[1],NULL,thread_func,(void *)t2) == -1) {
    perror("Could not create thread #2");
    exit(104);
  }
  printf("Register thread cleanup condition handler...\n");
  pgmptr.address = (_POINTER)thread_cleanup;
  pgmptr.nesting = NULL;
  token = 1;
  CEEHDLR (&pgmptr, &token, &fc);
  if ( _FBCHECK ( fc , CEE000 ) != 0 ) {
    printf( "CEEHDLR failed with message number %d\n",fc.tok_msgno);
    exit(105);
  }
  printf("Load DLL...\n");
  handle = dllload("CELDLL");
  if (handle == NULL) {
    perror("Could not load DLL CELDLL");
    exit(106);
  }

  printf("Query DLL with incorrect function name...\n");
  pgmptr.address = (_POINTER)dllqueryfn(handle,"name_not_in_dll");
  if (pgmptr.address != NULL) {
    perror("Found incorrect function name in DLL");
    exit(111);
  }

  printf("Query DLL...\n");
  pgmptr.address = (_POINTER)dllqueryfn(handle,"dump_n_perc");
  if (pgmptr.address == NULL) {
    perror("Could not find dump_n_perc");
    exit(107);
  }
```

Figure 5. The C program CELSAMP (Part 2 of 3)

```
 printf("Register condition handler...\n");
  pgmptr.nesting = NULL;
  token = 2;
  CEEHDLR (&pgmptr, &token, &fc);
  if ( _FBCHECK ( fc , CEE000 ) != 0 ) {
    printf( "CEEHDLR failed with message number %d\n",
       fc.tok_msgno);
    exit(108);
  }

  printf("Write to some files...\n");
  fp1 = fopen("myfile.data", "w");
  if (!fp1) {
    perror("Could not open myfile.data for write");
    exit(109);
  }

  fprintf(fp1, "record 1\n");
  fprintf(fp1, "record 2\n");
  fprintf(fp1, "record 3\n");

  fp2 = fopen("memory.data", "wb,type=memory");
  if (!fp2) {
    perror("Could not open memory.data for write");
    exit(112);
  }

  fprintf(fp2, "some data");
  fprintf(fp2, "some more data");
  fprintf(fp2, "even more data");

  printf("Divide by zero...\n");
  i = 1/i;
  printf("Error -- Should not get here\n");
  exit(110);
}
```

Figure 5. The C program CELSAMP (Part 3 of 3)

```
/* DLL containing Condition Handler that takes dump and percolates */
#pragma options(SERVICE("1.3.b"),TEST(SYM),NOOPT)
#pragma export(dump_n_perc)
#include <stdio.h>
#include <leawi.h>
#include <stdlib.h>
#include <string.h>
#include <ceeedcct.h>
char wsa_array[10] = { 'C','E','L','D','L','L',' ','W','S','A'};
#define OPT_STR "THREAD(ALL) BLOCKS STORAGE GENOPTS"
#define TITLE_STR "Sample dump produced by calling CEE3DMP"

void dump_n_perc(_FEEDBACK *cond,_INT4 *input_token,
                 _INT4 *result, _FEEDBACK *new_cond) {

  /* values for handling the conditions */
  #define percolate   20

  _CHAR80 title;
  _CHAR255 options;
  _FEEDBACK fc;

  printf(">>> dump_n_perc: Msg # is %d\n",cond->tok_msgno);

  /* check if the DIVIDE-BY-ZERO message (0C9) */
  if (cond->tok_msgno == 3209) {
    memset(options,' ',sizeof(options));
    memcpy(options,OPT_STR,sizeof(OPT_STR)-1);

    memset(title,' ',sizeof(title));
    memcpy(title,TITLE_STR,sizeof(TITLE_STR)-1);

    printf(">>> dump_n_perc: Taking dump\n");
    CEE3DMP(title,options,&fc);
    if ( _FBCHECK ( fc , CEE000 ) != 0 ) {
      printf("CEE3DMP failed with msgno %d\n",fc.tok_msgno);
      exit(299);
    }
  }
  *result = percolate;
  printf(">>> dump_n_perc: Percolating condition\n");
}
```

Figure 6. The C DLL CELDLL

For easy reference, the sections of the following dump are numbered to correspond with the descriptions in “Sections of the Language Environment dump” on page 56.

```
[1]CEE3DMP V1 R9.0: Sample dump produced by calling CEE3DMP                    01/05/07 11:22:37 PM                Page:    1

ASID: 003F   Job ID: JOB14342   Job name: CELSAMP    Step name: STEP1      PID: 33620309   Parent PID: 1   User name: HEALY

[2]CEE3845I CEEDUMP Processing started.

[3]CEE3DMP called by program unit //'POSIX.CRTL.C(CELDLL)' (entry point dump_n_perc) at statement 34 (offset +0000012E).


[4]Registers on Entry to CEE3DMP:


PM....... 0100
  GPR0..... 20FC8078  GPR1..... 20FC7F18  GPR2..... 20FC7F78  GPR3..... 213563EA
  GPR4..... 20FC7F28  GPR5..... 21356620  GPR6..... 00000002  GPR7..... 2090E2A8
  GPR8..... A09C6C34  GPR9..... 20FC0C00  GPR10.... 20FC5CA7  GPR11.... A0A82198
  GPR12.... 209159B0  GPR13.... 20FC7E80  GPR14.... A13564E0  GPR15.... A09F0ED0
  FPR0..... 4DBFF67D  46DBE848            FPR2..... 00000000  00000000
  FPR4..... 00000000  00000000            FPR6..... 00000000  00000000
    GPREG STORAGE:
      Storage around GPR0 (20FC8078)
        -0020 20FC8058  40404040 40404040 40404040 40404040  40404040 40404040 40404040 40404000  |                               .|
        +0000 20FC8078  00000000 00000000 00000000 00000000  2090E2D0 00000000 00000000 20FC7F28  |...................S...........".|
        +0020 20FC8098  00000000 00000000 00000000 00000000  00000000 20FC7E80 20FC8660 A09F1D0E  |......................=...f-....|
      Storage around GPR1 (20FC7F18)
        -0020 20FC7EF8  20FC5180 209CF4D8 209CF4D4 20FC7F68  20FC8018 20FC7F54 00000000 20FC7F68  |......4Q..4M.."......."......."."|
        +0000 20FC7F18  20FC7F28 20FC7F78 20FC8078 00000000  E2819497 93854084 A4949740 97999684  |.."..."........Sample dump prod|
        +0020 20FC7F38  A4838584 4082A840 83819393 89958740  C3C5C5F3 C4D4D740 40404040 40404040  |uced by calling CEE3DMP         |
⋮
      Storage around GPR15(209F0ED0)
        -0020 209F0EB0  209EFDA0 F2F0F0F6 F1F2F1F5 F1F0F2F5  F0F0F0F1 F0F9F0F0 0005C4F1 F9F0F800  |....20061215102500010900..D1908.|
        +0000 209F0ED0  A7F4000A 00C3C5C5 000005B8 00003328  47F0F001 90ECD00C A7B50004 209F4048  |x4...CEE.........00.....x..... .|
        +0020 209F0EF0  58BB0000 0D8041F0 00005800 B0085810  D04C1E01 5500C00C A7D40006 58F0C2BC  |.......0.........<......xM...0B.|
[5]Information for enclave main


  [6]Information for thread 20DA9FB000000000

 Registers on Entry to CEE3DMP:
    PM....... 0100
    GPR0..... 20FC8078  GPR1..... 20FC7F18  GPR2..... 20FC7F78  GPR3..... 213563EA
    GPR4..... 20FC7F28  GPR5..... 21356620  GPR6..... 00000002  GPR7..... 2090E2A8
    GPR8..... A09C6C34  GPR9..... 20FC0C00  GPR10.... 20FC5CA7  GPR11.... A0A82198
    GPR12.... 209159B0  GPR13.... 20FC7E80  GPR14.... A13564E0  GPR15.... A09F0ED0
    FPR0..... 4DBFF67D  46DBE848            FPR2..... 00000000  00000000
    FPR4..... 00000000  00000000            FPR6..... 00000000  00000000
    GPREG STORAGE:
      Storage around GPR0 (20FC8078)
        -0020 20FC8058  40404040 40404040 40404040 40404040  40404040 40404040 40404040 40404000  |                               .|
        +0000 20FC8078  00000000 00000000 00000000 00000000  2090E2D0 00000000 00000000 20FC7F28  |...................S...........".|
        +0020 20FC8098  00000000 00000000 00000000 00000000  00000000 20FC7E80 20FC8660 A09F1D0E  |......................=...f-....|
⋮
 [7]Traceback:

    DSA   Entry       E  Offset  Statement   Load Mod             Program Unit                  Service  Status
    1     dump_n_perc +0000012E  34          CELDLL               CELDLL                        1.3.B    Call
    2     CEEPGTFN    +0000005A               CEEPLPKA                                                    Call
    3     CEEHDSP     +000024BC               CEEPLPKA             CEEHDSP                  D1908    Call
    4     main        +000009BA  150          CELSAMP              CELSAMP                  1.1.D    Exception
    5     EDCZMINV    +000000C2               CEEEV003                                                    Call
    6     CEEBBEXT    +000001B6               CEEPLPKA             CEEBBEXT                 D1908    Call

    DSA   DSA Addr   E  Addr    PU Addr    PU Offset  Comp Date  Compile Attributes
    1     20FC7E80   213563B0   213563B0   +0000012E  20070105   C/C++     POSIX EBCDIC  HFP
    2     20FC7DC8   20A82198   20A822F8   -00000106  20061215   LIBRARY    POSIX
    3     20FC4CA8   209C4870   209C4870   +000024BC  20061215   CEL       POSIX
    4     20FC4208   20900478   20900478   +000009BA  20070105   C/C++     POSIX EBCDIC  HFP
    5     20FC40F0   20E629EE   20E629EE   +000000C2  20061215   LIBRARY    POSIX
    6     20FC4030   20992840   20992840   +000001B6  20061215   CEL       POSIX

    Fully Qualified Names
    DSA   Entry       Program Unit                                    Load Module
    1     dump_n_perc //'POSIX.CRTL.C(CELDLL)'                       CELDLL
    4     main        //'POSIX.CRTL.C(CELSAMP)'                       CELSAMP
```

Figure 7. Example dump using CEE3DMP (Part 1 of 9)

```
    [8]Condition Information for Active Routines

Condition Information for //'POSIX.CRTL.C(CELSAMP)' (DSA address 20FC4208)
      CIB Address: 20FC55C8
      Current Condition:
        CEE3209S The system detected a fixed-point divide exception (System Completion Code=0C9).
      Location:
        Program Unit: //'POSIX.CRTL.C(CELSAMP)'
        Entry:        main Statement: 150 Offset: +000009BA
      Machine State:
        ILC..... 0002    Interruption Code..... 0009
        PSW..... 078D2400 A0900E34
        GPR0..... 00000000  GPR1..... A0D9AD0C  GPR2..... 20FC42C5  GPR3..... 209004B2
        GPR4..... 20FC42C2  GPR5..... 20901288  GPR6..... 00000000  GPR7..... 00000001
        GPR8..... 00000030  GPR9..... 80000000  GPR10.... A0E629E2  GPR11.... A0992840
        GPR12.... 209159B0  GPR13.... 20FC4208  GPR14.... A0900E1E  GPR15.... 00000012

    Storage dump near condition, beginning at location: 20900E22
      +000000 20900E22  4400C1AC 5800D0AC 41600001 8E600020  1D601807 5000D0AC 4400C1AC 58F039E2  |..A.....-...-...-..&.....A..0.S|
    GPREG STORAGE:
      Storage around GPR0 (00000000)
        +0000 00000000    Inaccessible storage.
        +0020 00000020    Inaccessible storage.
        +0040 00000040    Inaccessible storage.
⋮
[9]Parameters, Registers, and Variables for Active Routines:

 dump_n_perc (DSA address 20FC7E80):
     UPSTACK DSA
      Parameters:
        new_cond         struct _FEEDBACK *
                                       0x2090E8F4
        result           signed long int *
                                       0x20FC56B4
        input_token      signed long int *
                                       0x20FC56A8
        cond             struct _FEEDBACK *
                                       0x20FC55E0
      Saved Registers:
        GPR0..... 20FC8078  GPR1..... 20FC7F18  GPR2..... 20FC7F78  GPR3..... 213563EA
        GPR4..... 20FC7F28  GPR5..... 21356620  GPR6..... 00000002  GPR7..... 2090E2A8
        GPR8..... A09C6C34  GPR9..... 20FC0C00  GPR10.... 20FC5CA7  GPR11.... A0A82198
        GPR12.... 209159B0  GPR13.... 20FC7E80  GPR14.... A13564E0  GPR15.... A09F0ED0
    GPREG STORAGE:
      Storage around GPR0 (20FC8078)
        -0020 20FC8058  40404040 40404040 40404040 40404040  40404040 40404040 40404040 40404000  |                               .|
⋮
      Local Variables:
        title[0..6]      unsigned char         'S'     'a'     'm'     'p'     'l'     'e'     ' '
        title[7..13]                           'd'     'u'     'm'     'p'     ' '     'p'     'r'
        title[14..20]                          'o'     'd'     'u'     'c'     'e'     'd'     ' '
        title[21..27]                          'b'     'y'     ' '     'c'     'a'     'l'     'l'
        title[28..34]                          'i'     'n'     'g'     ' '     'C'     'E'     'E'
        title[35..41]                          '3'     'D'     'M'     'P'     ' '     ' '     ' '
        title[42..48]                          ' '     ' '     ' '     ' '     ' '     ' '     ' '
                title[49..55] to title[70..76] elements same as above.
        title[77..79]                          ' '     ' '     ' '
        options[0..6]    unsigned char         'T'     'H'     'R'     'E'     'A'     'D'     '('
        options[7..13]                         'A'     'L'     'L'     ')'     ' '     'B'     'L'
        options[14..20]                        'O'     'C'     'K'     'S'     ' '     'S'     'T'
        options[21..27]                        'O'     'R'     'A'     'G'     'E'     ' '     'G'
        options[28..34]                        'E'     'N'     'O'     'P'     'T'     'S'     ' '
        options[35..41]                        ' '     ' '     ' '     ' '     ' '     ' '     ' '
                options[42..48] to options[245..251] elements same as above.
        options[252..254]                      ' '     ' '     ' '
        fc               struct _FEEDBACK
         tok_sev          signed short int        0
         tok_msgno        signed short int        0
         tok_case         unsigned:2                   0
         tok_sever        unsigned:3                   0
         tok_ctrl         unsigned:3                   0
         tok_facid[0..2]  unsigned char         '\0'    '\0'    '\0'
         tok_isi          signed int                   0
        __func__[0..6]   static unsigned char
                                               'd'     'u'     'm'     'p'     '_'     'n'     '_'
        __func__[7..11]                        'p'     'e'     'r'     'c'     '\0'
⋮
```

Figure 7. Example dump using CEE3DMP (Part 2 of 9)

```
  main (DSA address 20FC4208):
      UPSTACK DSA
      Saved Registers:
        GPR0..... 00000000  GPR1..... A0D9AD0C  GPR2..... 20FC42C5  GPR3..... 209004B2
        GPR4..... 20FC42C2  GPR5..... 20901288  GPR6..... 00000000  GPR7..... 00000001
        GPR8..... 00000030  GPR9..... 80000000  GPR10.... A0E629E2  GPR11.... A0992840
        GPR12.... 209159B0  GPR13.... 20FC4208  GPR14.... A0900E1E  GPR15.... 00000012
    GPREG STORAGE:
      Storage around GPR0 (00000000)
        +0000 00000000    Inaccessible storage.
⋮

[10]Control Blocks for Active Routines:

DSA for dump_n_perc: 20FC7E80
      +000000  FLAGS.... 1099      member... 2840      BKC...... 20FC7DC8  FWC...... 20FC80A8  R14...... A13564E0
      +000010  R15...... A09F0ED0  R0....... 20FC8078  R1....... 20FC7F18  R2....... 20FC7F78  R3....... 213563EA
      +000024  R4....... 20FC7F28  R5....... 21356620  R6....... 00000002  R7....... 2090E2A8  R8....... A09C6C34
      +000038  R9....... 20FC0C00  R10...... 20FC5CA7  R11...... A0A82198  R12...... 209159B0  reserved. 00000000
      +00004C  NAB...... 20FC80A8  PNAB..... 209CF57F  reserved. 209CE580  20FC7F68
      +000064  reserved. 20FC7F44  reserved. 2090E4BC  MODE..... 20FC8018  reserved. 2090E4C0
      +000078  reserved. 20FC5180  reserved. 209CF4D8
    DSA for CEEPGTFN: 20FC7DC8
      +000000  FLAGS.... 1000      member... 0000      BKC...... 20FC4CA8  FWC...... 20FC8128  R14...... A0A821F4
      +000010  R15...... 213563B0  R0....... 20FE5B40  R1....... 2090E2D0  R2....... 20FC55C8  R3....... 21366CE0
      +000024  R4....... 20FC7DC8  R5....... 209C95C8  R6....... 00000000  R7....... 20FC7E8C  R8....... 00000000
      +000038  R9....... A0992B28  R10...... 00000000  R11...... 209C3A88  R12...... 209159B0  reserved. 00000000
      +00004C  NAB...... 20FC7E80  PNAB..... 00000000  reserved. 00000000  00000000
      +000064  reserved. 00000000  reserved. 00000000  MODE..... 00000000  reserved. 00000000
      +000078  reserved. 00000000  reserved. 00000000
    DSA for CEEHDSP: 20FC4CA8
      +000000  FLAGS.... 0808      member... CEE1      BKC...... 20FC4208  FWC...... 20FC7DC8  R14...... A09C6D2E
      +000010  R15...... A0A82198  R0....... 21366CE0  R1....... 2090E2D0  R2....... 20FC55C8  R3....... 2090CDB0
      +000024  R4....... 209C949C  R5....... 209C95C8  R6....... 00000002  R7....... 2090E2A8  R8....... A09C6C34
      +000038  R9....... 20FC6CA6  R10...... 20FC5CA7  R11...... A09C4870  R12...... 209159B0  reserved. 00000000
      +00004C  NAB...... 20FC7DC8  PNAB..... 20FE663A  reserved. A0A512DA  20A5BE6C
      +000064  reserved. 210F72AC  reserved. 2090EFF0  MODE..... 0000010B  reserved. 20A584C0
      +000078  reserved. 20FE6630  reserved. 00000004
    DSA for main: 20FC4208
      +000000  FLAGS.... 1000      member... 0000      BKC...... 20FC40F0  FWC...... 20FC42E8  R14...... A0900E1E
      +000010  R15...... 20DA8624  R0....... 2090155C  R1....... 20FC42A0  R2....... 20FC42C5  R3....... 209004B2
      +000024  R4....... 20FC42C2  R5....... 20901288  R6....... 20FC42CC  R7....... 20FC42D0  R8....... 00000030
      +000038  R9....... 80000000  R10...... A0E629E2  R11...... A0992840  R12...... 209159B0  reserved. 00000000
      +00004C  NAB...... 20FC42E8  PNAB..... 00000000  reserved. 00000000  00000000
      +000064  reserved. 00000000  reserved. 00000000  MODE..... 00000000  reserved. 00000000
      +000078  reserved. 00000000  reserved. 00000000
    CIB for main: 20FC55C8
      +000000 20FC55C8  C3C9C240 00000000 00000000 010C0004  00C3C5C5 F2F0F0F6 00030C89 59C3C5C5  |CIB .............CEE2006...i.CEE|
      +000020 20FC55E8  00000002 20FC56D8 00030C89 59C3C5C5  00000002 00000000 20FC4208 A0B09168  |.......Q...i.CEE.............j.|
      +000040 20FC5608  00000000 20FC4208 20900E34 2090E6F0  00000003 00000000 00000000 00000000  |..............W0.................|
      +000060 20FC5628  00000000 00000000 40404040 40404040  40404040 40404040 40404040 40404040  |........                        |
      +000080 20FC5648  40404040 40404040 40404040 40404040  40404040 40404040 40404040 40404040  |                                |
      +0000A0 20FC5668  40404040 40404040 40404040 00404040  40250000 940C9000 00000009 00000000  |            .    ...m...........|
      +0000C0 20FC5688  00000000 20901698 20FC4208 20FC4208  20900E32 40404040 40404040 00000001  |.......q.............        ....|
      +0000E0 20FC56A8  00000002 00000003 00000002 00000014  00000003 40404040 40404040 00000000  |....................        ....|
      +000100 20FC56C8  00000008 2090E908 40404040 40404040  E9D4C3C8 02000001 00000000 A0D9AD0C  |......Z.        ZMCH.........R..|
⋮
```

Figure 7. Example dump using CEE3DMP (Part 3 of 9)

```
  [11]Storage for Active Routines:

DSA frame: 20FC7E80
      +000000 20FC7E80  10992840 20FC7DC8 20FC80A8 A13564E0  A09F0ED0 20FC8078 20FC7F18 20FC7F78  |.r. ..'H...y.............."...".|
      +000020 20FC7EA0  213563EA 20FC7F28 21356620 00000002  2090E2A8 A09C6C34 20FC0C00 20FC5CA7  |......"...........Sy..%.......*x|
      +000040 20FC7EC0  A0A82198 209159B0 00000000 20FC80A8  209CF57F 209CE580 209159B0 20FC7F68  |.y.q.j.........y..5"..V..j....".|
      +000060 20FC7EE0  20FC7F54 20FC7F44 2090E4BC 20FC8018  2090E4C0 20FC7F78 20FC5180 209CF4D8  |.."..."...U.......U..."..."....4Q|
      +000080 20FC7F00  209CF4D4 20FC7F68 20FC8018 20FC7F54  00000000 20FC7F68 20FC7F28 20FC7F78  |..4M.."....."....."...".."...".|
      +0000A0 20FC7F20  20FC8078 00000000 E2819497 93854084  A4949740 97999684 A4838584 4082A840  |........Sample dump produced by |
      +0000C0 20FC7F40  83819393 89958740 C3C5C5F3 C4D4D740  40404040 40404040 40404040 40404040  |calling CEE3DMP                 |
      +0000E0 20FC7F60  40404040 40404040 40404040 40404040  40404040 40404040 E3C8D9C5 C1C44DC1  |                        THREAD(A|
      +000100 20FC7F80  D3D35D40 C2D3D6C3 D2E240E2 E3D6D9C1  C7C540C7 C5D5D6D7 E3E24040 40404040  |LL) BLOCKS STORAGE GENOPTS       |
      +000120 20FC7FA0  40404040 40404040 40404040 40404040  40404040 40404040 40404040 40404040  |                                 |
      +000140 20FC7FC0 - +0001DF 20FC805F            same as above
      +0001E0 20FC8060  40404040 40404040 40404040 40404040  40404040 40404000 00000000 00000000  |                        .........|
      +000200 20FC8080  00000000 00000000 2090E2D0 00000000  00000000 20FC7F28 00000000 00000000  |.........S..........."........|
      +000220 20FC80A0  00000000 00000000 00000000 20FC7E80  20FC8660 A09F1D0E A09E2838 04000000  |.............=...f-............|
    DSA frame: 20FC7DC8
      +000000 20FC7DC8  10000000 20FC4CA8 20FC8128 A0A821F4  213563B0 20FE5B40 2090E2D0 20FC55C8  |......<y..a..y.4......$ ..S....H|
      +000020 20FC7DE8  21366CE0 20FC7DC8 209C95C8 00000000  20FC7E8C 00000000 A0992B28 00000000  |..%...'H..nH......=......r......|
      +000040 20FC7E08  209C3A88 209159B0 00000000 20FC7E80  00000000 00000000 00000000 00000000  |...h.j........=.................|
      +000060 20FC7E28  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
      +000080 20FC7E48  209C95C0 20FC7E80 20FC7E93 20FC7E8C  20FC7E7C 20FC7E78 20FC7E93 A09CE6BE  |..n...=...=l..=...=@..=...=l..W.|
      +0000A0 20FC7E68  209CE580 00000073 20FC5100 2090F110  20916350 20FC4030 10992840 20FC7DC8  |..V...........1..j.&.. ..r. ..'H|
    DSA frame: 20FC4208
      +000000 20FC4208  10000000 20FC40F0 20FC42E8 A0900E1E  20DA8624 2090155C 20FC42A0 20FC42C5  |...... 0...Y......f....*.......E|
      +000020 20FC4228  209004B2 20FC42C2 20901288 20FC42CC  20FC42D0 00000030 80000000 A0E629E2  |.......B...h.................W.S|
      +000040 20FC4248  A0992840 209159B0 00000000 20FC42E8  00000000 00000000 00000000 00000000  |.r. .j.........Y................|
      +000060 20FC4268  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
      +000080 20FC4288  00000000 00000000 00000000 00000000  20FE5898 00000000 2090155C 2090154D  |...................q.......*...(|
      +0000A0 20FC42A8  00000003 20901294 213667F0 00000000  2130420C 21305434 00000000 00000000  |.......m...0....................|
      +0000C0 20FC42C8  00000000 00000002 21366CE0 00000000  00000000 00000000 20FC0C00 00000000  |..........%.....................|
    DSA frame: 20FC40F0
      +000000 20FC40F0  10AF92CC 20FC4030 20FC4294 A1366D50  A0900478 20FC4208 20FC0CA0 A0E62AB0  |..k... ....m.._&.............W..|
      +000020 20FC4110  00000002 A0992924 20914648 20903DA4  209046E8 00000030 80000000 A0E629E2  |.....r...j.....u...Y.........W.S|
      +000040 20FC4130  A0992840 209159B0 00000000 20FC4208  20914648 00000000 00000000 00000000  |.r. .j...........j..............|
      +000060 20FC4150  00000000 00000000 00100000 00000001  00000001 00000200 00000000 00000000  |................................|
      +000080 20FC4170  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
      +0000A0 20FC4190 - +0000FF 20FC41EF            same as above
      +000100 20FC41F0  00000000 00000000 00000000 00000000  00000000 00000000 10000000 20FC40F0  |............................... 0|
  [12]Control Blocks Associated with the Thread:

    CAA: 209159B0
      +000000 209159B0  00000800 00000000 20FC4018 00000000  00000000 00000000 00000000 00000000  |.......... .....................|
      +000020 209159D0  00000000 00000000 20912A58 00000000  00000000 00000000 00000000 00000000  |.........j.....................|
      +000040 209159F0  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
      +000060 20915A10  00000000 00000000 00000000 00000000  00000000 80014608 00000000 00000000  |................................|
⋮
      +0003C0 20915D70  00000000 00000000 A7F4FEE8 A7F401A0  A09B77A0 A0AAEC90 A0A079F8 A0A79F20  |........x4.Yx4.............8.x..|
      +0003E0 20915D90  20BC5B4C 21366C20 00000000 00000000  00000000 00000000 20FC7B60 20916118  |..$<..%...................#-.j/.|
    Thread Synchronization Queue Element (SQEL): 2090EFF0
      +000000 2090EFF0  00000000 00000000 00000000 00000000  20FE5920 00000008 210F79E0 00000000  |................................|
      +000020 2090F010  209159B0 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |.j..............................|
    CEEDLLF: 21366C20
      +000000  EYE...... CEEDLLF   VERSION.. 01        FLAGS.... 00        SIZE..... 0060      SERVICE.. 04
      +00000D  REFTYPE.. 02        LOADTYPE. 00        reserved. 00        padding.. 00000000  PREV..... 21366BC0
      +000018  padding.. 00000000  NEXT..... 213668C0  FBTOK_A.. 00000DF6  FBTOK_B.. 41C3C5C5  FBTOK_C.. 00000000
      +00002C  padding.. 00000000  padding.. 00000000  DLLNAME.. 21366C88  padding.. 00000000  SYMNAME.. 21366C98
      +000040  DLLNMLEN. 00000006  SYMNMLEN. 0000000F  RETCODE1. 00000000  RSNCODE1. 00000000  RETCODE2. 00000000
      +000054  RSNCODE2. 00000000  reserved. 00000000  reserved. 00000000
    CEEDLLF_DLL_NAME(21366C88)
      +0000 21366C88  C3C5D3C4 D3D30000 21365000 00000018  |CELDLL....&.....|
    CEEDLLF_SYMBOL_NAME(21366C98)
      +0000 21366C98  95819485 6D9596A3 6D89956D 84939300  |name_not_in_dll.|
    DUMMY DSA: 20916350
      +000000  FLAGS.... 0000      member... 0000      BKC...... 00006F58  FWC...... 20FC4030  R14...... A09048D6
      +000010  R15...... A0992840  R0....... 7D000009  R1....... 20FC0CA0  R2....... 00000000  R3....... 00000000
      +000024  R4....... 00000000  R5....... 00000000  R6....... 00000000  R7....... A0917778  R8....... 20903DA0
      +000038  R9....... 008DCCD0  R10...... 00000000  R11...... A0904802  R12...... 209159B0  reserved. 00000000
      +00004C  NAB...... 20FC4030  PNAB..... 20FC4030  reserved. 00000000  00000000
      +000064  reserved. 00000000  reserved. 00000000  MODE..... 00000000  reserved. 00000000
      +000078  reserved. 00000000  reserved. 00000000
⋮
```

Figure 7. Example dump using CEE3DMP (Part 4 of 9)

```
[6]Information for thread 20DAEB0000000001
[7]Traceback:
    DSA   Entry       E  Offset  Statement   Load Mod             Program Unit                  Service  Status
    1     CEEOPML2    +00353C2C              CEEPLPKA             CEEOPML2                      D1908    Call
    2     EDCOWRP2    +00000F1E              CEEEV003                                           Call
    3     thread_func +000000AE  47          CELSAMP              CELSAMP                       1.1.D    Call
    4     CEEOPCMM    +00000908              CEEBINIT             CEEOPCMM                      D1908    Call

    DSA   DSA Addr   E  Addr    PU Addr    PU Offset  Comp Date  Compile Attributes
    1     21312F50   20A4EEA0   20A4EEA0   +00353C2C  20061215   CEL       POSIX
    2     21312CC8   20DA1BAC   20DA0908   +000021C2  20061215   LIBRARY    POSIX
    3     21312C20   20901140   20901140   +000000AE  20070105   C/C++     POSIX EBCDIC  HFP
    4     21359EE0   0000E460   0000E460   +00000908  20061215   CEL       POSIX

    Fully Qualified Names
    DSA   Entry       Program Unit                                        Load Module
    3     thread_func //'POSIX.CRTL.C(CELSAMP)'                           CELSAMP
[9]Parameters, Registers, and Variables for Active Routines:
    CEEOPML2 (DSA address 21312F50):
      UPSTACK DSA
      Saved Registers:
        GPR0..... 00000001  GPR1..... 21310D78  GPR2..... 210F70E4  GPR3..... 21310D78
        GPR4..... DECEF288  GPR5..... 00000000  GPR6..... 20FC0C58  GPR7..... 20FE5920
⋮
    thread_func (DSA address 21312C20):
      UPSTACK DSA
      Parameters:
        parm             void *             0x20901288
      Saved Registers:
        GPR0..... 00000001  GPR1..... 21310D78  GPR2..... 210F70E4  GPR3..... 21310D78
        GPR4..... DECEF288  GPR5..... 00000000  GPR6..... 20FC0C58  GPR7..... 20FE5920
⋮
[10]Control Blocks for Active Routines:
    DSA for CEEOPML2: 21312F50
      +000000  FLAGS.... 0000      member... 0001      BKC...... 21312CC8  FWC...... 213130D0  R14...... A0A4FC58
      +000010  R15...... A0A50EE0  R0....... 00000000  R1....... 21312FD4  R2....... 210F70E4  R3....... 21310D78
      +000024  R4....... 20FE5944  R5....... 20A5022C  R6....... 20FC0C58  R7....... 20FE5920  R8....... 20901288
⋮
[11]Storage for Active Routines:
    DSA frame: 21312CC8
      +000000 21312CC8  10914B58 21312C20 21312F50 A0DA2ACC  A0A4EEA0 00000000 21312CB8 20FC0C58  |.j.........&.....u.............|
      +000020 21312CE8  2090117A 21312C20 20901288 21312798  20FEE128 21359FEC 00000080 8000F45F  |...:.......h...q.............4^|
⋮
[12]Control Blocks Associated with the Thread:
    CAA: 21311BD8
      +000000 21311BD8  00000800 00000000 21312C08 00000000  00000000 00000000 00000000 00000000  |................................|
      +000020 21311BF8  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
⋮
 [13]Enclave variables:
    *.*.C(CELSAMP)':>mut
                     struct
     __m              unsigned long int
                                        553539872
    *.*.C(CELSAMP)':>thread[0]
                     struct
     __[0..6]         unsigned char      '\x20'  '\xDA'  '\xEB'    '\0'    '\0'    '\0'    '\0'
     __[7]            unsigned char      '\x01'
    *.*.C(CELSAMP)':>thread[1]
                     struct
     __[0..6]         unsigned char      '\x20'  '\xDB'  '\xEB'  '\x10'    '\0'    '\0'    '\0'
     __[7]            unsigned char      '\x02'
    *.*.C(CELSAMP)':>threads_joined
                     signed int                  0
    *.*.C(CELSAMP)':>t1
                     unsigned char *    0x20901288
    *.*.C(CELSAMP)':>t2
                     unsigned char *    0x20901294
    *.*.C(CELSAMP)':>main
                     signed int (void)
                                        0x20900478
    *.*.C(CELSAMP)':>thread_func
                     void * ()          0x20901140
    *.*.C(CELSAMP)':>thread_cleanup
                     void ()            0x20900EE0
    *.*.C(CELDLL)':>wsa_array[0..6] unsigned char         'C'     'E'     'L'     'D'     'L'     'L'     ' '
    *.*.C(CELDLL)':>wsa_array[7..9]                       'W'     'S'     'A'
    *.*.C(CELDLL)':>dump_n_perc
                     void ()            0x213563B0
```

Figure 7. Example dump using CEE3DMP (Part 5 of 9)

```
[14]Enclave Control Blocks:

    EDB: 20914648
      +000000 20914648  C3C5C5C5 C4C24040 C7000001 20915870  20914D50 00000000 00000000 00000000  |CEEEDB  G....j...j(&............|
      +000020 20914668  20914B58 20914B88 A0917778 20914198  00000000 00000000 20914768 00000000  |.j...j.h.j...j.q.........j......|
      +000040 20914688  00000000 00000000 00006F58 00000000  00000000 A0A34190 2090C880 20FC0C48  |..........?.........t....H.....|
      +000060 209146A8  0000F460 210F7000 20913E58 00000000  20916550 00000000 20AF6660 209159B0  |..4-.....j.......j.&.......-.j..|
      +000080 209146C8  90000000 0000FAF6 00000000 00000000  00000002 00000000 00006FF0 008FF4E8  |.......6.................?0..4Y|
      +0000A0 209146E8  00000001 00000100 2090C988 209146F0  00000000 00000000 00000000 00000002  |..........Ih.j.0.................|
    MEML: 20915870
      +000000 20915870  00000000 00000000 20994BE8 00000000  00000000 00000000 20994BE8 00000000  |.........r.Y.............r.Y....|
      +000020 20915890  00000000 00000000 20994BE8 00000000  209118D8 00000000 A0B09168 00000000  |.........r.Y.....j.Q......j.....|
      +000040 209158B0  00000000 00000000 20994BE8 00000000  00000000 00000000 20994BE8 00000000  |.........r.Y.............r.Y....|
      +000060 209158D0 - +00011F 2091598F            same as above
    Mutex and Condition Variable Blocks (MCVB+MHT+CHT): 210F7018
      +000000 210F7018  00008F50 210F7044 000003F8 00001FC0  00000000 20FC3088 210F7444 000000F8  |...&.......8...........h.......8|
      +000020 210F7038  000007C0 00000000 20FC30A0 00000000  00000000 00000000 00000000 00000000  |................................|
      +000040 210F7058  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
⋮
      +000460 210F7478  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
      +000480 210F7498 - +00053F 210F7557            same as above
    Thread Synchronization Enclave Latch Table (EPALT): 210F7544
      +000000 210F7544  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
      +000020 210F7564 - +00009F 210F75E3            same as above
      +0000A0 210F75E4  00000000 00000000 00000000 00000000  00000000 DF6F1010 2090EFF0 210F7850  |.....................?.....0...&|
⋮
      +000640 210F7B84  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
      +000660 210F7BA4 - +0009FF 210F7F43            same as above
    DLL Information:
    WSA Addr  Module Addr  Thread ID         Use Count  Name
    20FE5B40  213562F0     20DA9FB000000000  00000001   CELDLL
    HEAPCHK Option Control Block (HCOP): 20FC00D0
      +000000 20FC00D0  C8C3D6D7 00000038 00000001 00000000  00000000 0000000A 0000000A 00000000  |HCOP............................|
      +000020 20FC00F0  2138B028 20FC0108 21102028 00000000  00000000 00000000 C8C3C6E3 00000200  |.......................HCFT....|
    HEAPCHK Element Table (HCEL) for Heapid 21384F9C :
    Header: 2138B028
      +000000 2138B028  C8C3C5D3 21368028 00000000 21384F9C  000001F4 00000006 00000006 00000000  |HCEL..........|....4............|
                        Address  Seg Addr Length             Address  Seg Addr Length
    Table: 2138B048
      +000000 2138B048  2138A020 2138A000 00000050 2136D760  2138A070 2138A000 00000028 2136D888  |...........&..P-..............Qh|
      +000020 2138B068  2138A098 2138A000 00000108 2136D9B0  2138A1A0 2138A000 00000050 2136DAD8  |...q..........R............&...Q|
      +000040 2138B088  2138A1F0 2138A000 00000028 2136DC00  2138D020 2138D000 00000408 2136DD28  |...0............................|
    HEAPCHK Element Table (HCEL) for Heapid 21366FC4 :
    Header: 21368028
      +000000 21368028  C8C3C5D3 20FC0CE0 2138B028 21366FC4  000001F4 00000001 00000001 00000000  |HCEL..........?D...4............|
                        Address  Seg Addr Length             Address  Seg Addr Length
    Table: 21368048
      +000000 21368048  21367020 21367000 000002A8 20FC3310  00000000 00000000 00000000 00000000  |...........y....................|
    HEAPCHK Element Table (HCEL) for Heapid 00000000 :
    Header: 20FC0CE0
      +000000 20FC0CE0  C8C3C5D3 00000000 21368028 00000000  000001F4 00000005 00000005 00000000  |HCEL..............4............|
                        Address  Seg Addr Length             Address  Seg Addr Length
    Table: 20FC0D00
      +000000 20FC0D00  20FE4038 20FE4018 00001028 20FC2C48  20FE5060 20FE4018 00000828 20FC2D10  |.. ... ...........&-.. .........|
      +000020 20FC0D20  20FE5888 20FE4018 00000CC8 20FC2DE8  20FE6550 20FE4018 00002028 20FC2F18  |...h.. ....H...Y...&.. .........|
      +000040 20FC0D40  20FE8578 20FE4018 00000CC8 21366EA8  00000000 00000000 00000000 00000000  |..e... ....H..>y................|

WSA address.................20FC0C00
    Heap Storage Diagnostics
      Stg Addr  ID        Length      Entry         E Addr    E Offset    Load Mod
      2138A020  21384F9C  00000050                  20AB53F8  +00000000   CEEPLPKA
                                    CEEV#GTS      20AB53C8  +0001EF84   CEEPLPKA
                                    CEEVGTST      20AC65E0  +00000072   CEEPLPKA
                                    identify_cu   20D6F778  +0000055A   CEEEV003
                                    SetDumpVars   20D79000  +00000204   CEEEV003
                                    __zdmpd       20E4B9C0  +000002E4   CEEEV003
                                    CEEKDMDR      209E2838  +00003D68   CEEPLPKA
                                    CEEKDUMP      209F0ED0  +00000E3C   CEEPLPKA
                                    dump_n_perc   213563B0  +0000012E   CELDLL
                                    CEEPGTFN      20A82198  +0000005A   CEEPLPKA

       2138A070  21384F9C  00000028                  20AB53F8  +00000000   CEEPLPKA
                                    CEEV#GTS      20AB53C8  +0001EF84   CEEPLPKA
                                    CEEVGTST      20AC65E0  +00000072   CEEPLPKA
                                    identify_cu   20D6F778  +00000686   CEEEV003
                                    SetDumpVars   20D79000  +00000204   CEEEV003
                                    __zdmpd       20E4B9C0  +000002E4   CEEEV003
                                    CEEKDMDR      209E2838  +00003D68   CEEPLPKA
                                    CEEKDUMP      209F0ED0  +00000E3C   CEEPLPKA
                                    dump_n_perc   213563B0  +0000012E   CELDLL
                                    CEEPGTFN      20A82198  +0000005A   CEEPLPKA
```

Figure 7. Example dump using CEE3DMP (Part 6 of 9)

```
⋮
     20FE8578  00000000  00000CC8                 20AB53F8  +00000000   CEEPLPKA
                                 CEEV#GTS        20AB53C8  +0001EF84   CEEPLPKA
                                 CEEVGQT         20AC3008  +0000026A   CEEPLPKA
                                 flocks          20D8C398  +00000228   CEEEV003
                                 _fopen          20C50CE0  +000001F2   CEEEV003
                                 fopen           20C50F50  +0000006C   CEEEV003
                                 EDCOWRP3        20DA860C  +0000121A   CEEEV003
                                 main            20900478  +000007BC   CELSAMP
                                 EDCZMINV        20E629EE  -FFAB3B58   CEEEV003
                                 CEEBBEXT        20992840  +000001B6   CEEPLPKA

   Language Environment Trace Table:

     Most recent trace entry is at displacement: 002780
         Displacement                      Trace Entry in Hexadecimal                                  Trace Entry in EBCDIC
         ------------ ------------------------------------------------------------------------  --------------------------------
           +000000    Time 04.22.34.474835    Date 2007.01.06    Thread ID... 20DA9FB000000000
           +000010    Member ID.... 03    Flags..... 000000    Entry Type..... 00000001
           +000018    94818995 40404040 40404040 40404040  40404040 40404040 40404040 40404040  |main                            |
           +000038    60606E4D F0F8F55D 40979989 95A3864D  5D404040 40404040 40404040 40404040  |-->(085) printf()                |
           +000058    40404040 40404040 40404040 40404040  40404040 40404040 40404040 40404040  |                                |
           +000078    40404040 40404040                                                         |                                |

           +000080    Time 04.22.34.478351    Date 2007.01.06    Thread ID... 20DA9FB000000000
           +000090    Member ID.... 03    Flags..... 000000    Entry Type..... 00000002
           +000098    4C60604D F0F8F55D 40D9F1F5 7EF0F0F0  F0F0F0F0 C540C5D9 D9D5D67E F0F0F0F0  |<--(085) R15=0000000E ERRNO=0000|
           +0000B8    F0F0F0F0 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |0000............................|
           +0000D8    00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
           +0000F8    00000000 00000000                                                         |........                        |
⋮
           +002700    Time 04.22.34.494829    Date 2007.01.06    Thread ID... 20DA9FB000000000
           +002710    Member ID.... 03    Flags..... 000000    Entry Type..... 00000002
           +002718    4C60604D F0F8F55D 40D9F1F5 7EF0F0F0  F0F0F0F0 F040C5D9 D9D5D67E F0F0F0F0  |<--(085) R15=00000000 ERRNO=0000|
           +002738    F0F0F0F0 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |0000............................|
           +002758    00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
           +002778    00000000 00000000                                                         |........                        |

           +002780    Time 04.22.34.497209    Date 2007.01.06    Thread ID... 20DBEB1000000002
           +002790    Member ID.... 01    Flags..... 000000    Entry Type..... 00001910
           +002798    20DBEB10 00000002 21335798 21335740  80000000 00000000 00000000 00000000  |...........q... ................|
           +0027B8    00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
           +0027D8    00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
           +0027F8    00000000 00000000                                                         |........                        |
[15]Enclave Storage:
  Initial (User) Heap                                  : 20FE4018
       +000000 20FE4018  C8C1D5C3 20914B28 20914B28 00000000  A0FE4018 20FE9240 00008000 00002DD8  |HANC.j...j........ ...k .......Q|
       +000020 20FE4038  20FE4018 00001028 00000005 00000005  20FE5068 20FE5250 20FE528D 20FE52CA  |.. ..............&....&........|
       +000040 20FE4058  20FE5307 20FE5344 20FE5381 20FE53BE  20FE53FB 20FE5808 20FE5845 00000000  |...........a....................|
       +000060 20FE4078  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
       +000080 20FE4098  00000000 00000000 00000000 00000000  00000000 00000000 00000000 20FE5438  |...............................C|
       +0000A0 20FE40B8  20FE5475 20FE54B2 20FE54EF 20FE552C  20FE5569 20FE55A6 20FE55E3 00000000  |.......................w...T....|
⋮
       +004560 20FE8578  20FE4018 00000CC8 00000001 00000001  20FE5BC8 00000000 00000001 00000001  |.. ....H..........$H............|
       +004580 20FE8598  20FE5C50 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |..*&............................|
       +0045A0 20FE85B8  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
       +0045C0 20FE85D8 - +007FFF 20FEC017             same as above
    LE/370 Anywhere Heap                                   : 20FC0000
       +000000 20FC0000  C8C1D5C3 20FED000 20914B58 20914B58  A0FC0000 20FC3500 00004000 00000B00  |HANC.....j...j..... ..... .....|
       +000020 20FC0020  20FC0000 00000018 D2C4C240 00000000  00000000 00000000 20FC0000 00000090  |........KDB ....................|
       +000040 20FC0040  E3E5C240 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |TVB ............................|
⋮

       +0034E0 20FC34E0  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
       +003500 20FC3500 - +003FFF 20FC3FFF             same as above
    LE/370 Anywhere Heap                                   : 20FED000
       +000000 20FED000  C8C1D5C3 210F9000 20FC0000 20914B58  20FED000 00000000 00100028 00000000  |HANC.........j..................|
       +000020 20FED020  20FED000 00100008 BFF67D46 D755378E  20DA9FB0 00000000 03000000 00000001  |.........6'.P...................|
       +000040 20FED040  94818995 40404040 40404040 40404040  40404040 40404040 40404040 40404040  |main                            |
⋮
    Additional Heap, heapid = 21384F9C                     : 2138A000
       +000000 2138A000  C8C1D5C3 2138D000 21384F9C 21384F9C  2138A000 2138A218 000003E8 000001D0  |HANC......|...|.......s....Y....|
       +000020 2138A020  2138A000 00000050 00000000 21356E38  213563B0 2138A0A0 20912178 46F11000  |.......&......>.........j...1..|
       +000040 2138A040  00000003 00000000 00040000 2138A078  00000000 21356390 21356390 00000000  |................................|
       +000060 2138A060  213567BC 21356390 00000000 00000000  2138A000 00000028 00186161 7DD7D6E2  |.........................//'POS|
⋮
```

Figure 7. Example dump using CEE3DMP (Part 7 of 9)

```
[16]File Status and Attributes:
.
.
.
[17]Run-Time Options Report:

   LAST WHERE SET                OPTION
   ------------------------------------------------------------------------------
   Installation default            ABPERC(NONE)
   Installation default            ABTERMENC(ABEND)
   Installation default          NOAIXBLD
   Installation default            ALL31(ON)
   Installation default            ANYHEAP(16384,8192,ANYWHERE,FREE)
   Installation default          NOAUTOTASK
   Installation default            BELOWHEAP(8192,4096,FREE)
   Installation default            CBLOPTS(ON)
   Installation default            CBLPSHPOP(ON)
   Installation default            CBLQDA(OFF)
   Installation default            CEEDUMP(60,SYSOUT=*,FREE=END,SPIN=UNALLOC)
   Installation default            CHECK(ON)
   Installation default            COUNTRY(US)
   Installation default          NODEBUG
   Installation default            DEPTHCONDLMT(10)
   DD:CEEOPTS                      DYNDUMP(POSIX.HEALY.ZOS19,DYNAMIC,TDUMP)
   Installation default            ENVAR("")
   Installation default            ERRCOUNT(0)
   Installation default            ERRUNIT(6)
   Installation default            FILEHIST
   Installation default            FILETAG(NOAUTOCVT,NOAUTOTAG)
   Default setting               NOFLOW
   Installation default            HEAP(32768,32768,ANYWHERE,KEEP,8192,4096)
   Programmer default              HEAPCHK(ON,1,0,10,10)
   Programmer default              HEAPPOOLS(ON,8,10,32,10,128,10,256,10,1024,10,2048,10,0,10,0,10,0,10,0,10,0,10,0,10,0,10)
   Installation default            INFOMSGFILTER(OFF,,,,)
   Installation default            INQPCOPN
   Installation default            INTERRUPT(OFF)
   Installation default            LIBSTACK(4096,4096,FREE)
   Installation default            MSGFILE(SYSOUT,FBA,121,0,NOENQ)
   Installation default            MSGQ(15)
   Installation default            NATLANG(ENU)
   Ignored                       NONONIPTSTACK(See THREADSTACK)
   Installation default            OCSTATUS
   Installation default          NOPC
   Installation default            PLITASKCOUNT(20)
   Programmer default              POSIX(ON)
   Installation default            PROFILE(OFF,"")
   Installation default            PRTUNIT(6)
   Installation default            PUNUNIT(7)
   Installation default            RDRUNIT(5)
   Installation default            RECPAD(OFF)
   Installation default            RPTOPTS(OFF)
   Programmer default              RPTSTG(ON)
   Installation default          NORTEREUS
   Installation default          NOSIMVRD
   Installation default            STACK(131072,131072,ANYWHERE,KEEP,524288,131072)
   Installation default            STORAGE(NONE,NONE,NONE,0)
   Programmer default              TERMTHDACT(UADUMP,,96)
   Installation default          NOTEST(ALL,"*","PROMPT","INSPPREF")
   Installation default            THREADHEAP(4096,4096,ANYWHERE,KEEP)
   Installation default            THREADSTACK(OFF,4096,4096,ANYWHERE,KEEP,131072,131072)
   Programmer default              TRACE(ON,1048576,NODUMP,LE=1)
   Installation default            TRAP(ON,SPIE)
   Installation default            UPSI(00000000)
   Installation default          NOUSRHDLR(,)
   Installation default            VCTRSAVE(OFF)
   Installation default            XPLINK(OFF)
   Installation default            XUFLOW(AUTO)
```

Figure 7. Example dump using CEE3DMP (Part 8 of 9)

```
[18]Process Control Blocks:

  PCB: 20914198
    +000000 20914198  C3C5C5D7 C3C24040 03030288 00000000  00000000 00000000 209143D0 A0AF94D0  |CEEPCB  ...h.............j....m.|
    +000020 209141B8  A0AEFB50 A0AF6A08 A0AF6528 2090AAE8  20913F68 00000000 00000000 20914648  |...&...........Y.j...........j..|
    +000040 209141D8  A0AF6858 7F800000 00000000 000141D4  00000000 80000000 A0A5C1E0 00000000  |....".........M.........vA.....|

  MEML: 209143D0
    +000000 209143D0  00000000 00000000 20994BE8 00000000  00000000 00000000 20994BE8 00000000  |.........r.Y.............r.Y....|
    +000020 209143F0  00000000 00000000 20994BE8 00000000  2090FE68 00000000 A0B09168 20FC0000  |.........r.Y.............j.....|
    +000040 20914410  00000000 00000000 20994BE8 00000000  00000000 00000000 20994BE8 00000000  |.........r.Y.............r.Y....|
    +000060 20914430 - +00011F 209144EF             same as above

  Thread Synchronization Process Latch Table (PPALT): 210F7F44
    +000000 210F7F44  DF6F1010 2090EFF0 210F77EC 00000000  00000000 00000000 00000000 00000000  |.?.....0.......................|
    +000020 210F7F64  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
    +000040 210F7F84  00000000 00000000 00000000 00000000  DF6F1010 2090EFF0 210F7A44 00000000  |.................?.....0..:.....|
    +000060 210F7FA4  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
    +000080 210F7FC4 - +0009FF 210F8943             same as above

[19]Additional Language Specific Information:

  errno information :
  Thread Id .... 20DA9FB000000000 Errno ...... 0 Errnojr .... 00000000
[20]CEE3846I CEEDUMP Processing completed.
```

Figure 7. Example dump using CEE3DMP (Part 9 of 9)

Sections of the Language Environment dump

The sections of the dump listed here appear independently of the Language Environment-conforming languages used. Each conforming language adds language-specific storage and file information to the dump.

For a detailed explanation of language-specific dump output:

- For C/C++ routines, see “Finding C/C++ information in a Language Environment dump” on page 196.
- For COBOL routines, see “Finding COBOL information in a dump” on page 245.
- For Fortran routines, see “Finding Fortran information in a Language Environment dump” on page 271.
- For PL/I routines, see “Finding PL/I for MVS & VM information in a dump” on page 291.

[1] Page Heading

The page heading section appears on the top of each page of the dump and contains:

- CEE3DMP identifier
- Title

  For dumps generated as a result of an unhandled condition, the title is “Condition processing resulted in the Unhandled condition.”
- Product abbreviation of Language Environment
- Version number
- Release number
- Date
- Time
- Page number

The contents of the second line of the page heading vary depending on the environment in which the CEEDUMP is issued.

For CEEDUMPs produced under a batch environment, the following items are displayed:

- ASID: Describes the address space ID.
- Job ID: Describes the JES Job ID.
- Job name: Describes the job name.
- Step name: Describes the job's step name in which the CEEDUMP was produced.
- UserID: Describes the TSO userid who issued the job.

For jobs running with POSIX(ON), the following additional items are displayed:

- PID: Displays the associated process ID.
- Parent PID: Displays the associated parent PID.

For CEEDUMPs produced under the z/OS UNIX shell, the following items are displayed:

- ASID: Describes the address space ID.
- PID: Displays the associated process ID.
- Parent PID: Displays the associated parent PID.
- User name: Contains the userid associated to the CEEDUMP.

For CEEDUMPs produced under CICS, the following items are displayed:

- Transaction ID and task number.

[2] CEE3845I CEEDUMP Processing started.

Message CEE3845I identifies the start of the Language Environment dump processing. Similarly, message CEE3846I identifies the end of the dump processing, Message number CEE3845I can be used to locate the start of the next CEEDUMP report when scanning forward in a data set that contains several CEEDUMP reports.

[3] Caller Program Unit and Offset

This information identifies the routine name and offset in the calling routine of the call to the dump service.

[4] Registers on Entry to CEE3DMP

This section of the dump shows data at the time of the call to the dump service.

- Program mask

  The program mask contains the bits for the fixed-point overflow mask, decimal overflow mask, exponent underflow mask, and significance mask.
- General purpose registers (GPRs) 0–15

  On entry to CEE3DMP, the GPRs contain:

GPR 0	Working register
GPR 1	Pointer to the argument list
GPR 2–11	Working registers
GPR 12	Address of CAA
GPR 13	Pointer to caller's stack frame
GPR 14	Address of next instruction to run if the ALL31 run-time option is set to ON
GPR 15	Entry point of CEE3DMP
- Floating point registers (FPRs) 0 through 15

- Storage pointed to by General Purpose Registers

  Treating the contents of each register as an address, 32 bytes before and 64 bytes after the address are shown.

[5] - [17] Enclave Information

These sections show information that is specific to an enclave. When multiple enclaves are dumped, these sections will appear for each enclave.

[5] Enclave Identifier

This statement names the enclave for which information in the dump is provided. If multiple enclaves exist, the dump service generates data and storage information for the most current enclave, followed by previous enclaves in a last-in-first-out (LIFO) order. For more information about dumps for multiple enclaves, see “Multiple enclave dumps” on page 79.

[6] - [12] Thread Information

These sections show information that is specific to a thread. When multiple threads are dumped, these sections will appear for each thread.

[6] Information for thread

This section shows the system identifier for the thread. Each thread has a unique identifier.

[7] Traceback

In a multithread case, the traceback reflects only the current thread. For all active routines, the traceback section shows routine information in three parts. The first part contains:

- DSA number

  A number assigned to the information for this active routine by dump processing. The number is used to associate information from the first part of the traceback with information in the second and third parts of the traceback.
- Entry

  For COBOL, Fortran, PL/I, and Enterprise PL/I for z/OS routines, this is the entry point name. For C/C++ routines, this is the function name. If a function name or entry point was not specified for a particular routine, the string ’** NoName **’ will appear.
- Entry point offset
- Statement number

  Refers to the line number in the source code (program unit) in which a call was made or an exception took place (see Status column). The statement number appears only if your routine was compiled with the options required to generate statement numbers.
- Load module

  The load module name displayed can be a partitioned data set member or an UNIX executable file. The load module name is also displayed in the third part of the traceback.
- Program unit

For COBOL programs, program unit is the PROGRAM-ID name. For C, Fortran, and PL/I routines, program unit is the compile unit name. For Language Environment-conforming assemblers, program unit is either the EPNAME = value on the CEEPPA macro, or a fully qualified path name.

If the program unit name is available to Language Environment (for example, for C/C++, the routine was compiled with TEST(SYM)), the program unit name will appear under this column, according to the following rules:

- If your compiled routine is in a partitioned data set, only the member will be output.
- If your compiled routine is in a sequential data set, only the last qualifier will be shown.
- If your compiled routine is in an UNIX filename, only what fits of the filename will be displayed in a line.

- Service level

  The latest service level applied to the compile unit (for example, for IBM products, it would be the PTF number).

- Status

  Routine status can be 'call' or 'exception'.

The second part contains:

- DSA number

  A number assigned to the information for this active routine by dump processing. The number is used to associate information from the first part of the traceback with information in the second and third parts of the traceback.

- Stack frame (DSA) address
- Entry point address
- Program unit address
- Program unit offset

  The offset of the last instruction to run in the routine. If the offset is a negative number, zero, or a very large positive number, the routine associated with the offset probably did not allocate a save area or could have been called using SVC-assisted linkage. Adding the program unit address to the offset gives the location of the current instruction in the routine. This offset is from the starting address of the routine.

- Compile Date

  Contains the year, month and day in which the routine was compiled.

- Attributes

  The available compilation attributes of the compile unit including:

  - A label identifying the LE-supported language such as COBOL, ENT PL/I, C/C++, and so on.
  - Compilation attributes such as EBCDIC, ASCII, IEEE or hexadecimal floating point (HFP). The compilation attributes will only be displayed if there is enough information available.
  - If the CEEDUMP was created under a POSIX environment, POSIX will be displayed.

The third part of the traceback, which is also referred to as 'Fully Qualified Names' section, contains the following:

- DSA number
- Entry
- Program unit

Similar to the Program Unit column in part 1 except that the server name and the complete program unit (PU) name will be displayed. A PU name will appear here only if it is available to Language Environment.

- Load Module

  The complete pathname of a load module name residing in an UNIX filename will be displayed here if available. The load module's full pathname will be displayed if the PATH environment variable is set such that the pathname of the load module's directory appears before the current directory (.). For load modules found in data sets, the same output shown in the traceback part 1 will also be displayed here.

[8] Condition Information for Active Routines

This section displays the following information for all conditions currently active on the call chain:

- Statement showing failing routine and stack frame address of routine
- Condition information block (CIB) address
- Current condition, in the form of a Language Environment message for the condition raised or a Language Environment abend code, if the condition was caused by an abend
- Location

  For the failing routine, this is the program unit, entry routine, statement number, and offset.
- Machine state, which shows:
  - Instruction length counter (ILC)
  - Interruption code
  - *Program status word (PSW)*
  - Contents of GPRs 0–15
  - Storage dump near condition (2 hex-bytes of storage near the PSW)
  - Storage pointed to by General Purpose Registers
  - Contents of access registers, if available

  These values are the current values at the time the condition was raised.

[9] Parameters, Registers, and Variables for Active Routines

For each active routine, this section shows:

- Routine name and stack frame address
- Arguments

  For C/C++ and Fortran, arguments are shown here rather than with the local variables. For COBOL, arguments are shown as part of local variables. PL/I arguments are not displayed in the Language Environment dump.
- Saved registers

  This lists the contents of GPRs 0–15 at the time the routine transferred control.
- Storage pointed to by the saved registers

  Treating the saved contents of each register as an address, 32 bytes before and 64 bytes after the address shown.
- Local variables

  This section displays the local variables and arguments for the routine. This section also shows the variable type. Variables are displayed only if the symbol tables are available. To generate a symbol table and display variables, use the following compile options:

- For C, use TEST(SYM).
- For C++, use TEST.
- For VS COBOL II, use FDUMP.
- For COBOL/370, use TEST(SYM).
- For COBOL for OS/390 & VM, use TEST(SYM).
- For Enterprise COBOL for z/OS, use TEST(SYM)
- For Fortran, use SDUMP.
- For PL/I, arguments and variables are not displayed.

[10] Control Blocks for Active Routines

For each active routine controlled by the STACKFRAME option, this section lists contents of related control blocks. The Language Environment-conforming language determines which language-specific control blocks appear. The possible control blocks are:

- Stack frame
- Condition information block
- Language-specific control blocks

[11] Storage for Active Routines

This displays local storage for each active routine. The storage is dumped in hexadecimal, with EBCDIC translations on the right side of the page. There can be other information, depending on the language used. For C/C++ routines, this is the stack frame storage. For COBOL programs, this is language-specific information, WORKING-STORAGE, and LOCAL-STORAGE.

[12] Control Blocks Associated with the Thread

This section lists the contents of the Language Environment common anchor area (CAA), thread synchronization queue element (SQEL), DLL failure data, and dummy stack frame. Other language-specific control blocks can appear in this section. DLL failure data is described in “Using the DLL failure control block” on page 78.

[13] Enclave variables:

This section displays language specific global variables. This section also shows the variable type. Variables are displayed only if the symbol tables are available.

[14] Enclave Control Blocks

This section lists the contents of the Language Environment enclave data block (EDB) and enclave member list (MEML). The information presented may vary depending on which run-time options are set.

- If the POSIX run-time option is set to ON, this section lists the contents of the mutex and condition variable control blocks, the enclave level latch table, and the thread synchronization trace block and trace table.
- If DLLs have been loaded, this section shows information for each DLL including the DLL name, load address, use count, writeable static area (WSA) address, and the thread id of the thread that loaded the DLL.
- If the HEAPCHK run-time option is set to ON, this section shows the contents of the HEAPCHK options control block (HCOP) and the HEAPCHK element tables (HCEL). A HEAPCHK element table contains the location and length of all allocated storage elements for a heap in the order that they were allocated.

- When the *call-level* suboption of the HEAPHCK run-time option is set, any unfreed storage, which would indicate a storage leak, would be displayed in this area. The traceback could then be used to identify the program which did not free the storage.
- If the TRACE run-time option is set to ON, this section shows the contents of the Language Environment trace table.

Other language-specific control blocks can appear in this section.

[15] Enclave Storage

This section shows the Language Environment heap storage. For C/C++ and PL/I routines, heap storage is the dynamically allocated storage. For COBOL programs, it is the storage used for WORKING-STORAGE data items. This section also shows the writeable static area (WSA) storage for program objects. Other language-specific storage can appear in this section.

[17] Run-Time Options Report

This section lists the Language Environment run-time options in effect when the routine was executed.

[18] Process Control Blocks

This section lists the contents for the Language Environment process control block (PCB), process member list (MEML), and if the POSIX run-time option is set to ON, the process level latch table. Other language-specific control blocks can appear in this section.

[19] Additional Language Specific Information:

This section displays any additional information not included in other sections. For C/C++, it shows the thread id of the thread that generated the dump and the settings of the errno and errnojr variables for that thread.

[20] CEE3846I CEEDUMP Processing completed.

Message CEE3846I identifies the end of the Language Environment dump processing. Similarly, message CEE3845I identifies the start of the dump processing, Message number CEE3846I can be used to locate the end of the previous CEEDUMP report when scanning backward in a data set that contains several CEEDUMP reports.

Debugging with specific sections of the Language Environment dump

The following sections describe how you can use particular blocks of the dump to help you debug errors.

The tracebacks, condition information, and data values section

The CEE3DMP call with dump options TRACEBACK, CONDITION, and VARIABLES generates output that contains a traceback, information about any conditions, and a list of arguments, registers, and variables.

The traceback, condition, and variable information provided in the Language Environment dump can help you determine the location and context of the error without any additional information. The traceback section includes a sequential list for all active routines and the routine name, statement number, and offset where the

exception occurred. The condition information section displays a message describing the condition and the address of the condition information block. The arguments, registers, and variables section shows the values of your arrays, structures, arguments, and data during the sequence of calls in your application. Static data values do not appear. Single quotes indicate character fields.

These sections of the dump are shown in Figure 7 on page 48.

The upward-growing (non-XPLINK) stack frame section

The stack frame, also called dynamic save area (DSA), for each active routine is listed in the full dump.

A stack frame chain is associated with each thread in the run-time environment and is acquired every time a separately compiled procedure or block is entered. A stack frame is also allocated for each call to a Language Environment service. All stack frames are back-chained with a stopping stack frame (also called a dummy DSA) as the first stack frame on the stack. Register 13 addresses the recently active stack frame or a standard register save area (RSA). The standard save area back chain must be initialized, and it holds the address of the previous save area. Not all Language Environment-conforming compilers set the forward chain; thus, it cannot be guaranteed in all instances. Calling routines establish the member-defined fields.

When a routine makes a call, registers 0–15 contain the following values:

- R1 is a pointer to parameter list or 0 if no parameter list passed.
- R0, R2–R11 is unreferenced by Language Environment. Caller's values are passed transparently.
- R12 is the pointer to the CAA if entry to an external routine.
- R13 is the pointer to caller's stack frame.
- R14 is the return address.
- R15 is the address of the called entry point.

With an optimization level other than 0, C/C++ routines save only the registers used during the running of the current routine. Non-Language Environment RSAs can be in the save area chain. The length of the save area and the saved register contents do not always conform to Language Environment conventions. For a detailed description of stack frames Language Environment storage management, see *z/OS Language Environment Programming Guide*. Figure 8 on page 64 shows the format of the upward-growing stack frame.

Note: The *Member-defined* fields are reserved for the specific higher level language.

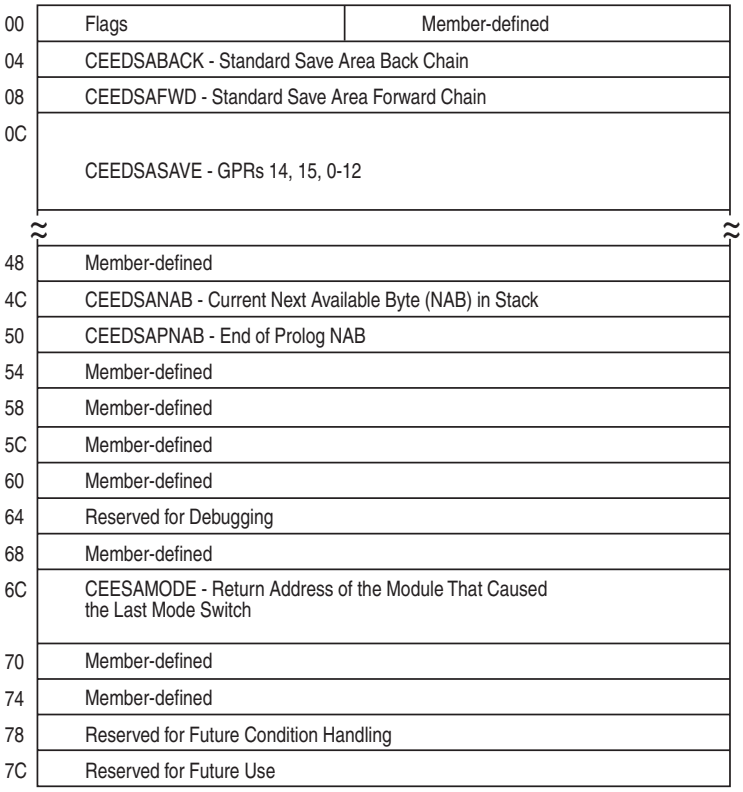


Figure 8. Upward-growing (non-XPLINK) stack frame format

The downward-growing (XPLINK) stack frame section

Figure 9 on page 65 shows the format of the downward-growing stack frame.

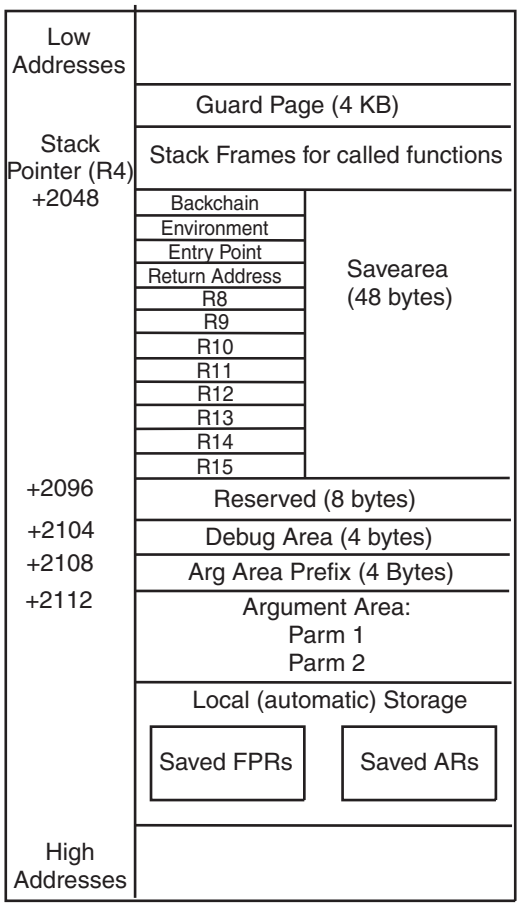


Figure 9. Downward-growing (XPLINK) stack frame format

For detailed information about the downward-growing stack, register conventions and parameter passing conventions, see *z/OS Language Environment Programming Guide*.

The Common Anchor Area

Each thread is represented by a common anchor area (CAA), which is the central communication area for Language Environment. All thread- and enclave-related resources are anchored, provided for, or can be obtained through the CAA. The CAA is generated during thread initialization and deleted during thread termination. When calling Language Environment-conforming routines, register 12 points to the address of the CAA.

Use CAA fields as described. Do not modify fields and do not use routine addresses as entry points, except as specified. Fields marked ‘Reserved’ exist for migration of specific languages, or internal use by Language Environment. Language Environment defines their location in the CAA, but not their use. Do not use or reference them except as specified by the language that defines them.

Figure 10 on page 66 shows the format of the Language Environment CAA.

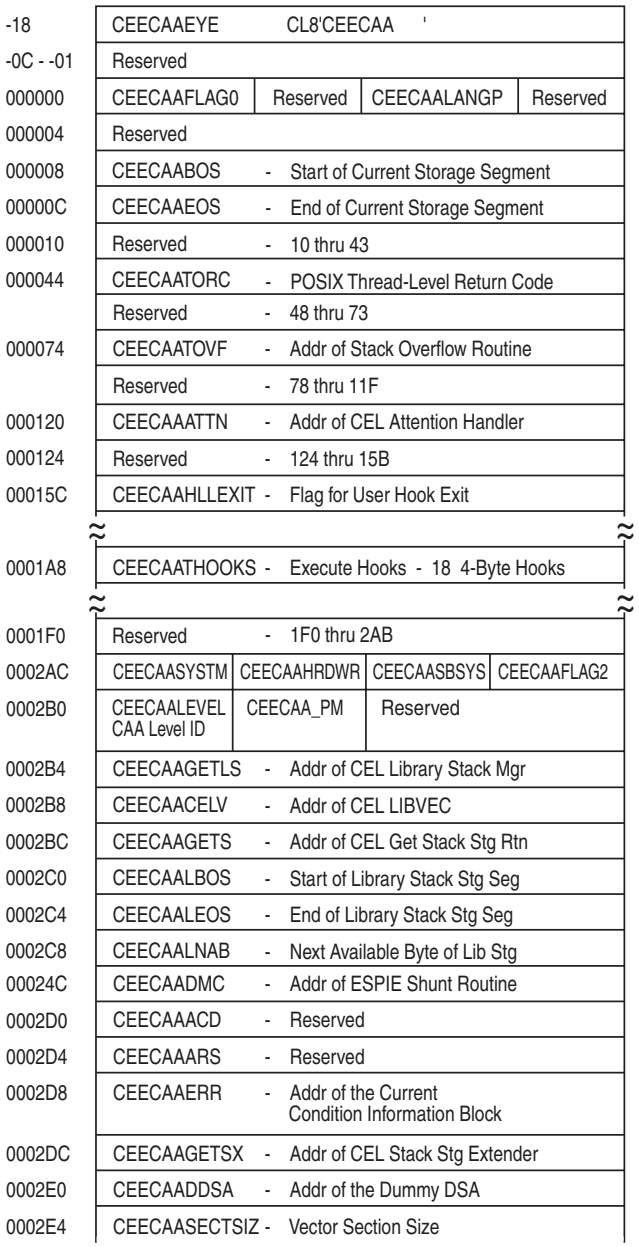


Figure 10. Common anchor area (Part 1 of 2)

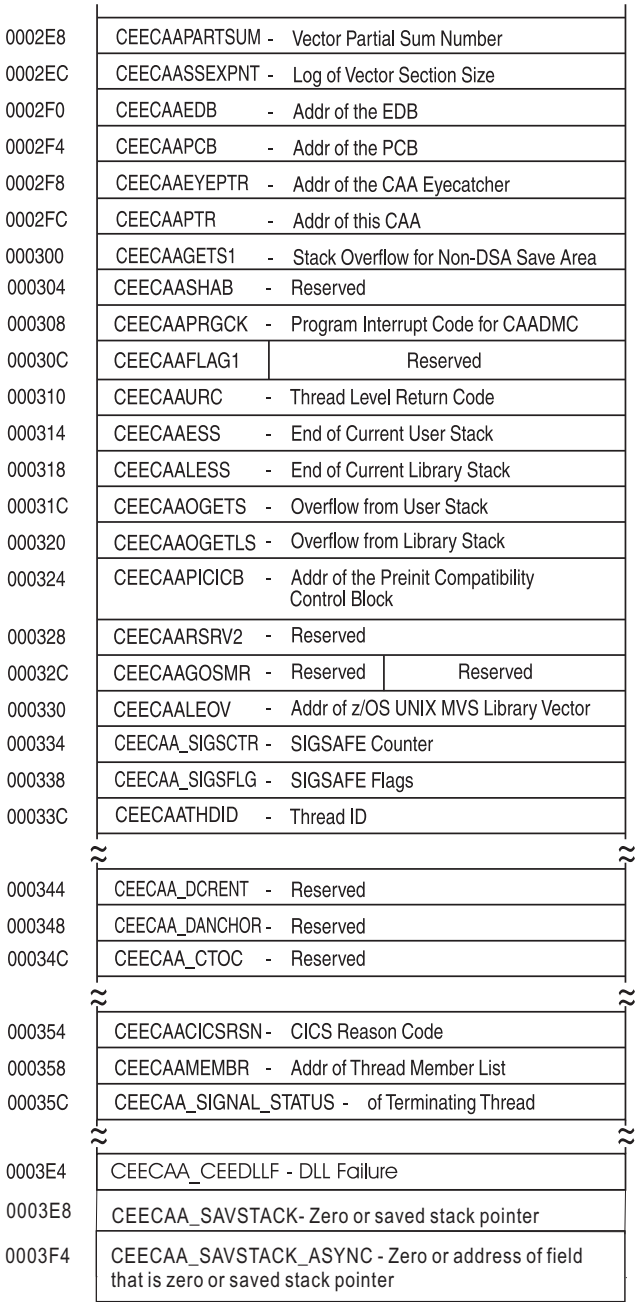


Figure 10. Common anchor area (Part 2 of 2)

Table 7 contains a list of CAA fields:

Table 7. List of CAA fields

CAA Field	Explanation
CEECAA_CEEDLLF	Address of the newest CEEDLLF control block.

Table 7. List of CAA fields (continued)

CAA Field	Explanation
CEECAAFLAG0	CAA flag bits. The bits are defined as follows: **Bit** **Description** **0–5** Reserved **6** CEECAAXHDL. A flag used by the condition handler. If the flag is set to 1, the application requires immediate return/percolation to the system on any interrupt or condition handler event. **7** Reserved
CEECAALANGP	PL/I language compatibility flags external to Language Environment. The bits are defined as follows: **Bit** **Description** **0–3** Reserved **4** CEECAATHFN. A flag set by PL/I to indicate a PL/I FINISH ON-unit is active. If the flag is set to 1, no PL/I FINISH ON-unit is active. If the flag is set to 0, a PL/I FINISH ON-unit could be active. **5–7** Reserved
CEECAABOS	Start of the current storage segment. This field is initially set during thread initialization. It indicates the start of the current stack storage segment. It is altered when the current stack storage segment is changed.
CEECAAEOS	This field is used to determine if a stack overflow routine must be called when allocating storage from the user stack. Normally, the value of this field will represent the end of the current user stack segment. However, its value can also be zero to force the call of a stack overflow routine for every allocation of storage from the user stack. This field is used by function prologs that do not use FASTLINK linkage conventions.
CEECAATORC	Thread level return code. The thread level return code set by CEESRC callable service.
CEECAATOVF	Address of stack overflow routine.
CEECAAATTN	Address of the Language Environment attention handling routine. The address of the Language Environment attention handling routine supports common run-time environment's polling code convention for attention processing.
CEECAAHLLEXIT	Address of the Exit List Control Block set by the HLL user exit CEEBINT.
CEECAAHOOKS	Hook area. This is the start of 18 fullword execute hooks. Language Environment initializes each fullword to X'07000000'. The hooks can be altered to support various debugging hook mechanisms.

Table 7. List of CAA fields (continued)

CAA Field	Explanation
CEECAASYSTM	Underlying operating system. The value indicates the operating system supporting the active environment. **Value** **Operating System** **0** Undefined. This value should not appear after Language Environment is initialized. **1** Unsupported **3** z/OS
CEECAAHRDWR	Underlying hardware. This value indicates the type of hardware on which the routine is running. **Value** **Hardware** **0** Undefined. This value should not appear after Language Environment is initialized. **1** Unsupported **2** System/370™, non-XA **3** System/370, XA **4** System/370, ESA
CEECAASBSYS	Underlying subsystem. This value indicates the subsystem (if any) on which the routine is running. **Value** **Subsystem** **0** Undefined. This value should not occur after Language Environment is initialized. **1** Unsupported **2** None. The routine is not running under a Language Environment-recognized subsystem. **3** TSO **4** IMS™ **5** CICS
CEECAAFLAG2	CAA Flag 2. **Bit** **Description** **0** Bimodal addressing is available. **1** Vector hardware is available. **2** Thread terminating. **3** Initial thread **4** Library trace is active. The TRACE run-time option was set. **5** Reserved **6** CEECAA_ENQ_Wait_Interruptible. Thread is in an enqueue wait. **7** Reserved

Table 7. List of CAA fields (continued)

CAA Field	Explanation
CEECAALEVEL	Language Environment level identifier. This contains a unique value that identifies each release of Language Environment. This number is incremented for each new release of Language Environment.
CEECAA_PM	Image of current program mask.
CEECAAGETLS	Address of stack overflow for library routines.
CEECAACELV	Address of the Language Environment library vector. This field is used to locate dynamically loaded Language Environment routines.
CEECAAGETS	Address of the Language Environment prolog stack overflow routine. The address of the Language Environment get stack storage routine is included in prolog code for fast reference.
CEECAALBOS	Start of the library stack storage segment. This field is initially set during thread initialization. It indicates the start of the library stack storage segment. It is altered when the library stack storage segment is changed.
CEECAALEOS	This field is used to determine if a stack overflow routine must be called when allocating storage from the library stack. Normally, the value of this field will represent the end of the current library stack segment. However, its value can also be zero to force the call of a stack overflow routine for every allocation of storage from the library stack. This field is used by function prologs that do not use FASTLINK linkage conventions.
CEECAALNAB	Next available library stack storage byte. This contains the address of the next available byte of storage on the library stack. It is modified when library stack storage is obtained or released.
CEECAADMC	Language Environment shunt routine address. Its value is initially set to 0 during thread initialization. If it is nonzero, this is the address of a routine used in specialized exception processing.
CEECAAACD	Most recent CAASHAB abend code.
CEEAAABCODE	Most recent abend completion code.
CEECAAARS	Most recent CAASHAB reason code.
CEECAAARSNCODE	Most recent abend reason code.
CEECAAERR	Address of the current condition information block. After completion of initialization, this always points to a condition information block. During exception processing, the current condition information block contains information about the current exception being processed. Otherwise, it indicates no exception being processed.
CEECAAGETSX	Address of the user stack extender routine. This routine is called to extend the current stack frame in the user stack. Its address is in the CEECAA for performance reasons.
CEECAADDSA	Address of the Language Environment dummy DSA. This address determines whether a stack frame is the dummy DSA, also known as the zeroth DSA.

Table 7. List of CAA fields (continued)

CAA Field	Explanation
CEECAASECTSIZ	Vector section size. This field is used by the vector math services.
CEECAAPARTSUM	Vector partial sum number. This field is used by the vector math services.
CEECAASSEXPNT	Log of the vector section size. This field is used by the vector math services.
CEECAAEDB	Address of the Language Environment EDB. This field points to the encompassing EDB.
CEECAAPCB	Address of the Language Environment PCB. This field points to the encompassing PCB.
CEECAAEYEPTR	Address of the CAA eye catcher. The CAA eye catcher is CEECAA. This field can be used for validation of the CAA.
CEECAAPTR	Address of the CAA. This field points to the CAA itself and can be used in validation of the CAA.
CEECAAGETS1	Non-DSA stack overflow. This field is the address of a stack overflow routine, which cannot guarantee that the current register 13 is pointing at a stack frame. Register 13 must point, at a minimum, to a save area.
CEECAASHAB	ABEND shunt routine. Its value is initially set to zero during thread initialization. If it is nonzero, this is the address of a routine used in specialized exception processing for ABENDs that are intercepted in the ESTAE exit.
CEECAAPRGCK	Routine interrupt code for CEECAADMC. If CEECAADMC is nonzero, and a routine interrupt occurs, this field is set to the routine interrupt code and control is passed to the address in CEECAAMDC.
CEECAAFLAG1	CAA flag bits. The bits are defined as follows: **Bit** — **Description** **0** — CEECAASORT. A call to DFSORT™ is active. **1** — CEECAA_USE_OLD_STK. Use the old stack. **2** — CEECAA_CICS_EXT_REG . ERTLI CICS extended register interface is in effect **3–7** — Reserved.
CEECAAURC	Thread level return code. This is the common place for members to set the return codes for subroutine-to-subroutine return code processing.
CEECAAESS	This field is used to determine if a stack overflow routine must be called when allocating storage from the user stack. Normally, the value of this field will represent the end of the current user stack segment. However, its value can also be zero to force the call of a stack overflow routine for every allocation of storage from the user stack. This field is used by function prologs that use FASTLINK linkage conventions.

Table 7. List of CAA fields (continued)

CAA Field	Explanation
CEECAALESS	This field is used to determine if a stack overflow routine must be called when allocating storage from the library stack. Normally, the value of this field will represent the end of the current library stack segment. However, its value can also be zero to force the call of a stack overflow routine for every allocation of storage from the library stack. This field is used by function prologs that use FASTLINK linkage conventions.
CEECAAOGETS	Overflow from user stack allocations.
CEECAAOGETLS	Overflow from library stack allocations.
CEECAARSRV1	Reserved.
CEECAAPICICB	Address of the preinitialization compatibility control block.
CEECAAOGETSX	User DSA exit from OPLINK.
CEECAARSRV2	Reserved.
CEECAAGOSMR	Go some more—Used CEEHTRAV multiple.
CEECAALEOV	This field is the address of the Language Environment library vector for z/OS UNIX support.
CEECAA_SIGSCTR	SIGSAFE counter.

Table 7. List of CAA fields (continued)

CAA Field	Explanation
CEECAA_SIGSFLG	SIGSAFE flags. SIGSAFE flags indicate the signal safety of the library. **Bit** **Description** **0** CEECAA_SIGPUTBACK. The signal cannot be delivered, therefore the signal is put back to the kernel. **1** CEECAA_SA_RESTART. Indicates that a signal registered with the SA_RESTART flag interrupted the last kernel call, and the signal catcher returned. **2** Reserved **3** CEECAA_SIGSAFE. It is safe to deliver the signal, while in library code. **4** CEECAA_CANCELSAFE. It is safe to deliver the cancel signal, while in library code. **5** CEECAA_SIGRESYNCH. CEECAA_sigputsynch flag was on last time CEEOSIGR resolicited a signal. **6** CEECAA_FRZ_UNSAFE. This thread is in an unsafe state to be frozen. **7** CEECAA_NOAPPREGS. User application registers may be saved in a nonstandard place. **8** CEECAA_EINTR_RSOL. Secondary Signal resolicitation is in progress, after EINTR errno from inner function. **9** CEECAA_EINTR_PUTB. Secondary resolicited signal has been put back. **10** CEECAA_EINTR_REST. User signal catcher returned after catching secondary resolicited signal with SA_RESTART in effect. **11** CEECAA_EINTR_SIGG. Stray signal interrupted CEEOSIGG while secondary signal resolicitation was in progress.
CEECAATHDID	Thread id. This field is the thread identifier.
CEECAA_DCRENT	DCE's read/write static external anchor.
CEECAA_DANCHOR	DCE's per-thread anchor.
CEECAA_CTOC	TOC anchor for CRENT.
CEECAACICSRSN	CICS reason code from member language.
CEECAAMEMBR	Address of thread-level member list.
CEECAA_SIGNAL_STATUS	Signal status of the terminating thread member list.
CEECAA_SAVSTACK	Zero or saved stack pointer. This field can be used to save the stack pointer before calling a routine with OS_NOSTACK linkage. After the call returns, this field must be set back to zero.

Table 7. List of CAA fields (continued)

CAA Field	Explanation
CEECAA_SAVSTACK_ASYNC	Zero or address of field that is zero or saved stack pointer. An application that has large sections of code that do not require access to the Language Environment stack but could benefit from having an additional register available can use this field.

For information about the DLL failure control block, CEEDLLF, see *z/OS Language Environment Vendor Interfaces*.

The condition information block

The Language Environment condition manager creates a condition information block (CIB) for each condition encountered in the Language Environment environment. The CIB holds data required by the condition handling facilities and pointers to locations of other data. The address of the current CIB is located in the CAA.

For COBOL, Fortran, and PL/I applications, Language Environment provides macros (in the SCEESAMP data set) that map the CIB. For C/C++ applications, the macros are in `leawi.h`.

Figure 11 on page 75 shows the condition information block.

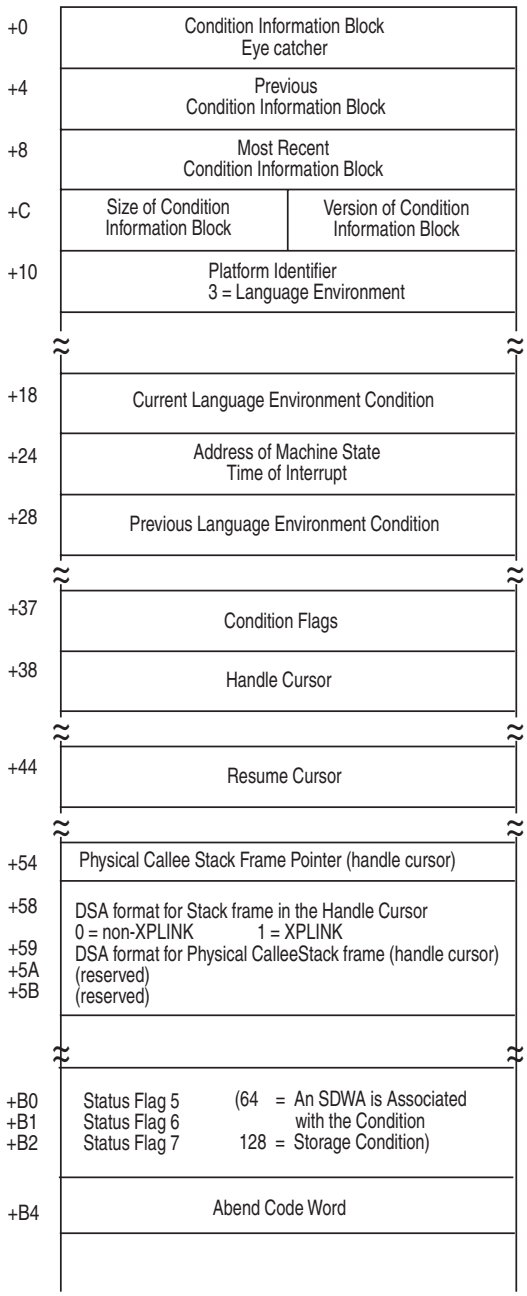


Figure 11. Condition information block (Part 1 of 2)

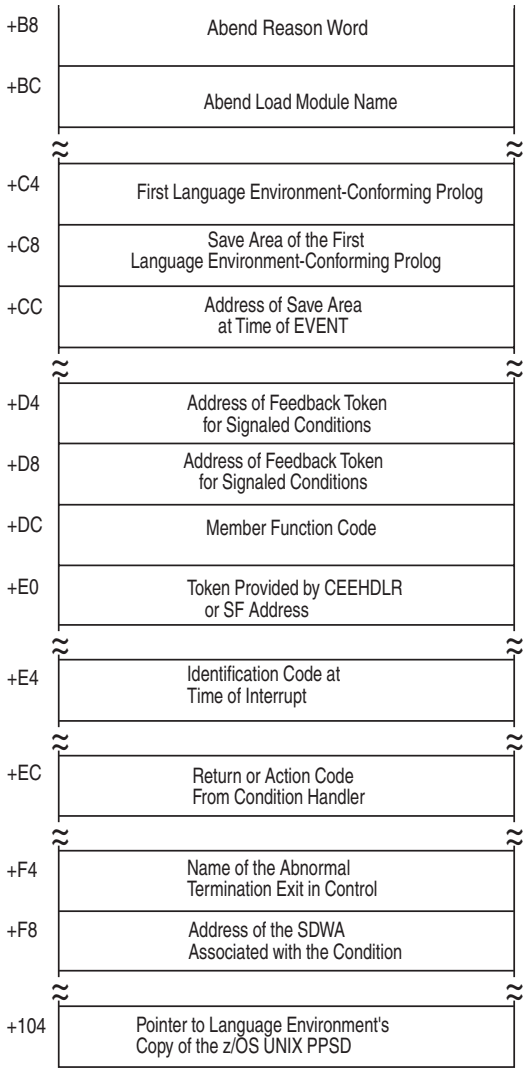


Figure 11. Condition information block (Part 2 of 2)

The flags for Condition Flag 4:

2 The resume cursor has been moved
4 Message service has processed the condition
8 The resume cursor has been moved explicitly

The flags for Status Flag 5, Language Environment events:

1 Caused by an attention interrupt
2 Caused by a signaled condition
4 Caused by a promoted condition
8 Caused by a condition management raised TIU
32 Caused by a condition signaled via CEEOKILL [1]
64 Caused by a program check
128 Caused by an abend

The flags for Status Flag 6, Language Environment actions:

1. The signaled-via-CEEOKILL flag is always set with the signaled flag; thus, a signaled condition can have a value of either 2 or 34. (The value is 2 if the signaled condition does not come through CEEOKILL. If it comes through CEEOKILL, its value is 2+32=34.)

2 Doing stack frame zero scan
4 H-cursor pointing to owning SF
8 Enable only pass (no condition pass)
16 MRC type 1
32 Resume allowed
64 Math service condition
128 Abend reason code valid

The language-specific function codes for the CIB:
X'1' For condition procedure
X'2' For enablement
X'3' For stack frame zero conditions

Using the machine state information block

The Language Environment machine state information block contains condition information pertaining to the hardware state at the time of the error. Figure 12 on page 78 shows the machine state information block.

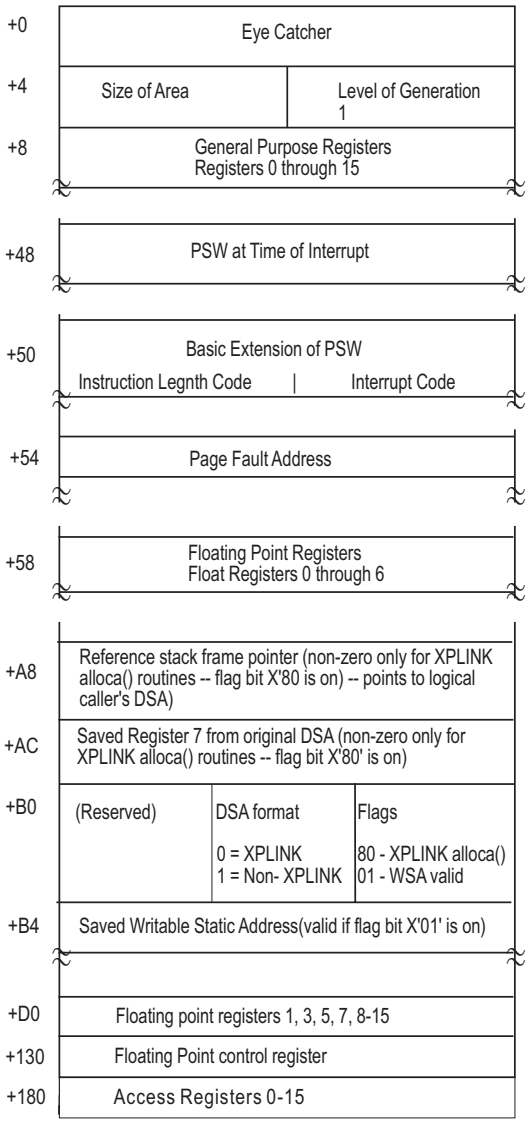


Figure 12. Machine state information block

Using the DLL failure control block

The CEEDLLF control block contains error diagnostics corresponding to an implicit or explicit DLL failure. Diagnostics describing up to 10 of the most recent DLL failures are available in a circular list of CEEDLLF control blocks. When viewing a dump, the in-use CEEDLLF control blocks are displayed from newest to oldest.

See “Understanding the Language Environment IPCS Verbexit LEDATA output” on page 89 for the contents of CEEDLLF fields.

Multiple enclave dumps

If multiple enclaves are used, the dump service generates data and storage information for the most current enclave and moves up the chain of enclaves to the starting enclave in a LIFO order. For example, if two enclaves are used, the dump service first generates output for the most current enclave. Then the service creates output for the previous enclave. A thread terminating in a non-POSIX environment is analogous to an enclave terminating because Language Environment Version 1 supports only single threads.

Figure 13 on page 80 illustrates the information available in the Language Environment dump and the order of information for multiple enclaves.

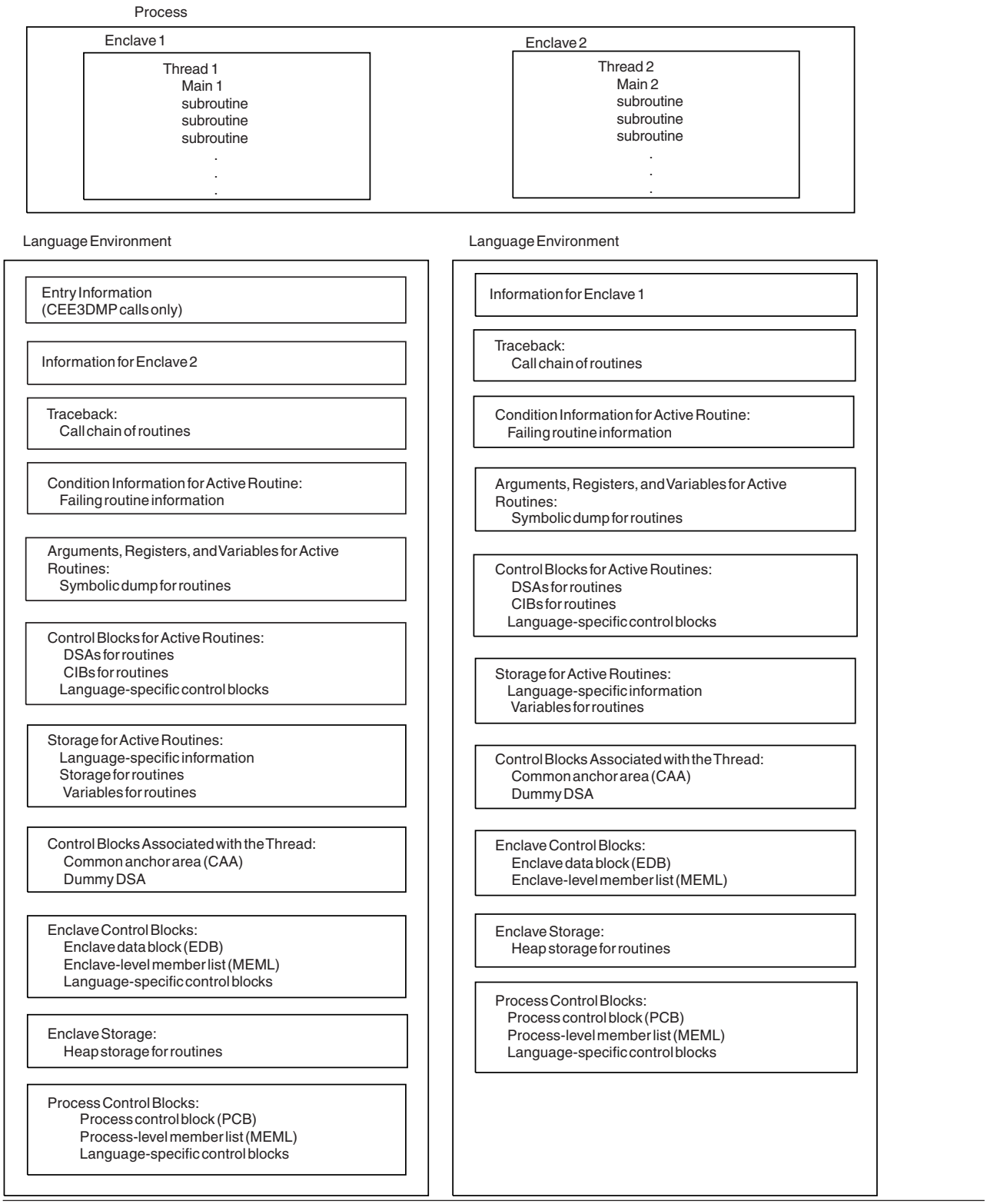


Figure 13. Language Environment dump of multiple enclaves

Generating a system dump

A system dump contains the storage information needed to diagnose errors. You can use Language Environment to generate a system dump through any of the following methods:

DYNDUMP(*hlq*,DYNAMIC,TDUMP)
: You can use the DYNDUMP run-time option to obtain IPCS-readable dumps of user applications that would ordinarily be lost due to the absence of a SYSMDUMP, SYSUDUMP, or SYSABEND DD statement.

TERMTHDACT(UAONLY, UATRACE, or UADUMP)
: You can use these run-time options, with TRAP(ON), to generate a system dump if an unhandled condition of severity 2 or greater occurs. For further details regarding the level of dump information produced by each of the TERMTHDACT suboptions, see “Generating a Language Environment dump with TERMTHDACT” on page 39.

TRAP(ON,NOSPIE) TERMTHDACT(UAIMM)
: TRAP(ON,NOSPIE) TERMTHDACT(UAIMM) generates a system dump of the user address space of the original abend or program interrupt prior to the Language Environment condition manager processing the condition.

ABPERC(abcode)
: The ABPERC run-time option specifies one abend code that is exempt from the Language Environment condition handler. The Language Environment condition handler percolates the specified abend code to the operating system. The operating system handles the abend and generates a system dump.

  ABPERC is ignored under CICS.

Abend Codes in Initialization Assembler User Exit
: Abend codes listed in the initialization assembler user exit are passed to the operating system. The operating system can then generate a system dump.

CEE3ABD
: You can use the CEE3ABD callable service to cause the operating system to handle an abend.

See system or subsystem documentation for detailed system dump information.

The method for generating a system dump varies for each of the Language Environment run-time environments. The following sections describe the recommended steps needed to generate a system dump in a batch, IMS, CICS, and z/OS UNIX shell run-time environments. Other methods may exist, but these are the recommended steps for generating a system dump.

For details on setting Language Environment run-time options, see *z/OS Language Environment Programming Guide*.

Steps for generating a system dump in a batch run-time environment

Perform the following steps to generate a system dump in a batch run-time environment:

1. Specify run-time options TERMTHDACT(UAONLY, UADUMP, UATRACE, or UAIMM), and TRAP(ON). If you specify the suboption UAIMM then you must set TRAP(ON,NOSPIE). The TERMTHDACT suboption determines the level of detail of the Language Environment formatted dump. For further details on the TERMTHDACT suboptions, see "Generating a Language Environment dump with TERMTHDACT" on page 39.
2. Decide whether to include a SYSMDUMP DD card or use the DYNDUMP run-time option.
   - Include a SYSMDUMP DD card with the desired data set name and DCB information:

     `LRECL=4160, BLKSIZE=4160, and RECFM=FBS.`
   - Specify the DYNDUMP run-time option with the following information:

     `DYNDUMP (hlq,DYNAMIC,TDUMP)`
3. Rerun the program.

When you are done, you have a generated system dump in a batch run-time environment.

Steps for generating a system dump in an IMS run-time environment

Perform the following steps to generate a system dump in an IMS run-time environment:

1. Specify run-time options TERMTHDACT(UAONLY, UADUMP, UATRACE, or UAIMM), ABTERM(ABEND), and TRAP(ON). If you specify the suboption UAIMM, then you must set TRAP(ON,NOSPIE). The TERMTHDACT suboption determines the level of detail of the Language Environment formatted dump. For further details on the TERMTHDACT suboptions, see "Generating a Language Environment dump with TERMTHDACT" on page 39.

   Restriction: In an IMS environment, you can only use CEEUOPT, CEEDOPT, or CEEROPT to change run-time options. CEEUOPT cannot be used by OS/VS COBOL or non-Language Environment assembler.
2. Decide whether to include a SYSMDUMP DD card or use the DYNDUMP run-time option.
   - Include a SYSMDUMP DD card with the desired data set name and DCB information:

     `LRECL=4160, BLKSIZE=4160, and RECFM=FBS.`
   - Specify the DYNDUMP run-time option with the following information:

     `DYNDUMP (hlq,DYNAMIC,TDUMP)`
3. Rerun the program.

When you are done, you have a generated system dump in an IMS run-time environment.

Steps for generating a system dump in a CICS run-time environment

Before you begin: Under CICS, a system dump provides the most useful information for diagnosing problems. However, if you have a Language Environment U4038 abend, CICS will not generate a system dump. In order to generate diagnostic information for a CICS run-time environment with a Language Environment U4038 abend, you must create a Language Environment U4039

abend. For instructions on how to create a Language Environment U4039 abend, see "Steps for generating a Language Environment U4039 abend."

Note: DYNDUMP is ignored in a CICS environment.

Perform the following steps to generate a system dump in a CICS run-time environment:

1. Specify run-time options TERMTHDACT(UAONLY, UADUMP, or UATRACE), ABTERM(ABEND), and TRAP(ON). The TERMTHDACT suboption determines the level of detail of the Language Environment formatted dump. For further details on the TERMTHDACT suboptions, see "Generating a Language Environment dump with TERMTHDACT" on page 39.
2. Update the transaction dump table with the CICS supplied CEMT command:

   ```
   CEMT SET TRD(40XX) SYS ADD
   ```

   Result: You will see CEMT output.

   Example:

   ```
   STATUS: RESULTS - OVERTYPE TO MODIFY
   Trd(4088)  Sys    Loc Max( 999 )  Cur(0000)
   ```
3. Rerun the program.

When you are done, you have a generated system dump in a CICS run-time environment.

Steps for generating a Language Environment U4039 abend

If you have a Language Environment U4038 abend, CICS will not generate a system dump. In order to generate diagnostic information, you must create a Language Environment U4039 abend by performing the following steps:

1. Specify DUMP=YES in CICS DFHSIT.
2. Relink your program by including CEEUOPT.

   Restriction:CEEUOPT cannot be used by OS/VS COBOL or non-Language Environment assembler.
3. Take CEECOPT from SCEESAMP and modify the Language Environment run-time options TERMTHDACT(UAONLY, UATRACE, or UADUMP), ABTERM(ABEND), and TRAP(ON).

   Result: By setting these run-time options, a Language Environment U4039 abend occurs which generates a system dump.
4. Rerun the program.

Note: In the CICS run-time environment, the TERMTHDACT suboption UAIMM is processed the same as UAONLY.

Steps for generating a system dump in a z/OS UNIX shell

Perform the following steps to generate a system dump from a z/OS UNIX shell:

- Using _BPXK_MDUMP
  1. Specify where to write the system dump
     - To write the system dump to a z/OS data set, issue the command:

       ```
       export _BPXK_MDUMP=filename
       ```

       where *filename* is a fully qualified data set name with DCB information: LRECL=4160, BLKSIZE=4160, and RECFM=FBS.

       Example:

```
export _BPXK_MDUMP=hlq.mydump
```

– To write the system dump to an HFS file, issue the command:

```
export _BPXK_MDUMP=filename
```

where *filename* is a fully qualified HFS filename.

Example:

```
export _BPXK_MDUMP=/tmp/mydump.dmp
```

2. Specify Language Environment run-time options:

```
export _CEE_RUNOPTS="termthdact(suboption)"
```

where *suboption* = UAONLY, UADUMP, UATRACE, or UAIMM. If UAIMM is set, TRAP(ON,NOSPIE) must also be set. The TERMTHDACT suboption determines the level of detail of the Language Environment formatted dump. For further details regarding the TERMTHDACT suboptions, see “Generating a Language Environment dump with TERMTHDACT” on page 39.

3. Rerun the program.

When you are done, the system dump is written to the data set name or HFS file name specified.

For additional BPXK_MDUMP information see *z/OS UNIX System Services Command Reference*.

- Using DYNDUMP

1. Specify Language Environment run-time options:

```
export _CEE_RUNOPTS="termthdact(suboption),DYNDUMP(hlq,DYNAMIC,TDUMP)"
```

where:

– *suboption* = UAONLY, UADUMP, UATRACE, or UAIMM. If UAIMM is set, TRAP(ON,NOSPIE) must also be set. The TERMTHDACT suboption determines the level of detail of the Language Environment formatted dump. For further details regarding the TERMTHDACT suboptions, see “Generating a Language Environment dump with TERMTHDACT” on page 39.

– *hlq* is the high level qualifier for the dump data set to be created.

2. Rerun the program.

When you are done, the system dump is written to the name generated by the DYNDUMP run-time option.

For additional DYNDUMP information see *z/OS Language Environment Programming Reference*.

Note: You can also specify the signal SIGDUMP on the kill command to generate a system dump of the user address space. For more information regarding the SIGDUMP signal, see *z/OS UNIX System Services Command Reference*.

Formatting and analyzing system dumps

You can use the interactive problem control system (IPCS) to format and analyze system dumps. Language Environment provides an IPCS Verbexit LEDATA that can be used to format Language Environment control blocks.

For more information on using IPCS, see *z/OS MVS IPCS User's Guide*.

Preparing to use the Language Environment support for IPCS

Guidelines: Use the following guidelines before you use IPCS to format Language Environment control blocks:

- Ensure that your IPCS job can find the CEEIPCSP member.

  IPCS provides an exit control table with imbed statements to enable other products to supply exit control information. The IPCS default table, BLSCECT, normally in the SYS1.PARMLIB library, has the following entry for Language Environment:

  ```
  IMBED MEMBER(CEEIPCSP) ENVIRONMENT(IPCS)
  ```

  The Language Environment-supplied CEEIPCSP member, installed in the SYS1.PARMLIB library, contains the Language Environment-specific entries for the IPCS exit control table.
- Provide an IPCSPARM DD statement to specify the libraries containing the IPCS control tables.

  Example:

  ```
  //IPCSPARM  DD  DSN=SYS1.PARMLIB,DISP=SHR
  ```
- Ensure that your IPCS job can find the Language Environment-supplied ANALYZE exit routines installed in the SYS1.MIGLIB library.
- To aid in debugging system or address space hang situations, Language Environment mutexes, latches and condition variables can be displayed if the CEEIPSCP member you are using is updated to identify the Language Environment ANALYZE exit, by including the following statement:

  ```
  EXIT EP(CEEEANLZ) ANALYZE
  ```

Language Environment IPCS Verbexit – LEDATA

Use the LEDATA Verbexit to format data for Language Environment. This Verbexit provides information about the following topics:

- A summary of Language Environment at the time of the dump
- Run-time Options
- Storage Management Control Blocks
- Condition Management Control Blocks
- Message Handler Control Blocks
- C/C++ Control Blocks
- COBOL Control Blocks

Format

Syntax

VERBEXIT LEDATA ['parameter[,parameter]...']

Report Type Parameters:

[**SUM**]
[**HEAP | STACK | SM**]
[**HPT**(*number*) [**HPTTCB** (*address*)] [**HPTCELL**(*address*)] [**HPTLOC**(*location*)]]
[**CM**]
[**MH**]
[**CEEDUMP**]
[**COMP**(*value*)]
[**PTBL(value)**]
[**ALL**]

Data Selection Parameters:

[**DETAIL | EXCEPTION**]

Control Block Selection Parameters:

[**CAA(***caa-address***)**]
[**DSA(***dsa-address***)**]
[**TCB(***tcb-address***)**]
[**ASID(***address-space-id***)**]
[**NTHREADS(***value***)**]

Parameters

Report type parameters

Use these parameters to select the type of report. You can specify as many reports as you wish. If you omit these parameters, the default is SUMMARY.

SUMmary

Requests a summary of the Language Environment at the time of the dump. The following information is included:

- TCB address
- Address Space Identifier
- Language Environment Release
- Active members
- Formatted CAA, PCB, RCB, EDB and PMCB
- Run-time Options in effect

HEAP | STACK | SM

HEAP

Requests a report on Storage Management control blocks pertaining to HEAP storage, as well as a detailed report on heap segments. The detailed report includes information about the free storage tree in the heap segment, and information about each allocated storage element. It also specifies a heappools report with information useful to find potential damaged cells.

Note: Language Environment does not provide support for alternative Vendor Heap Manager (VHM) data.

STACK
Requests a report on Storage Management control blocks pertaining to STACK storage.

SM
Requests a report on Storage Management control blocks. This is the same as specifying both HEAP and STACK.

HPT(*number***) [HPTTCB (***address***)] [HPTCELL(***address***)] [HPTLOC(***location***)]**

HPT(*number***)**
Requests that the heappools trace, if available, be formatted. If the value is 0 or *, the trace for every heappools poolid is formatted. If the value is a single number (1-12), the trace for the specific heappools poolid is formatted. If only the HPT keyword is specified with no value, the trace behaves similar to when the value is *. If no filter is specified, all of the entries are formatted for the specific poolid.

HPTTCB (*address***)**
Filters the heappool trace table, if available, printing only those entries for a given TCB address (*address*).

HPTCELL(*address***)**
Filters the heappool trace table, if available, printing only those entries for a given cell address (*address*).

HPTLOC(*location***)**
Filters the heappool trace table, if available, printing only those entries for a given virtual storage location (*location*). The following values are valid:

- 31: Display entries located in virtual storage below the bar.
- 64: Display entries located in virtual storage above the bar.
- ALL: Display entries located in virtual storage below or above the bar.

Notes:

1. Filter options without specifying HPT implies HPT(*).
2. User can specify multiple options together, like HPTTCB and HPTCELL. All pieces of information must match the trace entry for it to be formatted. If location and cell contradict each other, such as HPTLOC(31) and HPTCELL(64bit addr), an error will be displayed.

CM
Requests a report on Condition Management control blocks.

MH
Requests a report on Message Handler control blocks.

CEEdump
Requests a CEEDUMP-like report. Currently this includes the traceback, the Language Environment trace, and thread synchronization control blocks at process, enclave and thread levels.

PTBL(value)
Requests that PreInit tables be formatted according to the following values:,

CURRENT
If current is specified, the PreInit table associated with the current or specified TCB is displayed.

address
If an address is specified, the PreInit table at that address is specified.

***** All active and dormant PreInit tables within the current address space are displayed; this option is time-consuming.

ACTIVE
The PreInit tables for all TCBs in the address space are displayed.

COMP(value)
Requests component control blocks to be formatted according to the following values:

C Requests a report on C/C++ Run-Time control blocks.

CIO
Requests a report on C/C++ I/O control blocks.

COBOL
Requests a report on COBOL-specific control blocks.

ALL
Requests a report on all the previous control blocks.

If the value specified in COMP is not one of the values (C, CIO, COBOL, or ALL), a message is displayed and it continues executing as if COMP(ALL) was specified.

Note: The ALL parameter for LEDATA also generates a report that includes all the component control blocks.

ALL
Requests all above reports, as well as C/C++ and COBOL reports.

Data selection parameters

Data selection parameters limit the scope of the data in the report. If no data selection parameter is selected, the default is DETAIL.

DETail
Requests formatting all control blocks for the selected components. Only significant fields in each control block are formatted.

Note: For the Heap and Storage Management Reports, the DETAIL parameter will provide a detailed heap segment report for each heap segment in the dump. The detailed heap segment report includes information on the free storage tree in the heap segments, and all allocated storage elements. This report will also identify problems detected in the heap management data structures. For more information about the Heap Reports, see “Understanding the HEAP LEDATA output” on page 107.

EXCeption
Requests validating all control blocks for the selected components. Output is only produced naming the control block and its address for the first control block in a chain that is invalid. Validation consists of control block header verification at the very least.

Note: For the Summary, CEEDUMP, C/C++, and COBOL reports, the EXCEPTION parameter has not been implemented. For these reports, DETAIL output is always produced.

Control block selection parameters

Use these parameters to select the CAA and DSA control blocks used as the starting points for formatting.

CAA(caa-address)
specifies the address of the CAA. If not specified, the CAA address is obtained from the TCB.

DSA(dsa-address)
specifies the address of the DSA. If not specified, the DSA address is assumed to be the register 13 value for the TCB.

TCB(tcb-address)
specifies the address of the TCB. If not specified, the TCB address of the current TCB from the CVT is used.

ASID(address-space-id)
specifies the hexadecimal address space id. If not specified, the IPCS default address space id is used. This parameter is not needed when the dump only has one address space.

NTHREADS(value)
specifies the number of TCBs for which the traceback will be displayed. If NTHREADS is not specified, *value* will default to (1). If *value* is specified as asterisk (*), all TCBs will be displayed.

Usage Notes: Only hexadecimal characters can be specified as addresses provided in LEDATA parameters. Special characters cause the formatter to fail. Therefore, in order to specify a 64–bit address as a parameter, it must be in the form like 123456789 instead of 1_23456789.

Understanding the Language Environment IPCS Verbexit LEDATA output

The Language Environment IPCS Verbexit LEDATA generates formatted output of the Language Environment run-time environment control blocks from a system dump. Figure 14 on page 90 illustrates the output produced when the LEDATA Verbexit is invoked with the ALL parameter. The system dump being formatted was obtained by specifying the TERMTHDACT(UADUMP) run-time option when running the program CELSAMP in Figure 5 on page 44. “Sections of the Language Environment LEDATA Verbexit formatted output” on page 102 describes the information contained in the formatted output. Ellipses are used to summarize some sections of the dump.

For easy reference, the sections of the following dump are numbered to correspond with the descriptions in “Sections of the Language Environment LEDATA Verbexit formatted output” on page 102.

```
   ALL
   *******************************************************************************
                            LANGUAGE ENVIRONMENT DATA
   *******************************************************************************
   Language Environment Product 04 V01 R09.00

[1] TCB: 008DCB08                  LE Level: 15                   ASID: 003F

[2] Active Members: C/C++

[3]    CEECAA:  209159B0
       +000000  FLAG0:00    LANGP:08    BOS:20FC4018      EOS:00000000
       +000044  TORC:00000000     TOVF:80014608     ATTN:2090CDF8
       +00015C  HLLEXIT:00000000        HOOK:50C0D064 0DC058C0 C0060DCC
       +0001A4  DIMA:00009C64     ALLOC:0700C3C8    STATE:0700C3C8
       +0001B0  ENTRY:0700C3C8    EXIT:0700C3C8     MEXIT:0700C3C8
       +0001BC  LABEL:0700C3C8    BCALL:0700C3C8    ACALL:0700C3C8
       +0001C8  DO:0700C3C8       IFTRUE:0700C3C8   IFFALSE:0700C3C8
       +0001D4  WHEN:0700C3C8     OTHER:0700C3C8    CGOTO:0700C3C8
       +0001F0  CGENE:209125F8    CRENT:20FC0C00    CTHD:20910858
       +000210  EDCV:A0DA74E4     CEDB:209118D8     EDCOV:20DA094C
       +000258  TCASRV_USERWORD:00000000      TCASRV_WORKAREA:2090C5D8
       +000260  TCASRV_GETMAIN:00000000       TCASRV_FREEMAIN:00000000
       +000268  TCASRV_LOAD:8000FCD8    TCASRV_DELETE:8000FBF8
       +000270  TCASRV_EXCEPTION:00000000     TCASRV_ATTENTION:00000000
       +000278  TCASRV_MESSAGE:00000000       LWS:00000000      SAVR:20C67E8A
       +0002AC  SYSTM:03    HRDWR:03    SBSYS:02    FLAG2:B0    LEVEL:15
       +0002B1  PM:04       GETLS:80011EE0    CELV:A0917778     GETS:80011FD0
       +0002C0  LBOS:00019000     LEOS:00000000     LNAB:00019018
       +0002CC  DMC:00000000      ABCODE:00000000   RSNCODE:00000000
       +0002D8  ERR:20FC55C8      GETSX:800138B0    DDSA:20916350
       +0002E4  SECTSIZ:00000000        PARTSUM:00000000
       +0002EC  SSEXPNT:00000000        EDB:20914648      PCB:20914198
       +0002F8  EYEPTR:20915998   PTR:209159B0      GETS1:800139A8
       +000304  SHAB:00000000     PRGCK:00000004    FLAG1:00    URC:00000000
       +000314  ESS:00000000      LESS:00000000     OGETS:800140D0
       +000320  OGETLS:00000000   PICICB:00000000   GETSX:00000000    GOSMR:0000
       +000330  LEOV:A0A34190     SIGSCTR:00000000        SIGSFLG:00000000
       +00033C  THDID:20DA9FB0 00000000       DCRENT:00000000
       +000348  DANCHOR:00000000        CTOC:00000000     RCB:20913F68
       +000354  CICSRSN:00000000        MEMBR:209163F0
       +00035C  SIGNAL_STATUS:00000008        HCOM_REG7:00000000
       +000364  STACKFLOOR:7FFFFFFF     HPGETS:00000000   EDCHPXV:00000000
       +000370  FOR1:00000000     FOR2:00000000     THREADHEAPID:2091622C
       +00037C  SYS_RTNCODE:00000000    SYS_RSNCODE:00000000    GETFN:20A82198
       +000390  SIGNGPTR:20FC0C28       SIGNG:00000001    FORDBG:00000000
       +00039C  AB_STATUS:00      STACKDIRECTION:00       AB_GR0:00000000
       +0003A4  AB_ICD1:00000000        AB_ABCC:00000000        AB_CRC:00000000
       +0003B0  GTS:80011530      LERN5N1:00000000        HERP:209C9DF0
       +0003BC  USTKBOS:00000000        USTKEOS:00000000
       +0003C4  USERRTN:00000000        UDHOOK:A7F4FEE8 A7F401A0
       +0003D0  HPXV_B:A09B77A0   HPXV_M:A0AAEC90   HPXV_L:A0A079F8
       +0003DC  HPXV_O:A0A79F20   4VEC3:20BC5B4C    DLLF:21366C20
       +0003FC  SMCB:20916118     ERRCM:2090CDB0    MIB_PTR:00000000
       +000434  STV:00      A_ISA:00000000    ISA_SIZE:00000000
       +000440  PTATPTR:00000000        SIGSSDSA1:00      SIGSSDSA2:00
       +000446  STACKUNSTABLE:00  STACK_FLAG:00     SQELADDR:2090EFF0
       +00044C  VBA:20FC0040      TCS:21366818      THDSTATUS:00000000
       +00049C  TICB_PTR:2090E2A0       FWD_CHAIN:209159B0
       +0004A8  BKWD_CHAIN:209159B0     TCB@:008DCB08     SS_TOP_D:7FFFFFFF
       +000700  SS_DSA_U:00000000       DLLFFLAG:00

[4]    CEEDLLF:  21366C20
        +000000  EYE:CEEDLLF       VERSION:01  FLAGS:00    SIZE:0060   SERVICE:04
        +00000D  REFERENCE_TYPE:02       LOAD_TYPE:00      PREV:21366BC0
        +00001C  NEXT:213668C0     FBTOK:00000DF6 41C3C5C5 00000000 (CEE3574I)
        +000034  DLL_NAME:21366C88       SYMBOL_NAME:21366C98
        +000040  DLL_NAME_LEN:00000006   SYMBOL_NAME_LEN:0000000F
        +000048  RETCODE_1:00000000      RSNCODE_1:00000000
        +000050  RETCODE_2:00000000      RSNCODE_2:00000000

       CEEDLLF_DLL_NAME: 21366C88
        +000000 21366C88  C3C5D3C4 D3D30000 21365000 00000018  95819485 6D9596A3 6D89956D 84939300 |CELDLL....&.....name_not_in_dll.|

       CEEDLLF_SYMBOL_NAME: 21366C98
        +000000 21366C98  95819485 6D9596A3 6D89956D 84939300  21365000 00000018 95819485 6D9596A3 |name_not_in_dll...&.....name_not|
```

Figure 14. Example of formatted output from LEDATA Verbexit (Part 1 of 12)

```
[5]    CEEPCB:  20914198
       +000000  PCBEYE:CEEPCB     SYSTM:03    HRDWR:03    SBSYS:02    FLAG2:88
       +00000C  DBGEH:00000000    DMEMBR:209143D0   ZLOD:A0AF94D0
       +000020  ZDEL:A0AEFB50     ZGETST:A0AF6A08   ZFREEST:A0AF6528
       +00002C  LVTL:2090AAE8     RCB:20913F68      SYSEIB:00000000
       +000038  PSL:00000000      PSA:20914648      PSRA:A0AF6858
       +000044  OMVS_LEVEL:7F800000     PCB_CHAIN:00000000
       +00004C  PCB_VSSFE:000141D4      PCB_PRFEH:00000000
       +000056  HABD_CLEANUP:0000       LPKA_LODTYP:00000003    IMS:00000000
       +00008C  ABENDCODE:00000000      REASON:00000000   F3456:000080C2
       +000098  MEML:209143B8     MEMBR:209143D0    PCB_EYE:00000000
       +0000A4  PCB_BKC:00006F58        PCB_FWC:00000000
       +0000AC  PCB_R14:A09048D6        PCB_R15:00007910        PCB_R0:7D000009
       +0000B8  PCB_R1:00006FF0   PCB_R2:209046E0   PCB_R3:00000000
       +0000C4  PCB_R4:00000000   PCB_R5:00000000   PCB_R6:00000000
       +0000D0  PCB_R7:00000000   PCB_R8:20903DA0   PCB_R9:008DCCD0
       +0000DC  PCB_R10:00000000        PCB_R11:A0904802
       +0000E4  PCB_R12:00000000        CELV24:00000000   CELV31:A0917778
       +0000F0  SLDR:8000FDC8     SECTSIZ:00000000        PARTSUM:00000000
       +0000FC  SSEXPNT:00000000        BMPS:20918868     BMPE:20990FB0
       +000108  BLEHL:2090A5C0    BCMXB:20914018    BSTV:02     PM_BYTE:00
       +000112  INI_AMODE:00      FLAGS1:28   ISA:20905000
       +000118  ISA_SIZ:00011550        SRV_CNT:00000000
       +000120  SRV_UWORD:00000000      WORKAR:00000000   LOAD:00010280
       +00012C  DELETE:0000FFF8   GETSTOR:80011D58        FREESTOR:80011868
       +000138  EXCEPT:00000000   ATTN:00000000     MSGS:00000000
       +000144  ABEND:00009108    MSGOU:0000C760    GLAT:A0A32168
       +000150  RLAT:A0A68F70     ELAT:A0A27E90     1PTQ:A0A7B9F0
       +00015C  1ENV:A0A7AE90     DBG_LODTYP:FFFFFFFF     DUMMY_STK:20905010
       +000168  DUMMY_LIB:00000000      DUMMY_CAA:20909018
       +000170  TST_LVL:FFFFFFFF        GETCAA:20914178   SETCAA:20914180
       +00017C  LLTPTR:20909EA0   AUE:00000000      RC:00000000
       +000188  REASON:00000000   RC_MOD:00000000   AUE_UWORD:00000000
       +000194  FB_TOKEN:.............   EOV:A0A34190      PPA:210F7F44
       +0001A8  PPA_SIZ:00000A00        BELOW:20913E58    BELOW_LEN:000026F8
       +0001B4  PICB:2090C430     UTL1:00000008     ZINA:A0AF7C20
       +0001C0  ZINB:80014820     XPLINKFLAGS:00    FLAGS5:80
       +0001D4  LANGINIT:00000001 00000000 00000000 00000000 0000
       +0001E8  NUMINIT:00000001        LASTINIT:00000003
       +0001F0  LANGREUSE:00000000 00000000 00000000 00000000 0000
       +000202  REUSEMEMS:00000000 00000000 00000000 00000000 0000

      CEEMEML:  209143D0
       +000000  MEMLDEF:........  EXIT:20994BE8     LLVTL:00000000

[6]    CEERCB:  20913F68
       +000000  EYE:CEERCB        SYSTM:03    HRDWR:03    SBSYS:02    FLAGS:88
       +000014  DMEMBR:20909D78   ZLOD:A0AFB140     ZDEL:A0AF1A58
       +000020  ZGETST:A0AF6A08   ZFREEST:A0AF6528        VERSION_ID:04010900

[7]    CEEEDB:  20914648
       +000000  EYE:CEEEDB        FLAG1:D7    BIPM:00     BPM:00
       +00000B  CREATOR_ID:01     MEMBR:20915870    OPTCB:20914D50
       +000014  URC:00000000      RSNCD:00000000    DBGEH:00000000
       +000020  BANHP:20914B58    BBEHP:20914B88    BCELV:A0917778
       +00002C  PCB:20914198      ELIST:00000000    PL_ASTRPTR:00000000
       +000038  DEFPLPTR:20914768       CXIT_PAGE:00000000
       +000040  DEBUG_TERMID:00000000   PARENT:00000000   R13_PARENT:00006F58
       +000054  LEOV:A0A34190     ENVAR:2090C880    ENVIRON:20FC0C48
       +000060  CEEOSIGR:0000F460       OTRB:210F7000     PSA31:20913E58
       +00006C  PSL31:00000000    PSA24:20916550    PSL24:00000000
       +000078  PSRA:20AF6660     CAACHAIN@:209159B0      FLAG1A:90
       +000084  CEEOSGR1:0000FAF6       MEMBERCOMPAT1:00
       +000090  THREADSACTIVE:00000001        CURMSGFILEDCBPTR:00015060
       +000098  CEEINT_INPUT_R1:00006FF0      LAST_RBADDR:008FF4E8
       +0000A0  LAST_RBCNT:00000001

      CEEMEML:  20915870
       +000000  MEMLDEF:........  EXIT:20994BE8     LLVTL:00000000

[8]      PMCB:  2090C5A8
       +000000  EYE:PMCB    PREV$:00000000    NEXT$:00000000
       +000010  LVT_CURR$:A0917778      LLT_CURR$:21366050      FLAGS:20000000
[9] Language Environment Run-Time Options in effect.

    LAST WHERE SET          Override   OPTIONS
    ********************************************************************************
    INSTALLATION DEFAULT    OVR        ABPERC(NONE)
    INSTALLATION DEFAULT    OVR        ABTERMENC(ABEND)
    INSTALLATION DEFAULT    OVR      NOAIXBLD
    INSTALLATION DEFAULT    OVR        ALL31(ON)
```

Figure 14. Example of formatted output from LEDATA Verbexit (Part 2 of 12)

```
INSTALLATION DEFAULT    OVR        ANYHEAP(00016384,00008192,ANY  ,FREE)
INSTALLATION DEFAULT    OVR      NOAUTOTASK
INSTALLATION DEFAULT    OVR        BELOWHEAP(00008192,00004096,FREE)
INSTALLATION DEFAULT    OVR        CBLOPTS(ON)
INSTALLATION DEFAULT    OVR        CBLPSHPOP(ON)
INSTALLATION DEFAULT    OVR        CBLQDA(OFF)
INSTALLATION DEFAULT    OVR        CEEDUMP(00000060,SYSOUT=*,
                                          FREE=END,SPIN=UNALLOC)
INSTALLATION DEFAULT    OVR        CHECK(ON)
INSTALLATION DEFAULT    OVR        COUNTRY(US)
INSTALLATION DEFAULT    OVR      NODEBUG
INSTALLATION DEFAULT    OVR        DEPTHCONDLMT(00000010)
DD:CEEOPTS              OVR        DYNDUMP(POSIX.HEALY.ZOS19,
                                          DYNAMIC,TDUMP)
INSTALLATION DEFAULT    OVR        ENVAR("")
INSTALLATION DEFAULT    OVR        ERRCOUNT(00000000)
INSTALLATION DEFAULT    OVR        ERRUNIT(00000006)
INSTALLATION DEFAULT    OVR        FILEHIST
INSTALLATION DEFAULT    OVR        FILETAG(NOAUTOCVT,NOAUTOTAG)
DEFAULT SETTING         OVR      NOFLOW
INSTALLATION DEFAULT    OVR        HEAP(00032768,00032768,ANY  ,
                                       KEEP,00008192,00004096)
PROGRAMMER DEFAULT      OVR        HEAPCHK(ON,00000001,00000000,00000010,
                                          00000010)
PROGRAMMER DEFAULT      OVR        HEAPPOOLS(ON,
                                            00000008,00000010,
                                            00000032,00000010,
                                            00000128,00000010,
                                            00000256,00000010,
                                            00001024,00000010,
                                            00002048,00000010,
                                            00000000,00000010,
                                            00000000,00000010,
                                            00000000,00000010,
                                            00000000,00000010,
                                            00000000,00000010,
                                            00000000,00000010)
INSTALLATION DEFAULT    OVR        INFOMSGFILTER(OFF)
INSTALLATION DEFAULT    OVR        INQPCOPN
INSTALLATION DEFAULT    OVR        INTERRUPT(OFF)
INSTALLATION DEFAULT    OVR        LIBSTACK(00004096,00004096,FREE)
INSTALLATION DEFAULT    OVR        MSGFILE(SYSOUT  ,FBA ,00000121,00000000,
                                          NOENQ)
INSTALLATION DEFAULT    OVR        MSGQ(00000015)
INSTALLATION DEFAULT    OVR        NATLANG(ENU)
IGNORED                 OVR      NONONIPTSTACK(See THREADSTACK)
INSTALLATION DEFAULT    OVR        OCSTATUS
INSTALLATION DEFAULT    OVR      NOPC
INSTALLATION DEFAULT    OVR        PLITASKCOUNT(00000020)
PROGRAMMER DEFAULT      OVR        POSIX(ON)
INSTALLATION DEFAULT    OVR        PROFILE(OFF,"")
INSTALLATION DEFAULT    OVR        PRTUNIT(00000006)
INSTALLATION DEFAULT    OVR        PUNUNIT(00000007)
INSTALLATION DEFAULT    OVR        RDRUNIT(00000005)
INSTALLATION DEFAULT    OVR        RECPAD(OFF)
INSTALLATION DEFAULT    OVR        RPTOPTS(OFF)
PROGRAMMER DEFAULT      OVR        RPTSTG(ON)
INSTALLATION DEFAULT    OVR      NORTEREUS
INSTALLATION DEFAULT    OVR      NOSIMVRD
INSTALLATION DEFAULT    OVR        STACK(00131072,00131072,ANY  ,KEEP,
                                        00524288,00131072)
INSTALLATION DEFAULT    OVR        STORAGE(NONE,NONE,NONE,00000000)
PROGRAMMER DEFAULT      OVR        TERMTHDACT(UADUMP,CESE,00000096)
INSTALLATION DEFAULT    OVR      NOTEST(ALL,*,PROMPT,INSPPREF)
INSTALLATION DEFAULT    OVR        THREADHEAP(00004096,00004096,ANY  ,KEEP)
INSTALLATION DEFAULT    OVR        THREADSTACK(OFF,00004096,00004096,ANY  ,KEEP,
                                          00131072,00131072)
PROGRAMMER DEFAULT      OVR        TRACE(ON,01048576,NODUMP,LE=00000001)
INSTALLATION DEFAULT    OVR        TRAP(ON,SPIE)
INSTALLATION DEFAULT    OVR        UPSI(00000000)
INSTALLATION DEFAULT    OVR      NOUSRHDLR()
INSTALLATION DEFAULT    OVR        VCTRSAVE(OFF)
INSTALLATION DEFAULT    OVR        XPLINK(OFF)
INSTALLATION DEFAULT    OVR        XUFLOW(AUTO)
*******************************************************************************
```

Figure 14. Example of formatted output from LEDATA Verbexit (Part 3 of 12)

```
[10] Heap Storage Control Blocks

     Heappools trace available. To display: IP VERBX LEDATA 'HPT(*) CAA(209159B0)'

        ENSM:  20914B10
       +000000  EYE_CATCHER:ENSM  ST_HEAP_ALLOC_FLAG:00000000
       +000008  ST_HEAP_ALLOC_VAL:00000000    ST_HEAP_FREE_FLAG:00000000
       +000010  ST_HEAP_FREE_VAL:00000000     REPORT_STORAGE:20914BEC
       +000018  UHEAP:C8D7C3C2 20FE4018 20FE4018 00008000 00008000 00002000 00001000 00000000 00
       +000048  AHEAP:C8D7C3C2 20FC0000 2138E000 00004000 00002000 00002000 00001000 00000000 00
       +000078  BHEAP:C8D7C3C2 20914B88 20914B88 00002000 00001000 00002000 00001000 80000000 00
       +0000A8  ENSM_ADDL_HEAPS:21366FB8

        STSB:  20914BEC
       +000000  EYE_CATCHER:STSB  CRHP_REQ:00000002       DSHP_REQ:00000001
       +00000C  IPT_INIT_SIZE:00020000        NONIPT_INIT_SIZE:00020000
       +000014  IPT_INCR_SIZE:00020000        NONIPT_INCR_SIZE:00020000
       +00001C  THEAP_MAX_STOR:00000000
       Enclave Level Stack Statistics

        SKSB:  20914C84
       +000000  MAX_ALLOC:00009F28      CURR_ALLOC:00003E50
       +000008  LARGEST:00009F28        GETMAINS:00000001
       +000010  FREEMAINS:00000000

        SKSB:  20914CAC
       +000000  MAX_ALLOC:00001330      CURR_ALLOC:00000000
       +000008  LARGEST:00000D98        GETMAINS:00000002
       +000010  FREEMAINS:00000000

        SKSB:  20914C98
       +000000  MAX_ALLOC:000000D0      CURR_ALLOC:000000D0
       +000008  LARGEST:000000D0        GETMAINS:00000001
       +000010  FREEMAINS:00000000

       User Heap Control Blocks

        HPCB:  20914B28
       +000000  EYE_CATCHER:HPCB  FIRST:20FE4018    LAST:20FE4018

        HPSB:  20914C0C
       +000000  BYTES_ALLOC:00005228    CURR_ALLOC:00005228
       +000008  GET_REQ:00000005        FREE_REQ:00000000
       +000010  GETMAINS:00000001       FREEMAINS:00000000

        HPSB:  20914CC0
       +000000  BYTES_ALLOC:00000000    CURR_ALLOC:00000000
       +000008  GET_REQ:00000000        FREE_REQ:00000000
       +000010  GETMAINS:00000000       FREEMAINS:00000000

        HANC:  20FE4018
       +000000  EYE_CATCHER:HANC  NEXT:20914B28     PREV:20914B28
       +00000C  HEAPID:00000000   SEG_ADDR:A0FE4018       ROOT_ADDR:20FE9240
       +000018  SEG_LEN:00008000        ROOT_LEN:00002DD8

       This is the last heap segment in the current heap.

       Free Storage Tree for Heap Segment 20FE4018

              Node      Node     Parent     Left      Right     Left     Right
     Depth  Address    Length     Node      Node      Node     Length    Length
         0  20FE9240  00002DD8  00000000  00000000  00000000  00000000  00000000

       Map of Heap Segment 20FE4018

     To display entire segment: IP LIST 20FE4018 LEN(X'00008000') ASID(X'003F')

     20FE4038: Allocated storage element, length=00001028. To display: IP LIST 20FE4038 LEN(X'00001028') ASID(X'003F')
     20FE4040: 00000005 00000005 20FE5068 20FE5250  20FE528D 20FE52CA 20FE5307 20FE5344 |..........&....&.................|

     20FE5060: Allocated storage element, length=00000828. To display: IP LIST 20FE5060 LEN(X'00000828') ASID(X'003F')
     20FE5068: 00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000 |................................|

     20FE5888: Allocated storage element, length=00000CC8. To display: IP LIST 20FE5888 LEN(X'00000CC8') ASID(X'003F')
     20FE5890: 00000003 00000003 C3C4D3D3 00000000  40000000 00000000 209003B8 20903DB0 |........CDLL.... ................|

     20FE6550: Allocated storage element, length=00002028. To display: IP LIST 20FE6550 LEN(X'00002028') ASID(X'003F')
     20FE6558: 00000006 00000006 00000000 20FC2E84  70004000 00000000 20FE6584 00000000 |................d.. ........d....|

     20FE8578: Allocated storage element, length=00000CC8. To display: IP LIST 20FE8578 LEN(X'00000CC8') ASID(X'003F')
     20FE8580: 00000001 00000001 20FE5BC8 00000000  00000001 00000001 20FE5C50 00000000 |..........$H.............*&....|

     20FE9240: Free storage element, length=00002DD8. To display: IP LIST 20FE9240 LEN(X'00002DD8') ASID(X'003F')
```

Figure 14. Example of formatted output from LEDATA Verbexit (Part 4 of 12)

```
Summary of analysis for Heap Segment 20FE4018:
   Amounts of identified storage:  Free:00002DD8  Allocated:00005208  Total:00007FE0
   Number of identified areas   :  Free:       1  Allocated:       5  Total:       6
   00000000 bytes of storage were not accounted for.
   No errors were found while processing this heap segment.
   This is the last heap segment in the current heap.

  Anywhere Heap Control Blocks

    HPCB:  20914B58
  +000000  EYE_CATCHER:HPCB  FIRST:20FC0000    LAST:2138E000

    HPSB:  20914C3C
  +000000  BYTES_ALLOC:00371670    CURR_ALLOC:00319DB0
  +000008  GET_REQ:00000B58        FREE_REQ:00000B07
  +000010  GETMAINS:00000011       FREEMAINS:00000005

    HANC:  20FC0000
  +000000  EYE_CATCHER:HANC  NEXT:20FED000     PREV:20914B58
  +00000C  HEAPID:20914B58   SEG_ADDR:A0FC0000       ROOT_ADDR:20FC3500
  +000018  SEG_LEN:00004000        ROOT_LEN:00000B00

  Free Storage Tree for Heap Segment 20FC0000

         Node      Node     Parent     Left      Right     Left     Right
Depth  Address    Length     Node      Node      Node     Length    Length
    0  20FC3500  00000B00  00000000  20FC3278  00000000  00000090  00000000
    1  20FC3278  00000090  20FC3500  00000000  00000000  00000000  00000000

  Map of Heap Segment 20FC0000

To display entire segment: IP LIST 20FC0000 LEN(X'00004000') ASID(X'003F')

20FC0020: Allocated storage element, length=00000018. To display: IP LIST 20FC0020 LEN(X'00000018') ASID(X'003F')
20FC0028: D2C4C240 00000000 00000000 00000000                                      |KDB ............                |
```

⋮

```
  Below Heap Control Blocks

    HPCB:  20914B88
  +000000  EYE_CATCHER:HPCB  FIRST:20914B88    LAST:20914B88

           ** NO SEGMENTS ALLOCATED **

    HPSB:  20914C54
  +000000  BYTES_ALLOC:00000000    CURR_ALLOC:00000000
  +000008  GET_REQ:00000000        FREE_REQ:00000000
  +000010  GETMAINS:00000000       FREEMAINS:00000000

  Additional Heap Control Blocks

    HPSB:  20914C6C
  +000000  BYTES_ALLOC:00000908    CURR_ALLOC:00000908
  +000008  GET_REQ:00000007        FREE_REQ:00000000
  +000010  GETMAINS:00000003       FREEMAINS:00000002

    ADHP:  21366FB8
  +000000  EYE_CATCHER:ADHP  NEXT:F0F00000     HEAPID:21366FC4

    HPCB:  21366FC4
  +000000  EYE_CATCHER:HPCB  FIRST:21367000    LAST:21367000

    HANC:  21367000
  +000000  EYE_CATCHER:HANC  NEXT:21366FC4     PREV:21366FC4
  +00000C  HEAPID:21366FC4   SEG_ADDR:21367000       ROOT_ADDR:213672C8
  +000018  SEG_LEN:00001000        ROOT_LEN:00000D38

  This is the last heap segment in the current heap.

  Free Storage Tree for Heap Segment 21367000

         Node      Node     Parent     Left      Right     Left     Right
Depth  Address    Length     Node      Node      Node     Length    Length
    0  213672C8  00000D38  00000000  00000000  00000000  00000000  00000000

  Map of Heap Segment 21367000
```

Figure 14. Example of formatted output from LEDATA Verbexit (Part 5 of 12)

```
    To display entire segment: IP LIST 21367000 LEN(X'00001000') ASID(X'003F')

    21367020: Allocated storage element, length=000002A8. To display: IP LIST 21367020 LEN(X'000002A8') ASID(X'003F')
    21367028: D7C3C9C2 00000000 00000000 000102A0  00000000 00000000 00000000 00000000 |PCIB............................|

    213672C8: Free storage element, length=00000D38. To display: IP LIST 213672C8 LEN(X'00000D38') ASID(X'003F')

    Summary of analysis for Heap Segment 21367000:
       Amounts of identified storage:  Free:00000D38  Allocated:000002A8  Total:00000FE0
       Number of identified areas   :  Free:       1  Allocated:       1  Total:       2
       00000000 bytes of storage were not accounted for.
       No errors were found while processing this heap segment.
       This is the last heap segment in the current heap.

[11]Stack Storage Control Blocks

        SMCB:  20916118
      +000000  EYE_CATCHER:SMCB  US_EYE_CATCHER:USTK     USFIRST:20FC4018
      +00000C  USLAST:20FC4018   USBOS:20FC4018    USEOS:20FE4018
      +000018  USNAB:20FC7DC8    USINITSZ:00020000       USINCRSZ:00020000
      +000024  USANYBELOW:00000000     USKEEPFREE:00000000     USPOOL:00000002
      +000030  USPREALLOC:00000001     US_BYTES_ALLOC:00009F28
      +000038  US_CURR_ALLOC:00003E50        US_GETMAINS:00000000
      +000040  US_FREEMAINS:00000000   US_OPLINK:00      LS_THIS_IS:LSTK
      +00004C  LSFIRST:00019000        LSLAST:00019000   LSBOS:00019000
      +000058  LSEOS:0001A000    LSNAB:00000000    LSINITSZ:00001000
      +000064  LSINCRSZ:00001000       LSANYBELOW:80000000
      +00006C  LSKEEPFREE:00000001     LSPOOL:80000001   LSPREALLOC:00000000
      +000078  LS_BYTES_ALLOC:000000D0       LS_CURR_ALLOC:000000D0
      +000080  LS_GETMAINS:00000000    LS_FREEMAINS:00000000   LS_OPLINK:00
      +00008C  RSBOS:20FC4000    RSEOS:20FC4018    RSIZE:00000018
      +000098  RSACTIVE:00000001       SA_REG00:20FC7E68
      +0000A0  SA_REG01:20FC7DC8       SA_REG02:20914648
      +0000A8  SA_REG03:20914198       SA_REG04:209C949C
      +0000B0  SA_REG05:20FC512C       SA_REG06:00000000
      +0000B8  SA_REG07:2090E2A8       SA_REG08:A09C83C2
      +0000C0  SA_REG09:20FC6CA6       SA_REG10:20FC5CA7
      +0000C8  SA_REG11:209D4C70       SA_REG12:209159B0
      +0000D0  SA_REG13:20FC4CA8       SA_REG14:A09D4CA2
      +0000D8  SA_REG15:00000000
      +0000DC  SAVEREG_XINIT:00000000 00000000 00000000 00000000
      +0000EC  CEEVGTSI:800120C0       ST_DSA_ALLOC_FLAG:00000000
      +0000F4  ST_DSA_ALLOC_VAL:00000000     ALLOCSEG:00000000
      +0000FC  BELOW16M_FLAG:00000000        LOCAL_ALLOC:FFFFFF00
      +00010C  LOCAL_GETMAINS:00000000       LOCAL_FREEMAINS:00000000
      +00015C  MOREFLAGS:00000000      DS_THIS_IS:....   DSFIRST:20916278
      +000168  DSLAST:20916278   DSBOS:20916278    DSINITSZ:00000000
      +00017C  DSINCRSZ:00000000       DSGUARDSZ:00000000
      +000184  DSKEEPFREE:00000000     DSPOOL:00000000   DSPREALLOC:00000000
      +000190  DS_BYTES_ALLOC:00000000       DS_CURR_ALLOC:00000000
      +000198  DS_GETMAINS:00000000    DS_FREEMAINS:00000000
      +0001A0  DS_FLAGS:00000000

      DSA backchain

         DSA:  20FC7DC8
      +000000  FLAGS:0000  MEMD:0000   BKC:20FC4CA8      FWC:20FC7EC8
      +00000C  R14:A0AE4FBE      R15:A0AE7128      R0:20992840
      +000018  R1:20FC7E5C       R2:20FC40F0       R3:A0917778
      +000024  R4:20FC7E78       R5:20FC4030       R6:00000000
      +000030  R7:20FC7E88       R8:00000001       R9:FFFFFFFC
      +00003C  R10:00000000      R11:A0AE4DB8      R12:209159B0
      +000048  LWS:00000000      NAB:20FC7E68      PNAB:00000000
      +000064  RENT:00000000     CILC:00000000     MODE:00000000
      +000078  RMR:00000000

      Contents of DSA  at location 20FC7DC8:

      +00000000  00000000 20FC4CA8 20FC7EC8 A0AE4FBE  A0AE7128 20992840 20FC7E5C 20FC40F0 |......<y..=H..|......r. ..=*.. 0|
      +00000020  A0917778 20FC7E78 20FC4030 00000000  20FC7E88 00000001 FFFFFFFC 00000000 |.j....=... .......=h............|
      +00000040  A0AE4DB8 209159B0 00000000 20FC7E68  00000000 00000000 00000000 00000000 |..(..j........=.................|
      +00000060  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000 |................................|
      +00000080  20FC512C 20FC5244 20FC515C 20FC5184  20FC5188 20FC7E8C 20FC7E7C 20FC7E80 |...........*...d...h..=...=@..=.|

         DSA:  20FC4CA8
      +000000  FLAGS:0808  MEMD:CEE1   BKC:20FC4208      FWC:20FC7DC8
      +00000C  R14:A09C8580      R15:209D4C70      R0:00000073
      +000018  R1:20FC5100       R2:20914648       R3:20914198
      +000024  R4:209C949C       R5:20FC512C       R6:00000000
      +000030  R7:2090E2A8       R8:A09C83C2       R9:20FC6CA6
      +00003C  R10:20FC5CA7      R11:A09C4870      R12:209159B0
      +000048  LWS:00000000      NAB:20FC7DC8      PNAB:20FE663A
      +000064  RENT:210F72AC     CILC:2090EFF0     MODE:0000010B
      +000078  RMR:20FE6630
```

Figure 14. Example of formatted output from LEDATA Verbexit (Part 6 of 12)

```
Contents of DSA  at location 20FC4CA8:

+00000000  0808CEE1 20FC4208 20FC7DC8 A09C8580  209D4C70 00000073 20FC5100 20914648 |.........'H..e...<.........j..|
+00000020  20914198 209C949C 20FC512C 00000000  2090E2A8 A09C83C2 20FC6CA6 20FC5CA7 |.j.q..m..........Sy..cB..%w..*x|
+00000040  A09C4870 209159B0 00000000 20FC7DC8  20FE663A A0A512DA 20A543BA 20A5BE6C |.....j........'H.....v...v...v.%|
+00000060  20FC4B74 210F72AC 2090EFF0 0000010B  20A584C0 20FC2E94 20FE6630 00000004 |..........0.....vd....m........|
+00000080  20FC5168 20FC5178 20FC5246 209C95C0  209C95C4 20FC517C 20FC5247 209C95C0 |.............n...nD...@......n.|
+000000A0  209C95C0 209C95C0 209C95C0 A09C4D04  209C5820 00000073 20FC5100 20914648 |..n...n...n...(.............j..|
+000000C0  2090CDB0 209C949C 00000000 2090E52C  00000000 20FC6CA6 20FC5CA7 A09C4870 |......m.......V.......%w..*x....|
+000000E0  209159B0 2090E52C A09C529A 209C5D44  00000073 209C95A8 00000001 2090CDB0 |.j....V.......).......ny........|

To display entire DSA: IP LIST 20FC4CA8 LEN(X'00003120') ASID(X'003F')

   DSA:  20FC4208
+000000  FLAGS:1000  MEMD:0000   BKC:20FC40F0      FWC:20FC42E8
+00000C  R14:A0900E1E      R15:20DA8624      R0:2090155C
+000018  R1:20FC42A0       R2:20FC42C5       R3:209004B2
+000024  R4:20FC42C2       R5:20901288       R6:20FC42CC
+000030  R7:20FC42D0       R8:00000030       R9:80000000
+00003C  R10:A0E629E2      R11:A0992840      R12:209159B0
+000048  LWS:00000000      NAB:20FC42E8      PNAB:00000000
+000064  RENT:00000000     CILC:00000000     MODE:00000000
+000078  RMR:00000000

Contents of DSA  at location 20FC4208:

+00000000  10000000 20FC40F0 20FC42E8 A0900E1E  20DA8624 2090155C 20FC42A0 20FC42C5 |...... 0...Y......f....*.......E|
+00000020  209004B2 20FC42C2 20901288 20FC42CC  20FC42D0 00000030 80000000 A0E629E2 |.......B...h.................W.S|
+00000040  A0992840 209159B0 00000000 20FC42E8  00000000 00000000 00000000 00000000 |.r. .j.........Y.............|
+00000060  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000 |................................|
+00000080  00000000 00000000 00000000 00000000  20FE5898 00000000 2090155C 2090154D |.................q.......*...(|
+000000A0  00000003 20901294 213667F0 00000000  2130420C 21305434 00000000 00000000 |.......m...0.................|
+000000C0  00000000 00000002 21366CE0 00000000  00000000 00000000 20FC0C00 00000000 |.........%.....................|

   DSA:  20FC40F0
+000000  FLAGS:10AF  MEMD:92CC   BKC:20FC4030      FWC:20FC4294
+00000C  R14:A1366D50      R15:A0900478      R0:20FC4208
+000018  R1:20FC0CA0       R2:A0E62AB0       R3:00000002
+000024  R4:A0992924       R5:20914648       R6:20903DA4
+000030  R7:209046E8       R8:00000030       R9:80000000
+00003C  R10:A0E629E2      R11:A0992840      R12:209159B0
+000048  LWS:00000000      NAB:20FC4208      PNAB:20914648
+000064  RENT:00000000     CILC:00100000     MODE:00000001
+000078  RMR:00000000

Contents of DSA  at location 20FC40F0:

+00000000  10AF92CC 20FC4030 20FC4294 A1366D50  A0900478 20FC4208 20FC0CA0 A0E62AB0 |..k... ....m._&.............W..|
+00000020  00000002 A0992924 20914648 20903DA4  209046E8 00000030 80000000 A0E629E2 |.....r...j.....u...Y.........W.S|
+00000040  A0992840 209159B0 00000000 20FC4208  20914648 00000000 00000000 00000000 |.r. .j...........j..............|
+00000060  00000000 00000000 00100000 00000001  00000001 00000200 00000000 00000000 |................................|
+00000080  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000 |................................|
+000000A0  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000 |................................|
+000000C0  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000 |................................|
+000000E0  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000 |................................|

To display entire DSA: IP LIST 20FC40F0 LEN(X'00000118') ASID(X'003F')

   DSA:  20FC4030
+000000  FLAGS:0000  MEMD:0000   BKC:20916350      FWC:20FC44A8
+00000C  R14:A09929F8      R15:20E629EE      R0:7D000009
+000018  R1:20FC40B0       R2:209046E0       R3:00000002
+000024  R4:A0992924       R5:20914648       R6:20903DA4
+000030  R7:209046E8       R8:00000030       R9:00000008
+00003C  R10:A0E629E2      R11:A0992840      R12:209159B0
+000048  LWS:00000000      NAB:20FC40F0      PNAB:00000000
+000064  RENT:00000000     CILC:00000000     MODE:00000000
+000078  RMR:00000000
```

Figure 14. Example of formatted output from LEDATA Verbexit (Part 7 of 12)

```
        Contents of DSA  at location 20FC4030:

        +00000000  00000000 20916350 20FC44A8 A09929F8  20E629EE 7D000009 20FC40B0 209046E0 |.....j.&...y.r.8.W..'..... .....|
        +00000020  00000002 A0992924 20914648 20903DA4  209046E8 00000030 00000008 A0E629E2 |.....r...j.....u...Y.........W.S|
        +00000040  A0992840 209159B0 00000000 20FC40F0  00000000 00000000 00000000 00000000 |.r. .j........ 0.............. |
        +00000060  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000 |................................|
        +00000080  20992B08 20903DA4 20FC40E0 20914780  20FC40D0 20FC40D8 20FC40D4 A0A34190 |.r.....u.. ..j.... ... Q.. M.t..|
        +000000A0  20FC0CA0 00000000 00000000 20AF9CD6  00000001 A0AF7CD8 209159B0 00000000 |..............O......@Q.j......|

        User Stack Control Blocks

          STKH:  20FC4018
        +000000  EYE_CATCHER:STKU  NEXT:2091611C     PREV:2091611C
        +00000C  SEGMENT_LEN:00020000

        Library Stack Control Blocks

          STKH:  00019000
        +000000  EYE_CATCHER:STKL  NEXT:20916160     PREV:20916160
        +00000C  SEGMENT_LEN:00001000

[12]Condition Management Control Blocks

          HCOM:  2090CDB0
        +000000  PICA_AREA:00000000 00000000   EYES:HCOM   CAA_PTR1:209159B0
        +000014  CVTDCB:9B   FLAG:60F0C000     EXIT_STK:21366D50
        +000020  RSM_PTR:00000000        HDLL_STK:21366D08
        +000028  SRP_TOKEN:00000000      CSTK:2136CE48     CIBH:20FC5AD8
        +000084  COND_LOG:2136A028       DSA_4083:00000000
        +00009C  HCHK5_RESULTS:00000000        SHUNT_VALIDFLAG:00000001
        +000480  SHUNT_COUNTER:00000018        SHUNT_ADDR:209F5940
        +000488  SHUNT_PSW:078D2000 A09F5948
        +000490  SHUNT_REG0:00000000     SHUNT_REG1:20FC9EFC
        +000498  SHUNT_REG2:00000000     SHUNT_REG3:00000000
        +0004A0  SHUNT_REG4:5ECEF2C8     SHUNT_REG5:00000001
        +0004A8  SHUNT_REG6:00000008     SHUNT_REG7:00000000
        +0004B0  SHUNT_REG8:00001000     SHUNT_REG9:5ECEF2C8
        +0004B8  SHUNT_REG10:209F5940    SHUNT_REG11:A09F4EE0
        +0004C0  SHUNT_REG12:209159B0    SHUNT_REG13:20FC9DA0
        +0004C8  SHUNT_REG14:A09F585A    SHUNT_REG15:00000000
        +0004D0  SHUNT_CODE1:00000000    SHUNT_CODE2:00000004
        +000514  SIGNAL_LOG:210F9028

          CIBH:  20FC5AD8
        +000000  EYE:CIBH    BACK:2090E2A8     FRWD:00000000
        +000010  PTR_CIB:00000000        FLAG1:00    ERROR_LOCATION_FLAGS:00
        +000018  HDLQ:00000000     STATE:00000000    PRM_DESC:00000000
        +000024  PRM_PREFIX:00000000
        +000028  PRM_LIST:00000000 00000000 00000000 00000000
        +000038  PARM_DESC:00000000      PARM_PREFIX:00000000
        +000040  PARM_LIST:00000000 00000000 00000000 00000000   FUN:00000000
        +000054  CIB_SIZ:0000      CIB_VER:0000      FLG_5:00    FLG_6:00
        +00005A  FLG_7:00    FLG_8:00    FLG_1:00    FLG_2:00    FLG_3:00
        +00005F  FLG_4:00    ABCD:00000000     ABRC:00000000
        +000068  OLD_COND_64:00000000 00000000
        +000070  OLD_MIB:00000000        COND_64:00000000 00000000
        +00007C  MIB:00000000      PL:00000000       SV2:00000000
        +000088  SV1:00000000      INT:00000000      MID:00000000
        +000094  HDL_SF:00000000   HDL_EPT:00000000        HDL_RST:00000000
        +0000A0  RSM_SF:00000000   RSM_POINT:00000000      RSM_MACHINE:00000000
        +0000B0  COND_DEFAULT:00000000   Q_DATA_TOKEN:00000000   FDBK:00000000
        +0000BC  ABNAME:........   BBRANCH_OFFSET:00000000
        +000220  BBRANCH_STMTID:........       BBRANCH_STMTLEN:0000
                 Machine State
        +000248  MCH_EYE:....
        +000250  GPR00:00000000    GPR01:00000000
        +000258  GPR02:00000000    GPR03:00000000
        +000260  GPR04:00000000    GPR05:00000000
        +000268  GPR06:00000000    GPR07:00000000
        +000270  GPR08:00000000    GPR09:00000000
        +000278  GPR10:00000000    GPR11:00000000
        +000280  GPR12:00000000    GPR13:00000000
        +000288  GPR14:00000000    GPR15:00000000
        +000290  PSW:00000000 00000000
        +000298  ILC:0000    IC1:00      IC2:00      PFT:00000000
        +0002A0  FLT_0:00000000 00000000       FLT_2:00000000 00000000
        +0002B0  FLT_4:00000000 00000000       FLT_6:00000000 00000000
        +0002EC  INT_SF:00000000   FLAGS:00    EXT:00000000      BEA:00000000
        +000308  SAVSTACK_ASYNC_PTR:00000000
```

Figure 14. Example of formatted output from LEDATA Verbexit (Part 8 of 12)

```
+000318  FLT_1:00000000 00000000
+000320  FLT_3:00000000 00000000
+000328  FLT_5:00000000 00000000
+000330  FLT_7:00000000 00000000
+000338  FLT_8:00000000 00000000       FLT_9:00000000 00000000
+000348  FLT_10:00000000 00000000      FLT_11:00000000 00000000
+000358  FLT_12:00000000 00000000      FLT_13:00000000 00000000
+000368  FLT_14:00000000 00000000      FLT_15:00000000 00000000
+000378  FPC:00000000      APF_FLAGS:00
+000388  GPR_H00:00000000        GPR_H01:00000000
+000390  GPR_H02:00000000        GPR_H03:00000000
+000398  GPR_H04:00000000        GPR_H05:00000000
+0003A0  GPR_H06:00000000        GPR_H07:00000000
+0003A8  GPR_H08:00000000        GPR_H09:00000000
+0003B0  GPR_H10:00000000        GPR_H11:00000000
+0003B8  GPR_H12:00000000        GPR_H13:00000000
+0003C0  GPR_H14:00000000        GPR_H15:00000000
+0003C8  AR00:00000000     AR01:00000000
+0003D0  AR02:00000000     AR03:00000000
+0003D8  AR04:00000000     AR05:00000000
+0003E0  AR06:00000000     AR07:00000000
+0003E8  AR08:00000000     AR09:00000000
+0003F0  AR10:00000000     AR11:00000000
+0003F8  AR12:00000000     AR13:00000000
+000400  AR14:00000000     AR15:00000000

+000AE0  ABCC:00000000     HRC:00000000      RSM_SF_FMT:00
+000AE9  RSM_PH_CALLEE_FMT:00    SV1_FMT:00  RSM_PH_CALLEE:00000000
+000AF0  INT_FCN_EP:00000000     HDL_SF_FMT:00     HDL_PH_CALLEE_FMT:00
+000AF6  SV2_FMT:00  HDL_PH_CALLEE:00000000

  CIBH:  2090E2A8
+000000  EYE:CIBH    BACK:00000000     FRWD:20FC5AD8
+000010  PTR_CIB:20FC55C8        FLAG1:C5    ERROR_LOCATION_FLAGS:3F
+000018  HDLQ:00000000     STATE:00000000    PRM_DESC:00000000
+000024  PRM_PREFIX:00000000
+000028  PRM_LIST:20FC55E0 20FC56A8 20FC56B4 2090E8F4
+000038  PARM_DESC:00000000      PARM_PREFIX:00000000
+000040  PARM_LIST:20FC56A4 20FC55C8 20FC56B4 2090E8F4   FUN:00000067
+000054  CIB_SIZ:010C      CIB_VER:0004      FLG_5:48    FLG_6:23
+00005A  FLG_7:00    FLG_8:00    FLG_1:00    FLG_2:00    FLG_3:00
+00005F  FLG_4:05    ABCD:940C9000     ABRC:00000009
+000068  OLD_COND_64:00030C89 59C3C5C5 (CEE3209S)
+000070  OLD_MIB:00000002        COND_64:00030C89 59C3C5C5 (CEE3209S)
+00007C  MIB:00000002      PL:20901698       SV2:20FC4208
+000088  SV1:20FC4208      INT:20900E32      MID:00000003
+000094  HDL_SF:20916350   HDL_EPT:20994BE8        HDL_RST:00000000
+0000A0  RSM_SF:20FC4208   RSM_POINT:20900E34      RSM_MACHINE:2090E6F0
+0000B0  COND_DEFAULT:00000003   Q_DATA_TOKEN:2090E3E0   FDBK:00000000
+0000BC  ABNAME:........   BBRANCH_OFFSET:00000000
+000220  BBRANCH_STMTID:........       BBRANCH_STMTLEN:0000
         Machine State
+000248  MCH_EYE:ZMCH
+000250  GPR00:00000000    GPR01:A0D9AD0C
+000258  GPR02:20FC42C5    GPR03:209004B2
+000260  GPR04:20FC42C2    GPR05:20901288
+000268  GPR06:00000000    GPR07:00000001
+000270  GPR08:00000030    GPR09:80000000
+000278  GPR10:A0E629E2    GPR11:A0992840
+000280  GPR12:209159B0    GPR13:20FC4208
+000288  GPR14:A0900E1E    GPR15:00000012
+000290  PSW:078D2400 A0900E34
+000298  ILC:0002    IC1:00      IC2:09      PFT:00000000
+0002A0  FLT_0:4DBFF67D 46DBE848       FLT_2:00000000 00000000
+0002B0  FLT_4:00000000 00000000       FLT_6:00000000 00000000
+0002EC  INT_SF:00000000   FLAGS:40    EXT:00000000      BEA:00000000
+000308  SAVSTACK_ASYNC_PTR:00000000
+000318  FLT_1:00000000 00000000
+000320  FLT_3:00000000 00000000
+000328  FLT_5:00000000 00000000
+000330  FLT_7:00000000 00000000
+000338  FLT_8:00000000 00000000       FLT_9:00000000 00000000
+000348  FLT_10:00000000 00000000      FLT_11:00000000 00000000
+000358  FLT_12:00000000 00000000      FLT_13:00000000 00000000
+000368  FLT_14:00000000 00000000      FLT_15:00000000 00000000
```

Figure 14. Example of formatted output from LEDATA Verbexit (Part 9 of 12)

```
        +000378  FPC:00000000      APF_FLAGS:00
        +000388  GPR_H00:00000000        GPR_H01:00000000
        +000390  GPR_H02:00000000        GPR_H03:00000000
        +000398  GPR_H04:00000000        GPR_H05:00000000
        +0003A0  GPR_H06:00000000        GPR_H07:00000000
        +0003A8  GPR_H08:00000000        GPR_H09:00000000
        +0003B0  GPR_H10:00000000        GPR_H11:00000000
        +0003B8  GPR_H12:00000000        GPR_H13:00000000
        +0003C0  GPR_H14:00000000        GPR_H15:00000000
        +0003C8  AR00:00000000     AR01:00000000
        +0003D0  AR02:00000000     AR03:00000000
        +0003D8  AR04:00000000     AR05:00000000
        +0003E0  AR06:00000000     AR07:00000000
        +0003E8  AR08:00000000     AR09:00000000
        +0003F0  AR10:00000000     AR11:00000000
        +0003F8  AR12:00000000     AR13:00000000
        +000400  AR14:00000000     AR15:00000000

        +000AE0  ABCC:00000000     HRC:00000000      RSM_SF_FMT:00
        +000AE9  RSM_PH_CALLEE_FMT:00    SV1_FMT:00  RSM_PH_CALLEE:00000000
        +000AF0  INT_FCN_EP:00000000     HDL_SF_FMT:00     HDL_PH_CALLEE_FMT:00
        +000AF6  SV2_FMT:00  HDL_PH_CALLEE:20FC4030

           CIB:  20FC55C8
        +000000  EYE:CIB     BACK:00000000     FRWD:00000000     SIZ:010C
        +00000E  VER:0004    PLAT_ID:00C3C5C5        COND_64:000300C6 59C3C5C5 (CEE0198S)
        +000020  MIB:00000000      MACHINE:20FC56D8        OLD_COND_64:00030C89 59C3C5C5 (CEE3209S)
        +000030  OLD_MIB:00000002        FLG_1:00    FLG_2:00    FLG_3:00
        +000037  FLG_4:04    HDL_SF:20FC4030   HDL_EPT:20994BE8
        +000040  HDL_RST:00000000        RSM_SF:20FC4208   RSM_POINT:20900E34
        +00004C  RSM_MACHINE:2090E6F0    COND_DEFAULT:00000003
        +000054  PH_CALLEE_SF:20FC40F0   HDL_SF_FMT:00     PH_CALLEE_SF_FMT:00
        +00005A  BBRANCH_STMTLEN:0000    BBRANCH_OFFSET:00000000
        +000060  BBRANCH_STMTID:........       VSR:40404040 40404040
        +000098  VSTOR:40404040    VRPSA:40404040    MCB:40404040
        +0000A4  MRN:40404040 40404040   MFLAG:00    FLG_5:48    FLG_6:23
        +0000B2  FLG_7:00    FLG_8:00    ABCD:940C9000     ABRC:00000009
        +0000BC  ABNAME:00000000 00000000      PL:20901698       SV2:20FC4208
        +0000CC  SV1:20FC4208      INT:20900E32      Q_DATA_TOKEN:40404040
        +0000D8  FDBK:40404040     FUN:00000067      TOKE:20FC4030
        +0000E4  MID:00000003      STATE:00000000    RTCC:FFFFFFFC
        +0000F0  PPAV:00000003     AB_TERM_EXIT:40404040 40404040
        +0000FC  SDWA_PTR:00000000       SIGNO:00000008    PPSD:2090E908
[13]Message Processing Control Blocks

          CMXB:  20914018
        +000000  EYE:CMXB    SIZE:0148   FLAGS:8000  DHEAD1:0001A000
        +00000C  DHEAD2:00015000

        MDST forward chain from CMXBDHEAD(1)

          MDST:  0001A000
        +000000  EYE:MDST    SIZE:0100   CTL:40      CEEDUMPLOC:00
        +000008  NEXT:00015000     PREV:00000000     DDNAM:CEEDUMP

          MDST:  00015000
        +000000  EYE:MDST    SIZE:0100   CTL:40      CEEDUMPLOC:00
        +000008  NEXT:00000000     PREV:0001A000     DDNAM:SYSOUT

        MDST back chain from CMXBDHEAD(2)

          MDST:  00015000
        +000000  EYE:MDST    SIZE:0100   CTL:40      CEEDUMPLOC:00
        +000008  NEXT:00000000     PREV:0001A000     DDNAM:SYSOUT
          MDST:  0001A000
        +000000  EYE:MDST    SIZE:0100   CTL:40      CEEDUMPLOC:00
        +000008  NEXT:00015000     PREV:00000000     DDNAM:CEEDUMP
```

Figure 14. Example of formatted output from LEDATA Verbexit (Part 10 of 12)

```
        TMXB:  2090EEC0
      +000000  EYE:TMXB    MIB_CHAIN_PTR:21383028

         MGF:  21383028
      +000000  EYE:CMIB    PREV:2136D668     NEXT:20FC3410

         MGF:  20FC3410
      +000000  EYE:CMIB    PREV:21383028     NEXT:2090EEF8

         MGF:  2090EEF8
      +000000  EYE:CMIB    PREV:20FC3410     NEXT:2136D668

         MGF:  2136D668
      +000000  EYE:CMIB    PREV:2090EEF8     NEXT:21383028

[14] Information for enclave main

[15]  Information for thread 20DA9FB000000000
      PCB Address: 20914198
      TCB Address: 008DCB08

[16]  Registers and PSW:
      GPR0..... 84000000  GPR1..... 84000FC7  GPR2..... 20FC55C8  GPR3..... 00020009
      GPR4..... 209C949C  GPR5..... 20FC512C  GPR6..... 00000000  GPR7..... 2090E2A8
      GPR8..... 20FC55C8  GPR9..... 20FC6CA6  GPR10.... 20FC512C  GPR11.... 209D4C70
      GPR12.... 209159B0  GPR13.... 20FC7DC8  GPR14.... A09D4CA2  GPR15.... 00000000
      PSW..... 078D1400 A09D4D46

[17]  Traceback:
        DSA      Entry       E  Offset  Statement   Load Mod             Program Unit                   Service  Status
        1        CEEHSDMP    +000000D6              CEEPLPKA             CEEHSDMP                       D1908    Call
        2        CEEHDSP     +00003D0E              CEEPLPKA             CEEHDSP                        D1908    Call
        3        main        +000009BA              CELSAMP                                                      Exception
        4        EDCZMINV    +000000C0              CEEEV003                                                     Call
        5        CEEBBEXT    +000001B6              CEEPLPKA             CEEBBEXT                       D1908    Call

        DSA   DSA Addr   E  Addr    PU Addr    PU Offset  Comp Date  Compile Attributes
        1     20FC7DC8   209D4C70   209D4C70   +000000D6  20061215   CEL       POSIX
        2     20FC4CA8   209C4870   209C4870   +00003D0E  20061215   CEL       POSIX
        3     20FC4208   20900478   20900478   +000009BA  20070105   C/C++     POSIX EBCDIC  HFP
        4     20FC40F0   20E629EE   20E629EE   +000000C0  20061215   LIBRARY  POSIX
        5     20FC4030   20992840   20992840   +000001B6  20061215   CEL       POSIX

[18]  Control Blocks Associated with the Thread:
        Thread Synchronization Queue Element (SQEL): 2090EFF0
          +000000 2090EFF0  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000 |................................|
          +000020 2090F010  209159B0 00000000 00000000 00000000  00000000 00000000 00000000 00000000 |.j..............................|

[19]  Enclave Control Blocks:
        Mutex and Condition Variable Blocks (MCVB+MHT+CHT): 210F7018
          +000000 210F7018  00008F50 210F7044 000003F8 00001FC0  00000000 20FC3088 210F7444 000000F8 |...&.......8..........h.......8|
          +000020 210F7038  000007C0 00000000 20FC30A0 00000000  00000000 00000000 00000000 00000000 |................................|
          +000040 210F7058  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000 |................................|
⋮
        Thread Synchronization Enclave Latch Table (EPALT): 210F7544
          +000000 210F7544  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000 |................................|
          +000020 210F7564 - +00055F 210F7AA3             same as above
          +000560 210F7AA4  00000000 00000000 00000000 00000000  A0A83100 00000000 00000000 00000000 |................y...............|
          +000580 210F7AC4  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000 |................................|
          +0005A0 210F7AE4 - +00061F 210F7B63             same as above
          +000620 210F7B64  00000000 00000000 00000000 00000000  00000000 00000000 20A83100 00000000 |........................y.......|
          +000640 210F7B84  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000 |................................|
          +000660 210F7BA4 - +0009FF 210F7F43             same as above
        Thread Synchronization Trace Block (OTRB): 210F7000
          +000000 210F7000  210EF000 00000002 000007FF 210EF000  A0000000 A0000000 00008F50 210F7044 |..0...........0............&....|
        Thread Synchronization Trace Table (OTRTBL): 210EF000
          +000000 210EF000  0000C7D3 40D5E640 210F79E0 00000002  21334BD8 21333D78 DECCC288 00000000 |..GL NW ...........Q......Bh....|
          +000020 210EF020  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000 |................................|
          +000040 210EF040 - +007FFF 210F6FFF             same as above
        HEAPCHK Option Control Block (HCOP): 20FC00D0
          +000000 20FC00D0  C8C3D6D7 00000038 00000001 00000000  00000000 0000000A 0000000A 00000000 |HCOP.........................|
          +000020 20FC00F0  21368028 20FC0108 21102028 00000000  00000000 00000000 C8C3C6E3 00000200 |.....................HCFT....|
        HEAPCHK Element Table (HCEL) for Heapid 21366FC4 :
        Header: 21368028
          +000000 21368028  C8C3C5D3 20FC0CE0 00000000 21366FC4  000001F4 00000001 00000001 00000000 |HCEL..........?D...4............|
                            Address  Seg Addr Length             Address  Seg Addr Length
```

Figure 14. Example of formatted output from LEDATA Verbexit (Part 11 of 12)

```
        Table: 21368048
          +000000 21368048  21367020 21367000 000002A8 20FC3310  00000000 00000000 00000000 00000000 |...........y.....................|
        HEAPCHK Element Table (HCEL) for Heapid 00000000 :
        Header: 20FC0CE0
          +000000 20FC0CE0  C8C3C5D3 00000000 21368028 00000000  000001F4 00000005 00000005 00000000 |HCEL.............4.............|
                            Address  Seg Addr Length              Address  Seg Addr Length
        Table: 20FC0D00
          +000000 20FC0D00  20FE4038 20FE4018 00001028 20FC2C48  20FE5060 20FE4018 00000828 20FC2D10 |.. ... ...........&-.. .........|
          +000020 20FC0D20  20FE5888 20FE4018 00000CC8 20FC2DE8  20FE6550 20FE4018 00002028 20FC2F18 |...h.. ....H...Y...&.. .........|
          +000040 20FC0D40  20FE8578 20FE4018 00000CC8 21366EA8  00000000 00000000 00000000 00000000 |..e... ....H..>y................|

[20] Language Environment Trace Table:

        Most recent trace entry is at displacement: 004700

            Displacement                      Trace Entry in Hexadecimal                                    Trace Entry in EBCDIC
            ------------ ------------------------------------------------------------------------  --------------------------------
              +000000    Time 04.22.34.474835    Date 2007.01.06    Thread ID... 20DA9FB000000000
              +000010    Member ID.... 03    Flags..... 0000CE    Entry Type..... 00000001
              +000018    94818995 40404040 40404040 40404040  40404040 40404040 40404040 40404040  |main                            |
              +000038    60606E4D F0F8F55D 40979989 95A3864D  5D404040 40404040 40404040 40404040  |-->(085) printf()               |
              +000058    40404040 40404040 40404040 40404040  40404040 40404040 40404040 40404040  |                                |
              +000078    40404040 40404040                                                         |                                |

              +000080    Time 04.22.34.478351    Date 2007.01.06    Thread ID... 20DA9FB000000000
              +000090    Member ID.... 03    Flags..... 0000CE    Entry Type..... 00000002
              +000098    4C60604D F0F8F55D 40D9F1F5 7EF0F0F0  F0F0F0F0 C540C5D9 D9D5D67E F0F0F0F0  |<--(085) R15=0000000E ERRNO=0000|
              +0000B8    F0F0F0F0 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |0000............................|
              +0000D8    00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
              +0000F8    00000000 00000000                                                         |........                        |

              +000100    Time 04.22.34.478354    Date 2007.01.06    Thread ID... 20DA9FB000000000
              +000110    Member ID.... 03    Flags..... 0000CE    Entry Type..... 00000003
              +000118    94818995 40404040 40404040 40404040  40404040 40404040 40404040 40404040  |main                            |
              +000138    60606E4D F1F5F55D 4097A388 99858184  6D94A4A3 85A76D89 9589A34D 5D404040  |-->(155) pthread_mutex_init()   |
              +000158    40404040 40404040 40404040 40404040  40404040 40404040 40000000 00000000  |                           .....|
              +000178    00000000 00000000                                                         |........                        |

              +000180    Time 04.22.34.478361    Date 2007.01.06    Thread ID... 20DA9FB000000000
              +000190    Member ID.... 03    Flags..... 0000CE    Entry Type..... 00000004
              +000198    4C60604D F1F5F55D 40D9F1F5 7EF0F0F0  F0F0F0F0 F040C5D9 D9D5D67E F0F0F0F0  |<--(155) R15=00000000 ERRNO=0000|
              +0001B8    F0F0F0F0 40C5D9D9 D5D6F27E F0F0F0F0  F0F0F0F0 00000000 00000000 00000000  |0000 ERRNO2=00000000............|
              +0001D8    00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
              +0001F8    00000000 00000000                                                         |........                        |
⋮
              +004600    Time 04.22.38.116963    Date 2007.01.06    Thread ID... 20DA9FB000000000
              +004610    Member ID.... 03    Flags..... 0000CE    Entry Type..... 00000002
              +004618    4C60604D F0F8F55D 40D9F1F5 7EF0F0F0  F0F0F0F0 F040C5D9 D9D5D67E F0F0F0F0  |<--(085) R15=00000000 ERRNO=0000|
              +004638    F0F0F0F0 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |0000............................|
              +004658    00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
              +004678    00000000 00000000                                                         |........                        |

              +004680    Time 04.22.38.116964    Date 2007.01.06    Thread ID... 20DA9FB000000000
              +004690    Member ID.... 03    Flags..... 0000CE    Entry Type..... 00000001
              +004698    A3889985 81846D83 93858195 A4974040  40404040 40404040 40404040 40404040  |thread_cleanup                  |
              +0046B8    60606E4D F0F8F55D 40979989 95A3864D  5D404040 40404040 40404040 40404040  |-->(085) printf()               |
              +0046D8    40404040 40404040 40404040 40404040  40404040 40404040 40404040 40404040  |                                |
              +0046F8    40404040 40404040                                                         |                                |

              +004700    Time 04.22.38.116969    Date 2007.01.06    Thread ID... 20DA9FB000000000
              +004710    Member ID.... 03    Flags..... 0000CE    Entry Type..... 00000002
              +004718    4C60604D F0F8F55D 40D9F1F5 7EF0F0F0  F0F0F0F0 F040C5D9 D9D5D67E F0F0F0F0  |<--(085) R15=00000000 ERRNO=0000|
              +004738    F0F0F0F0 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |0000............................|
              +004758    00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
              +004778    00000000 00000000                                                         |........                        |

[21] Process Control Blocks:

       Thread Synchronization Process Latch Table (PPALT): 210F7F44
         +000000 210F7F44  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000 |................................|
         +000020 210F7F64 - +0009FF 210F8943             same as above

[22] No PIPICB associated with CAA at address : 209159B0
⋮
    Exiting Language Environment Data
```

Figure 14. Example of formatted output from LEDATA Verbexit (Part 12 of 12)

Sections of the Language Environment LEDATA Verbexit formatted output

The sections of the output listed here appear independently of the Language Environment-conforming languages used.

[1] - [9] Summary

These sections are included when the SUMMARY parameter is specified on the LEDATA invocation.

[1] Summary Header

The summary header section contains:
- Address of Thread control block (TCB)
- Release number
- Address Space ID (ASID)

[2] Active Members List

This list of active members is extracted from the enclave member list (MEML).

[3] CEECAA

This section formats the contents of the Language Environment common anchor area (CAA). See “The Common Anchor Area” on page 65 for a description of the fields in the CAA.

[4] CEEDLLF

This section formats the contents of all Language Environment CEEDLLF (DLLF) control blocks that are in use. See The CEEDLLF DLL Failure Control Block in *z/OS Language Environment Vendor Interfaces* for more information about the CEEDLLF control block chain.

[5] CEEPCB

This section formats the contents of the Language Environment process control block (PCB), and the process level member list.

[6] CEERCB

This section formats the contents of the Language Environment region control block (RCB).

[7] CEEEDB

This section formats the contents of the Language Environment enclave data block (EDB), and the enclave level member list.

[8] PMCB

This section formats the contents of the Language Environment program management control block (PMCB).

[9] Run-Time Options

This section lists the run-time options in effect at the time of the dump, and indicates where they were set.

[10] Heap Storage Control Blocks

This section is included when the HEAP or SM parameter is specified on the LEDATA invocation.

This section formats the Enclave-level storage management control block (ENSM) and for each different type of heap storage:

- Heap control block (HPCB)
- Chain of heap anchor blocks (HANC). A HANC immediately precedes each segment of heap storage.

This section includes a detailed heap segment report for each segment in the dump. For more information about the detailed heap segment report, see "Understanding the HEAP LEDATA output" on page 107.

[11] Stack Storage Control Blocks

This section is included when the STACK or SM parameter is specified on the LEDATA invocation.

This section formats:

- Storage management control block (SMCB)
- Chain of dynamic save areas (DSA)

  See "The upward-growing (non-XPLINK) stack frame section" on page 63 or "The downward-growing (XPLINK) stack frame section" on page 64 for a description of the fields in the DSA.
- Chain of stack segment headers (STKH)

  An STKH immediately precedes each segment of stack storage.

[12] Condition Management Control Blocks

This section is included when the CM parameter is specified on the LEDATA invocation.

This section formats the chain of Condition Information Block Headers (CIBH) and Condition Information Blocks. The Machine State Information Block is contained with the CIBH starting with the field labeled MCH_EYE. See "The condition information block" on page 74 for a description of fields in these control blocks.

[13] Message Processing Control Blocks

This section is included when the MH parameter is specified on the LEDATA invocation.

[14] - [21] CEEDUMP Formatted Control Blocks

These sections are included when the CEEDUMP parameter is specified on the LEDATA invocation.

[14]-[17] NTHREADS information

One or more instances of these sections are included when the NTHREADS() parameter is specified on the LEDATA invocation. For a description of NTHREADS, see “Report type parameters” on page 86.

[14] Enclave Identifier

This statement names the enclave for which information is provided.

[15] Information for thread

This section shows the system identifier for the thread. Each thread has a unique identifier.

[16] Registers and PSW

This section displays the register and program status word (PSW) values that were used to create the traceback. These values may come from the TCB, the RTM2 work area, a linkage stack entry or output from the BPXGMSTA service. This section is not displayed when the DSA() parameter is specified on the LEDATA invocation.

[17] Traceback

For all active routines in a particular thread, the traceback section shows routine information in two parts. The first part contains the following items:

- DSA number

  A number assigned to the information for this active routine by dump processing. The number is used to associate information from the first part of the traceback with information in the second part of the traceback.
- Entry

  For COBOL, Fortran, and PL/I routines, this is the entry point name. For C/C++ routines, this is the function name. If a function name or entry point was not specified for a particular routine, the string ’** NoName **’ will appear.
- Entry point offset
- Statement number

  This field contains no Language Environment data.
- Load module
- Program unit

  The primary entry point of the external procedure. For COBOL programs, this is the PROGRAM-ID name. For C, Fortran, and PL/I routines, this is the compile unit name. For Language Environment-conforming assemblers, this is the EPNAME = value on the CEEPPA macro.
- Service level

  The latest service level applied to the compile unit (for example, for IBM products, it would be the PTF number).
- Status

  Routine status can be call, exception, or running.

The second part contains the following items:

- DSA number

A number assigned to the information for this active routine by dump processing. The number is used to associate information from the first part of the traceback with information in the second part of the traceback.

- Stack frame (DSA) address
- Entry point address
- Program unit address
- Program unit offset

  The offset of the last instruction to run in the routine. If the offset is a negative number, zero, or a very large positive number, the routine associated with the offset probably did not allocate a save area, or the routine could have been called using SVC-assisted linkage. Adding the program unit address to the offset gives you the location of the current instruction in the routine. This offset is from the starting address of the routine.
- Compile Date

  Contains the year, month and day in which the routine was compiled.
- Attributes

  The available compilation attributes of the compile unit including:
  - A label identifying the LE-supported language such as COBOL, ENT PL/I, C/C++, and so on.
  - Compilation attributes such as EBCDIC, ASCII, IEEE, or hexadecimal floating point (HFP). The compilation attributes will only be displayed if there is enough information available.
  - POSIX, If the CEEDUMP was created under a POSIX environment.

[18] Control Blocks Associated with the Thread

This section lists the contents of the thread synchronization queue element (SQEL).

[19] Enclave Control Blocks

If the POSIX run-time option was set to ON, this section lists the contents of the mutex and condition variable control blocks, the enclave level latch table, and the thread synchronization trace block and trace table. If the HEAPCHK run-time option is set to ON, this section lists the contents of the HEAPCHK options control block (HCOP) and the HEAPCHK element tables (HCEL). A HEAPCHK element table contains the location and length of all allocated storage elements for a heap in the order that they were allocated.

[20] Language Environment Trace Table

If the TRACE run-time option was set to ON, this section shows the contents of the Language Environment trace table.

[21] Process Control Blocks

If the POSIX run-time option was set to ON, this section lists the contents of the process level latch table.

[22] Preinitialization Information

This section is included when the PTBL parameter is specified on the LEDATA invocation.

This section formats information related to preinitialization. See PTBL LEDATA output for more information. If the preinitialization service CEEPIPI was not used to initialize this environment, the message: `No PIPICB associated with CAA` is displayed instead.

PTBL LEDATA output

The Language Environment IPCS Verbexit LEDATA command generates formatted output of PreInit tables when the PTBL or ALL parameter are specified. If ALL is specified, PTBL defaults to CURRENT value. Figure 15 illustrates the output produced when the Verbexit LEDATA command is invoked with the PTBL parameter.

```
PTBL(CURRENT)
********************************************************************************
                          LANGUAGE ENVIRONMENT DATA
********************************************************************************

 Language Environment Product 04 V01 R09.00


PreInitialization Programming Interface Trace Data
CEEPIPI Environment Table Entry and Trace Entry :
 Active CEEPIPI Environment (  Address 20905CB0 )
 Eyecatcher  : CEEXIPTB
 TCB address : 008D6E88

 CEEPIPI Environment :
  Non-XPLINK Environment
  Environment Type : MAIN
  Sequence of Calls not active
  Exits not established
  Signal Interrupt Routines not registered
  Service Routines are not active

  CEEPIPI Environment Enclave Initialized
  Number of CEEPIPI Table Entries = 3

 CEEPIPI Table Entry Information :
 CEEPIPI Table Index 0  ( Entry 1   )
  Routine Name  = ISJPPCA3
  Routine Type  = C/C++
  Routine Entry Point  = A0910530
  Routine Function Pointer  = A0910620
  Routine Entry is Non-XPLINK
  Routine was loaded by Language Environment
  Routine Address was resolved
  Routine Function Descriptor was valid
  Routine Return Code    = 0
  Routine Reason Code    = 0

  Entry of routine in CEEPIPI Table for Index 0  ( 20905DB8 )

   +000000 20905DB8  A0910620 20919B30 80000000 00000000  00000000 00000000 00000000 00000000 |.j...j..........................|
   +000020 20905DD8  00000000 00000000 00000000 A0910530  00000003 209197D8 00000003 20910530 |.............j.......jpQ.....j..|
   +000040 20905DF8  A0910530 00009AD0 C9E2D1D7 D7C3C1F3  00000000 00000000 00000000 00000000 |.j......ISJPPCA3................|

 CEEPIPI Table Index 1  ( Entry 2   ) not in use.

 CEEPIPI Table Index 2  ( Entry 3   ) not in use.
```

Figure 15. Example of formatted PTBL output from LEDATA Verbexit (Part 1 of 2)

```
 CEEPIPI Trace Table Entries :
 Call Type =  INIT_MAIN
  PIPI Driver Address  = A090068A
  Load Service Return Code   = 0
  Load Service Reason Code   = 0
  Most Recent Return Code    = 0
  Most Recent Reason Code    = 0
  An ABEND will be issued if storage can not be obtained
  PreInit Environment will not allow EXEC CICS commands
  Service RC = 0 :A new environment was initialized.

 Call Type =  ADD_ENTRY
  Routine Table Index        = 1
  Routine Name  = ISJPPCA1
  Routine Address = A0FCC548
  Load Service Return Code   = 0
  Load Service Reason Code   = 3
  Service RC = 0 :The routine was added to the PreInit table.

 Call Type =  IDENTIFY_ENTRY
  Routine Table Index        = 1
  Routine Programming Language  = C/C++
  Service RC = 0 :The programming language has been returned.

 Call Type =  CALL_MAIN
  Routine Table Index     = 1
  Enclave Return Code     = 0
  Enclave Reason Code     = 0
  Routine Feedback Code   = 0000000000000000
  Service RC = 0 :The environment was activated and the routine called.

 Call Type =  DELETE_ENTRY
  Routine Table Index     = 1
  Routine Name  = ISJPPCA1
  Routine Address = A0FCC548
  Service RC = 0 :The routine was deleted from the PreInit table.

 Call Type =  CALL_MAIN
  Routine Table Index     = 0
  Enclave Return Code     = 0
  Enclave Reason Code     = 0
  Routine Feedback Code   = 0000000000000000
  Service RC = 0 :The environment was activated and the routine called.

Exiting Language Environment Data
```

Figure 15. Example of formatted PTBL output from LEDATA Verbexit (Part 2 of 2)

Understanding the HEAP LEDATA output

The Language Environment IPCS Verbexit LEDATA generates a detailed heap segment report when the HEAP option is used with the DETAIL option, or when the SM,DETAIL option is specified. The detailed heap segment report is useful when trying to pinpoint damage because it provides very specific information. The report describes the nature of the damage, and specifies where the actual damage occurred. The report can also be used to diagnose storage leaks, and to identify heap fragmentation. Figure 16 on page 108 illustrates the output produced by specifying the HEAP option. “Heap report sections of the LEDATA output” on page 111 describes the information contained in the formatted output.

For easy reference, the sections of the dump are numbered to correspond with the description of each section that follows. Ellipses are used to summarize some sections of the dump.

Note: Language Environment does not provide support for alternative Vendor Heap Manager (VHM) data. LEDATA verb exit will state that an alternative VHM is in use.

```
IP VERBEXIT LEDATA 'HEAP'
*******************************************************************************
                          LANGUAGE ENVIRONMENT DATA
 *******************************************************************************
 Language Environment Productt 04 V01 R02.00

 Heap Storage Control Blocks

     ENSM:  00014D30
   +0000A8  ENSM_ADDL_HEAPS:259B1120

   User Heap Control Blocks

     HPCB:  00014D48
   +000000  EYE_CATCHER:HPCB  FIRST:25995000    LAST:25995000

     HANC:  25995000
   +000000  EYE_CATCHER:HANC  NEXT:00014D48     PREV:00014D48
   +00000C  HEAPID:00000000   SEG_ADDR:25995000       ROOT_ADDR:259950B0
   +000018  SEG_LEN:00008000        ROOT_LEN:00007F50

   This is the last heap segment in the current heap.

[1]Free Storage Tree for Heap Segment 25995000

           Node      Node     Parent     Left      Right     Left     Right
 Depth  Address    Length     Node      Node      Node     Length    Length
     0  259950B0  00007F50  00000000  00000000  00000000  00000000  00000000

[2]Map of Heap Segment 25995000

 To display entire segment: IP LIST 25995000 LEN(X'00008000') ASID(X'0021')

 25995020: Allocated storage element, length=00000038. To display: IP LIST 25995020 LEN(X'00000038') ASID(X'0021')
 25995028: C3C4D3D3 00000000 40000000 00000000  24700F98 24703F70 25993870 00000490 |CDLL.... .........q.....r.....|

 25995058: Allocated storage element, length=00000038. To display: IP LIST 25995058 LEN(X'00000038') ASID(X'0021')
 25995060: C3C4D3D3 25995028 80000000 00000000  247006F0 24700770 2471CEB0 00000150 |CDLL.r&............0...........&|

 25995090: Allocated storage element, length=00000010. To display: IP LIST 25995090 LEN(X'00000010') ASID(X'0021')
 25995098: 259ADBB8 00000000                                                       |........                        |

 259950A0: Allocated storage element, length=00000010. To display: IP LIST 259950A0 LEN(X'00000010') ASID(X'0021')
 259950A8: 259ADBE0 00000000                                                       |........                        |

 259950B0: Free storage element, length=00007F50. To display: IP LIST 259950B0 LEN(X'00007F50') ASID(X'0021')

 Summary of analysis for Heap Segment 25995000:

    Amounts of identified storage:  Free:00007F50  Allocated:00000090  Total:00007FE0
    Number of identified areas   :  Free:       1  Allocated:       4  Total:       5
    00000000 bytes of storage were not accounted for.
    No errors were found while processing this heap segment.
    This is the last heap segment in the current heap.


 Anywhere Heap Control Blocks

     HPCB:  00014D78
   +000000  EYE_CATCHER:HPCB  FIRST:24A91000    LAST:259C2000

     HANC:  24A91000
   +000000  EYE_CATCHER:HANC  NEXT:25993000     PREV:00014D78
   +00000C  HEAPID:00014D78   SEG_ADDR:24A91000       ROOT_ADDR:00000000
   +000018  SEG_LEN:00F00028        ROOT_LEN:00000000

   Free Storage Tree for Heap Segment 24A91000

       The free storage tree is empty.
```

Figure 16. Example formatted detailed heap segment report from LEDATA Verbexit (Part 1 of 4)

```
   Map of Heap Segment 24A91000

 To display entire segment: IP LIST 24A91000 LEN(X'00F00028') ASID(X'0021')

 24A91020: Allocated storage element, length=00F00008. To display: IP LIST 24A91020 LEN(X'00F00008') ASID(X'0021')
 24A91028: B035F6D8 B2C00081 24ABED80 00000000  03000000 00000001 94818995 40404040 |..6Q...a.............main    |

Summary of analysis for Heap Segment 24A91000:
    Amounts of identified storage:  Free:00000000  Allocated:00F00008  Total:00F00008
    Number of identified areas   :  Free:       0  Allocated:       1  Total:       1
    00000000 bytes of storage were not accounted for.
    No errors were found while processing this heap segment.
⋮

     HANC:  259AC000
   +000000  EYE_CATCHER:HANC  NEXT:259AF000     PREV:2599D000
   +00000C  HEAPID:00014D78   SEG_ADDR:259AC000       ROOT_ADDR:259AC020
   +000018  SEG_LEN:00002000        ROOT_LEN:00000C30

   Free Storage Tree for Heap Segment 259AC000

          Node      Node     Parent     Left      Right     Left     Right
 Depth  Address    Length     Node      Node      Node     Length    Length
     0  259AC020  00000C30  00000000  00000000  259ADC48  00000000  000003B8
     1  259ADC48  000003B8  259AC020  00000000  00000000  00000000  00000000

   Map of Heap Segment 259AC000

 To display entire segment: IP LIST 259AC000 LEN(X'00002000') ASID(X'0021')

 259AC020: Free storage element, length=00000C30. To display: IP LIST 259AC020 LEN(X'00000C30') ASID(X'0021')

 259ACC50: Allocated storage element, length=00000728. To display: IP LIST 259ACC50 LEN(X'00000728') ASID(X'0021')
 259ACC58: D3D3E340 071C0001 00000000 00000000  00000000 00000003 00000040 20010003 |LLT ..................... ....|

 259AD378: Allocated storage element, length=00000080. To display: IP LIST 259AD378 LEN(X'00000080') ASID(X'0021')
 259AD380: 00000000 00000000 247006F0 247006F0  000008A8 2471CEB0 00000000 00000001 |...........0...0...y............|

 259AD3F8: Allocated storage element, length=00000068. To display: IP LIST 259AD3F8 LEN(X'00000068') ASID(X'0021')
 259AD400: C5E3C3E2 00000007 00000000 25993870  A4797478 247971E0 25993870 A4797478 |ETCS.........r..u........r..u...|

 259AD460: Allocated storage element, length=00000728. To display: IP LIST 259AD460 LEN(X'00000728') ASID(X'0021')
 259AD468: C3D3D3E3 071C0001 00000000 00000000  00000000 00000001 00000040 60010005 |CLLT...................... -...|

 259ADB88: Allocated storage element, length=00000028. To display: IP LIST 259ADB88 LEN(X'00000028') ASID(X'0021')
 259ADB90: 180F58FF 001007FF 24700AB8 2471CEB0  2479A6E8 FFFFFFFE 247006F0 259AD380 |..................wY.......0..L.|

 259ADBB0: Allocated storage element, length=00000028. To display: IP LIST 259ADBB0 LEN(X'00000028') ASID(X'0021')
 259ADBB8: 00000000 25995098 70004000 00000000  00000000 00000000 00000000 00000000 |.....r.&q.......................|

 259ADBD8: Allocated storage element, length=00000028. To display: IP LIST 259ADBD8 LEN(X'00000028') ASID(X'0021')
 259ADBE0: 00000000 259950A8 70004000 00000000  00000000 00000000 00000000 00000000 |.....r.&y.......................|

 259ADC00: Allocated storage element, length=00000048. To display: IP LIST 259ADC00 LEN(X'00000048') ASID(X'0021')
 259ADC08: C1C4C8D7 F0F00000 259ADC14 C8D7C3C2  259AE000 259AE000 00001000 00001000 |ADHP00......HPCB................|

 259ADC48: Free storage element, length=000003B8. To display: IP LIST 259ADC48 LEN(X'000003B8') ASID(X'0021')

 Summary of analysis for Heap Segment 259AC000:
    Amounts of identified storage:  Free:00000FE8  Allocated:00000FF8  Total:00001FE0
    Number of identified areas   :  Free:       2  Allocated:       8  Total:      10
    00000000 bytes of storage were not accounted for.
    No errors were found while processing this heap segment.
⋮
```

Figure 16. Example formatted detailed heap segment report from LEDATA Verbexit (Part 2 of 4)

```
  Below Heap Control Blocks

    HPCB:  00014DA8
  +000000  EYE_CATCHER:HPCB  FIRST:00044000    LAST:00044000

    HANC:  00044000
  +000000  EYE_CATCHER:HANC  NEXT:00014DA8     PREV:00014DA8
  +00000C  HEAPID:00014DA8   SEG_ADDR:80044000       ROOT_ADDR:00044388
  +000018  SEG_LEN:00002000        ROOT_LEN:00001C78

  This is the last heap segment in the current heap.

  Free Storage Tree for Heap Segment 00044000

         Node      Node     Parent     Left      Right     Left     Right
Depth  Address    Length     Node      Node      Node     Length    Length

    0  00044388  00001C78  00000000  00000000  00000000  00000000  00000000

  Map of Heap Segment 00044000

To display entire segment: IP LIST 00044000 LEN(X'00002000') ASID(X'0021')

00044020: Allocated storage element, length=00000048. To display: IP LIST 00044020 LEN(X'00000048') ASID(X'0021')
00044028: C8C4D3E2 00000000 00044220 00000040  00010000 00000001 000241E0 24701038 |HDLS.......... .................|

00044068: Allocated storage element, length=00000128. To display: IP LIST 00044068 LEN(X'00000128') ASID(X'0021')
00044070: 07000700 05E0900F E0A641DE 002258C0  E11258F0 E1160B0F E2C6E7D4 01200001 |.........w.........0....SFXM....|

00044190: Allocated storage element, length=00000088. To display: IP LIST 00044190 LEN(X'00000088') ASID(X'0021')
00044198: C3E2E3D2 00000000 00000000 00800001  00000001 00000068 04000000 00000000 |CSTK............................|

00044218: Allocated storage element, length=00000048. To display: IP LIST 00044218 LEN(X'00000048') ASID(X'0021')
00044220: C8C4D3E2 00044028 00000000 00000040  00010000 00000002 000241E0 259ADB90 |HDLS.. ........ .................|

00044260: Allocated storage element, length=00000128. To display: IP LIST 00044260 LEN(X'00000128') ASID(X'0021')
00044268: 07000700 05E0900F E0A641DE 002258C0  E11258F0 E1160B0F E2C6E7D4 01200001 |.........w.........0....SFXM....|

00044388: Free storage element, length=00001C78. To display: IP LIST 00044388 LEN(X'00001C78') ASID(X'0021')

Summary of analysis for Heap Segment 00044000:
   Amounts of identified storage:  Free:00001C78  Allocated:00000368  Total:00001FE0
   Number of identified areas   :  Free:       1  Allocated:       5  Total:       6
   00000000 bytes of storage were not accounted for.
   No errors were found while processing this heap segment.
   This is the last heap segment in the current heap.

  Additional Heap Control Blocks

    ADHP:  259B1120
  +000000  EYE_CATCHER:ADHP  NEXT:259B24A8     HEAPID:259B112C

    HPCB:  259B112C
  +000000  EYE_CATCHER:hpcb  FIRST:259B112C    LAST:259B112C

    ADHP:  259B24A8
  +000000  EYE_CATCHER:ADHP  NEXT:259ADC08     HEAPID:259B24B4

    HPCB:  259B24B4
  +000000  EYE_CATCHER:hpcb  FIRST:259B24B4    LAST:259B24B4

    ADHP:  259ADC08
  +000000  EYE_CATCHER:ADHP  NEXT:F0F00000     HEAPID:259ADC14

    HPCB:  259ADC14
  +000000  EYE_CATCHER:HPCB  FIRST:259AE000    LAST:259AE000

    HANC:  259AE000
  +000000  EYE_CATCHER:HANC  NEXT:259ADC14     PREV:259ADC14
  +00000C  HEAPID:259ADC14   SEG_ADDR:259AE000       ROOT_ADDR:259AE1E8
  +000018  SEG_LEN:00001000        ROOT_LEN:00000E18
```

Figure 16. Example formatted detailed heap segment report from LEDATA Verbexit (Part 3 of 4)

```
   This is the last heap segment in the current heap.

   Free Storage Tree for Heap Segment 259AE000

          Node      Node     Parent     Left      Right     Left     Right
 Depth  Address    Length     Node      Node      Node     Length    Length
     0  259AE1E8  00000E18  00000000  00000000  00000000  00000000  00000000

   Map of Heap Segment 259AE000

 To display entire segment: IP LIST 259AE000 LEN(X'00001000') ASID(X'0021')

 259AE020: Allocated storage element, length=000001C8. To display: IP LIST 259AE020 LEN(X'000001C8') ASID(X'0021')
 259AE028: D7C3C9C2 00000000 00000000 000101BC  00000000 00000000 00000000 00000000 |PCIB............................|

 259AE1E8: Free storage element, length=00000E18. To display: IP LIST 259AE1E8 LEN(X'00000E18') ASID(X'0021')

 Summary of analysis for Heap Segment 259AE000:
    Amounts of identified storage:  Free:00000E18  Allocated:000001C8  Total:00000FE0
    Number of identified areas   :  Free:       1  Allocated:       1  Total:       2
    00000000 bytes of storage were not accounted for.
    No errors were found while processing this heap segment.
    This is the last heap segment in the current heap.

Exiting Language Environment Data
```

Figure 16. Example formatted detailed heap segment report from LEDATA Verbexit (Part 4 of 4)

Heap report sections of the LEDATA output

The Heap Report sections of the LEDATA output provide information for each heap segment in the dump. The detailed heap segment reports include information on the free storage tree in the heap segments, the allocated storage elements, and the cause of heap management data structure problems.

[1]Free Storage Tree Report

Within each heap segment, Language Environment keeps track of unallocated storage areas by chaining them together into a tree. Each free area represents a node in the tree. Each node contains a header, which points to its left and right child nodes. The header also contains the length of each child.

The LEDATA HEAP option formats the free storage tree within each heap, and validates all node addresses and lengths within each node. Each node address is validated to ensure that it:

- Falls on a doubleword boundary
- Falls within the current heap segment
- Does not point to itself
- Does not point to a node that was previously traversed

Each node length is validated to ensure that it:

- Is a multiple of 8
- Is not larger than the heap segment length
- Does not cause the end of the node to fall outside of the current heap segment
- Does not cause the node to overlap another node

If the formatter finds a problem, then it will place an error message describing the problem directly after the formatted line of the node that failed validation

[2]Heap Segment Map Report

The LEDATA HEAP option produces a report that lists all of the storage areas within each heap segment, and identifies the area as either allocated or freed. For each

allocated area the contents of the first X'20' bytes of the area are displayed in order to help identify the reason for the storage allocation.

Each allocated storage element has an 8 byte prefix used by Language Environment to manage the area. The first fullword contains a pointer to the start of the heap segment. The second fullword contains the length of the allocated storage element. The formatter validates this header to ensure that its heap segment pointer is valid. The length is also validated to ensure that it:

- Is a multiple of 8
- Is not zero
- Is not larger than the heap segment length
- Does not cause the end of the element to fall outside of the current heap segment
- Does not cause the element to overlap a free storage node

If the heap_free_value of the STORAGE run-time option was specified, then the formatter also checks that the free storage within each free storage element is set to the requested heap_free_value. If a problem is found, then an error message describing the problem is placed after the formatted line of the storage element that failed validation.

Diagnosing heap damage problems

Heap storage errors can occur when an application allocates a heap storage element that is too small for it to use, and therefore, accidently overlays heap storage. If this situation occurs then some of the typical error messages generated are:

- The node address does not represent a valid node within the heap segment
- The length of the segment is not valid, or
- The heap segment pointer is not valid.

If one of the above error messages is generated by one of the reports, then examine the storage element that immediately precedes the damaged node to determine if this storage element is owned by the application program. Check the size of the storage element and ensure that it is sufficient for the program's use. If the size of the storage element is not sufficient then adjust the allocation size.

If an error occurs indicating that the node's pointers form a circular loop within the free storage tree, then check the Free Storage Tree Report to see if such a loop exists. If a loop exists, then contact the IBM support center for assistance because this may be a problem in the Language Environment heap management routines.

Additional diagnostic information regarding heap damage can be obtained by using the HEAPCHK run-time option. This option provides a more accurate time perspective on when the heap damage actually occurred, which could help to determine the program that caused the damage. For more information on HEAPCHK, see *z/OS Language Environment Programming Reference*.

Diagnosing storage leak problems

A storage leak occurs when a program does not return storage back to the heap after it has finished using it. To determine if this problem exists, do one of the following:

- The *call-level* suboption of the HEAPCHK run-time option causes a report to be produced in the CEEDUMP. Any still-allocated (that is, not freed) storage identified by HEAPCHK is listed in the report, along with the corresponding traceback. This shows any storage that wasn't freed, as well as all the calls that

were involved in allocating the storage. For more information about the HEAPCHK run-time option, see *z/OS Language Environment Programming Reference* .

- Examine the Heap Segment Map report to see if any data areas, within the allocated storage elements, appear more frequently than expected. If they do, then check to see if these data areas are still being used by the application program. If the data areas are not being used, then change the program to free the storage element after it is done with it.

Diagnosing heap fragmentation problems

Heap fragmentation occurs when allocated storage is interlaced with many free storage areas that are too small for the application to use. Heap fragmentation could indicate that the application is not making efficient use of its heap storage. Check the Heap Segment Map report for frequent free storage elements that are interspersed with the allocated storage elements.

Understanding the heappool LEDATA output

The Language Environment IPCS Verbexit LEDATA generates a detailed heappool report when heappools is ON. The detailed heappool report is useful when trying to find potential damaged cells because it provides very specific information.Figure 17 on page 114 illustrates the details of heappool report. “Heappool report sections of the LEDATA output” on page 118 describes the information contained in the formatted output.

```
Heap Pool Report
    QPCB:  25C1EA00
  +000000  EYECATCHER:QPCB   LENGTH:00000F00   NUMPOOLS:0000000A
  +00000C  LARGEST_CELL_SIZE:00000800    BIG_REQUESTS:00000000
  +000014  STORAGE_HITS_ADDR:00000000    FLAGS:0400  NUMGETARRAYS:05
  +00001B  NUMCELLSIZES:06   GET_POOLINFO_ARRAYS_PTR:25C1EB00
-
  Data for pool 1:
POOLDATA:  25C1EE00
  +000000  POOL_INDEX:00000001     INPUT_CELL_SIZE:00000008
  +000008  CELL_SIZE:00000010      INPUT_PERCENT:00000001
  +000010  CELL_POOL_SIZE:00000140       CELL_POOL_NUM:00000014
  +000018  POOL_LATCH_ADDR:25C54BD4      POOL_EXTENTS:00000001
  +000020  LAST_CELL:25C45C30      NEXT_CELL:25C45B10
  +000028  Q_CONTROL_INFO:0000031F       Q_FIRST_CELL:25C45B00
  +000030  POOL_NUM_GET_TOTAL:00000190   POOL_NUM_FREE:00000001
  +000038  POOL_EXTENTS_ANCHOR:25C45AF8        POOL_INDEX_SAME_SIZE:01
  +00003D  POOL_INDEX_SIZE:01      POOL_NUM_SAME_SIZE:01
  +000040  POOL_TRACE_TABLE:25C56060
    [2]Heap Pool Extent Mapping
  EXTENT:  25C45AF8
  +000000  EYE_CATCHER:EX31  NEXT_EXTENT:00000000
    To display entire pool extent: IP LIST 25C45AF8 LEN(X'00000148') ASID(X'0020')
    25C45B00: Free storage cell. To display: IP LIST 25C45B00 LEN(X'00000010') ASID(X'0020')
    [1]Verifying free chain for pool: 1...
       No errors were found while processing free chain.
    Summary of analysis for Pool 1:
       Number of cells:  Unused:       19  Free:       1  Allocated:       0  Total Used:       20
       00000000 free cells were not accounted for.
       No errors were found while processing this Pool.
-
  Data for pool 2:
POOLDATA:  25C1EF00
  +000000  POOL_INDEX:00000002     INPUT_CELL_SIZE:00000020
  +000008  CELL_SIZE:00000028      INPUT_PERCENT:00000001
  +000010  CELL_POOL_SIZE:00000140       CELL_POOL_NUM:00000008
  +000018  POOL_LATCH_ADDR:25C54BE8      POOL_EXTENTS:00000001
  +000020  LAST_CELL:25C45D68      NEXT_CELL:25C45C78
  +000028  Q_CONTROL_INFO:0000031F       Q_FIRST_CELL:25C45C50
  +000030  POOL_NUM_GET_TOTAL:00000190   POOL_NUM_FREE:00000001
  +000038  POOL_EXTENTS_ANCHOR:25C45C48        POOL_INDEX_SAME_SIZE:01
  +00003D  POOL_INDEX_SIZE:02      POOL_NUM_SAME_SIZE:01
  +000040  POOL_TRACE_TABLE:25C86080
  [2]Heap Pool Extent Mapping
  EXTENT:  25C45C48
  +000000  EYE_CATCHER:EX31  NEXT_EXTENT:00000000
    To display entire pool extent: IP LIST 25C45C48 LEN(X'00000148') ASID(X'0020')
    25C45C50: Free storage cell. To display: IP LIST 25C45C50 LEN(X'00000028') ASID(X'0020')
  [1]Verifying free chain for pool: 2...
       No errors were found while processing free chain.
    Summary of analysis for Pool 2:
       Number of cells:  Unused:       7  Free:       1  Allocated:       0  Total Used:       8
       00000000 free cells were not accounted for.
       No errors were found while processing this Pool.
-
  Data for pool 3:
POOLDATA:  25C1F000
  +000000  POOL_INDEX:00000003     INPUT_CELL_SIZE:00000080
  +000008  CELL_SIZE:00000088      INPUT_PERCENT:00000001
  +000010  CELL_POOL_SIZE:00000220       CELL_POOL_NUM:00000004
  +000018  POOL_LATCH_ADDR:25C54BFC      POOL_EXTENTS:00000002
  +000020  LAST_CELL:25C45F38      NEXT_CELL:25C45F38
  +000028  Q_CONTROL_INFO:0000095D       Q_FIRST_CELL:25C45DA0
  +000030  POOL_NUM_GET_TOTAL:000004B4   POOL_NUM_FREE:00000003
  +000038  POOL_EXTENTS_ANCHOR:25C45D98        POOL_INDEX_SAME_SIZE:01
  +00003D  POOL_INDEX_SIZE:03      POOL_NUM_SAME_SIZE:01
  +000040  POOL_TRACE_TABLE:25CB60A0
```

Figure 17. Example formatted detailed heappool report from LEDATA Verbexit (Part 1 of 4)

```
[2]Heap Pool Extent Mapping
  EXTENT:  25C45D98
  +000000  EYE_CATCHER:EX31  NEXT_EXTENT:25C43898
    To display entire pool extent: IP LIST 25C45D98 LEN(X'00000228') ASID(X'0020')
    25C45DA0: Free storage cell. To display: IP LIST 25C45DA0 LEN(X'00000088') ASID(X'0020')
    25C45E28: Free storage cell. To display: IP LIST 25C45E28 LEN(X'00000088') ASID(X'0020')
    25C45EB0: Free storage cell. To display: IP LIST 25C45EB0 LEN(X'00000088') ASID(X'0020')
  EXTENT:  25C43898
  +000000  EYE_CATCHER:EX31  NEXT_EXTENT:00000000
    To display entire pool extent: IP LIST 25C43898 LEN(X'00000228') ASID(X'0020')
    25C438A0: Allocated storage cell. To display: IP LIST 25C438A0 LEN(X'00000088') ASID(X'0020')
    25C438A8: C3C4D3D3 00000000 40000000 00000000 25C00000 25C016F8 25E37038 00004EC0|CDLL.... ........{...{.8.T....+{|
    25C43928: Allocated storage cell. To display: IP LIST 25C43928 LEN(X'00000088') ASID(X'0020')
    25C43930: 00000000 25C1F8E0 20004000 00000000 25C43954 00000000 00000000 00000000|.....A8\.. ......D.............|
    25C439B0: Allocated storage cell. To display: IP LIST 25C439B0 LEN(X'00000088') ASID(X'0020')
    25C439B8: 00000000 25C1F8EC 20004000 00000000 25C439DC 00000000 00000000 00000000|.....A8... ......D.............|
    25C43A38: Allocated storage cell. To display: IP LIST 25C43A38 LEN(X'00000088') ASID(X'0020')
    25C43A40: 00000000 25C1BBD8 20004000 00000000 25C43A64 00000000 00000000 00000000|.....A.Q.. ......D.............|
  [1]Verifying free chain for pool: 3...
       No errors were found while processing free chain.
    Summary of analysis for Pool 3:
       Number of cells:  Unused:       1  Free:       3  Allocated:       4  Total Used:       8
       00000000 free cells were not accounted for.
       No errors were found while processing this Pool.
-
  Data for pool 4:
POOLDATA:  25C1F100
  +000000  POOL_INDEX:00000004     INPUT_CELL_SIZE:00000100
  +000008  CELL_SIZE:00000108      INPUT_PERCENT:00000001
  +000010  CELL_POOL_SIZE:00000420       CELL_POOL_NUM:00000004
  +000018  POOL_LATCH_ADDR:25C54C10      POOL_EXTENTS:00000001
  +000020  LAST_CELL:25C462E8      NEXT_CELL:25C461E0
  +000028  Q_CONTROL_INFO:0000063E       Q_FIRST_CELL:25C45FD0
  +000030  POOL_NUM_GET_TOTAL:00000320   POOL_NUM_FREE:00000002
  +000038  POOL_EXTENTS_ANCHOR:25C45FC8        POOL_INDEX_SAME_SIZE:01
  +00003D  POOL_INDEX_SIZE:04      POOL_NUM_SAME_SIZE:01
  +000040  POOL_TRACE_TABLE:25CE60C0
  [2]Heap Pool Extent Mapping
  EXTENT:  25C45FC8
  +000000  EYE_CATCHER:EX31  NEXT_EXTENT:00000000
    To display entire pool extent: IP LIST 25C45FC8 LEN(X'00000428') ASID(X'0020')
    25C45FD0: Free storage cell. To display: IP LIST 25C45FD0 LEN(X'00000108') ASID(X'0020')
    25C460D8: Free storage cell. To display: IP LIST 25C460D8 LEN(X'00000108') ASID(X'0020')
  [1]Verifying free chain for pool: 4...
       No errors were found while processing free chain.
    Summary of analysis for Pool 4:
       Number of cells:  Unused:       2  Free:       2  Allocated:       0  Total Used:       4
       00000000 free cells were not accounted for.
       No errors were found while processing this Pool.
-
  Data for pool 5.1:
POOLDATA:  25C1F200
  +000000  POOL_INDEX:00000005     INPUT_CELL_SIZE:00000400
  +000008  CELL_SIZE:00000408      INPUT_PERCENT:00000001
  +000010  CELL_POOL_SIZE:00001020       CELL_POOL_NUM:00000004
  +000018  POOL_LATCH_ADDR:25C54C24      POOL_EXTENTS:00000002
  +000020  LAST_CELL:25E48C48      NEXT_CELL:25E48438
  +000028  Q_CONTROL_INFO:000001DD       Q_FIRST_CELL:25C42858
  +000030  POOL_NUM_GET_TOTAL:000000F2   POOL_NUM_FREE:00000003
  +000038  POOL_EXTENTS_ANCHOR:25E48028        POOL_INDEX_SAME_SIZE:01
  +00003D  POOL_INDEX_SIZE:05      POOL_NUM_SAME_SIZE:05
  +000040  POOL_TRACE_TABLE:25D160E0
```

Figure 17. Example formatted detailed heappool report from LEDATA Verbexit (Part 2 of 4)

```
   [2]Heap Pool Extent Mapping
   EXTENT:  25E48028
   +000000  EYE_CATCHER:EX31  NEXT_EXTENT:25C42040
     To display entire pool extent: IP LIST 25E48028 LEN(X'00001028') ASID(X'0020')
     25E48030: Free storage cell. To display: IP LIST 25E48030 LEN(X'00000408') ASID(X'0020')
   EXTENT:  25C42040
   +000000  EYE_CATCHER:EX31  NEXT_EXTENT:00000000
     To display entire pool extent: IP LIST 25C42040 LEN(X'00001028') ASID(X'0020')
     25C42048: Allocated storage cell. To display: IP LIST 25C42048 LEN(X'00000408') ASID(X'0020')
     25C42050: 25C43070 25C43258 25C43295 25C432D2 25C4330F 25C4334C 25C43389 25C433C6|.D...D...D.n.D.K.D...D.<.D.i.D.F|
     25C42450: Allocated storage cell. To display: IP LIST 25C42450 LEN(X'00000408') ASID(X'0020')
     25C42458: 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000|................................|
     25C42858: Free storage cell. To display: IP LIST 25C42858 LEN(X'00000408') ASID(X'0020')
     25C42C60: Free storage cell. To display: IP LIST 25C42C60 LEN(X'00000408') ASID(X'0020')
   [1]Verifying free chain for pool: 5.1...
        No errors were found while processing free chain.
     Summary of analysis for Pool 5.1:
        Number of cells:  Unused:       3  Free:       3  Allocated:       2  Total Used:       8
        00000000 free cells were not accounted for.
        No errors were found while processing this Pool.
-
   Data for pool 5.2:
POOLDATA:  25C1F300
   +000000  POOL_INDEX:00000006     INPUT_CELL_SIZE:00000400
   +000008  CELL_SIZE:00000408      INPUT_PERCENT:00000001
   +000010  CELL_POOL_SIZE:00001020       CELL_POOL_NUM:00000004
   +000018  POOL_LATCH_ADDR:25C54C24      POOL_EXTENTS:00000001
   +000020  LAST_CELL:25C47018      NEXT_CELL:25C47018
   +000028  Q_CONTROL_INFO:000001DD       Q_FIRST_CELL:25C46400
   +000030  POOL_NUM_GET_TOTAL:000000F0   POOL_NUM_FREE:00000003
   +000038  POOL_EXTENTS_ANCHOR:25C463F8        POOL_INDEX_SAME_SIZE:02
   +00003D  POOL_INDEX_SIZE:05      POOL_NUM_SAME_SIZE:05
   +000040  POOL_TRACE_TABLE:25D46100
   [2]Heap Pool Extent Mapping
   EXTENT:  25C463F8
   +000000  EYE_CATCHER:EX31  NEXT_EXTENT:00000000
     To display entire pool extent: IP LIST 25C463F8 LEN(X'00001028') ASID(X'0020')
     25C46400: Free storage cell. To display: IP LIST 25C46400 LEN(X'00000408') ASID(X'0020')
     25C46808: Free storage cell. To display: IP LIST 25C46808 LEN(X'00000408') ASID(X'0020')
     25C46C10: Free storage cell. To display: IP LIST 25C46C10 LEN(X'00000408') ASID(X'0020')
   [1]Verifying free chain for pool: 5.2...
        No errors were found while processing free chain.
     Summary of analysis for Pool 5.2:
        Number of cells:  Unused:       1  Free:       3  Allocated:       0  Total Used:       4
        00000000 free cells were not accounted for.
        No errors were found while processing this Pool.
-
   Data for pool 5.3:
POOLDATA:  25C1F400
   +000000  POOL_INDEX:00000007     INPUT_CELL_SIZE:00000400
   +000008  CELL_SIZE:00000408      INPUT_PERCENT:00000001
   +000010  CELL_POOL_SIZE:00001020       CELL_POOL_NUM:00000004
   +000018  POOL_LATCH_ADDR:25C54C24      POOL_EXTENTS:00000001
   +000020  LAST_CELL:25E49C78      NEXT_CELL:25E49C78
   +000028  Q_CONTROL_INFO:000001DD       Q_FIRST_CELL:25E49060
   +000030  POOL_NUM_GET_TOTAL:000000F0   POOL_NUM_FREE:00000003
   +000038  POOL_EXTENTS_ANCHOR:25E49058        POOL_INDEX_SAME_SIZE:03
   +00003D  POOL_INDEX_SIZE:05      POOL_NUM_SAME_SIZE:05
   +000040  POOL_TRACE_TABLE:25D76120
   [2]Heap Pool Extent Mapping
   EXTENT:  25E49058
   +000000  EYE_CATCHER:EX31  NEXT_EXTENT:00000000
     To display entire pool extent: IP LIST 25E49058 LEN(X'00001028') ASID(X'0020')
     25E49060: Free storage cell. To display: IP LIST 25E49060 LEN(X'00000408') ASID(X'0020')
     25E49468: Free storage cell. To display: IP LIST 25E49468 LEN(X'00000408') ASID(X'0020')
     25E49870: Free storage cell. To display: IP LIST 25E49870 LEN(X'00000408') ASID(X'0020')
   [1]Verifying free chain for pool: 5.3...
        No errors were found while processing free chain.
     Summary of analysis for Pool 5.3:
        Number of cells:  Unused:       1  Free:       3  Allocated:       0  Total Used:       4
        00000000 free cells were not accounted for.
        No errors were found while processing this Pool.
-
```

Figure 17. Example formatted detailed heappool report from LEDATA Verbexit (Part 3 of 4)

```
  Data for pool 5.4:
POOLDATA:  25C1F500
  +000000  POOL_INDEX:00000008     INPUT_CELL_SIZE:00000400
  +000008  CELL_SIZE:00000408      INPUT_PERCENT:00000001
  +000010  CELL_POOL_SIZE:00001020       CELL_POOL_NUM:00000004
  +000018  POOL_LATCH_ADDR:25C54C24      POOL_EXTENTS:00000001
  +000020  LAST_CELL:25C48048      NEXT_CELL:25C48048
  +000028  Q_CONTROL_INFO:000001DD       Q_FIRST_CELL:25C47430
  +000030  POOL_NUM_GET_TOTAL:000000F0   POOL_NUM_FREE:00000003
  +000038  POOL_EXTENTS_ANCHOR:25C47428        POOL_INDEX_SAME_SIZE:04
  +00003D  POOL_INDEX_SIZE:05      POOL_NUM_SAME_SIZE:05
  +000040  POOL_TRACE_TABLE:25DA6140
  [2]Heap Pool Extent Mapping
  EXTENT:  25C47428
  +000000  EYE_CATCHER:EX31  NEXT_EXTENT:00000000
    To display entire pool extent: IP LIST 25C47428 LEN(X'00001028') ASID(X'0020')
    25C47430: Free storage cell. To display: IP LIST 25C47430 LEN(X'00000408') ASID(X'0020')
    25C47838: Free storage cell. To display: IP LIST 25C47838 LEN(X'00000408') ASID(X'0020')
    25C47C40: Free storage cell. To display: IP LIST 25C47C40 LEN(X'00000408') ASID(X'0020')
  [1]Verifying free chain for pool: 5.4...
       No errors were found while processing free chain.
    Summary of analysis for Pool 5.4:
       Number of cells:  Unused:       1  Free:       3  Allocated:       0  Total Used:       4
       00000000 free cells were not accounted for.
       No errors were found while processing this Pool.
-
  Data for pool 5.5:
POOLDATA:  25C1F600
  +000000  POOL_INDEX:00000009     INPUT_CELL_SIZE:00000400
  +000008  CELL_SIZE:00000408      INPUT_PERCENT:00000001
  +000010  CELL_POOL_SIZE:00001020       CELL_POOL_NUM:00000004
  +000018  POOL_LATCH_ADDR:25C54C24      POOL_EXTENTS:00000001
  +000020  LAST_CELL:25C49078      NEXT_CELL:25C49078
  +000028  Q_CONTROL_INFO:000001DD       Q_FIRST_CELL:25C48460
  +000030  POOL_NUM_GET_TOTAL:000000F0   POOL_NUM_FREE:00000003
  +000038  POOL_EXTENTS_ANCHOR:25C48458        POOL_INDEX_SAME_SIZE:05
  +00003D  POOL_INDEX_SIZE:05      POOL_NUM_SAME_SIZE:05
  +000040  POOL_TRACE_TABLE:25DD6160
  [2]Heap Pool Extent Mapping
  EXTENT:  25C48458
  +000000  EYE_CATCHER:EX31  NEXT_EXTENT:00000000
    To display entire pool extent: IP LIST 25C48458 LEN(X'00001028') ASID(X'0020')
    25C48460: Free storage cell. To display: IP LIST 25C48460 LEN(X'00000408') ASID(X'0020')
    25C48868: Free storage cell. To display: IP LIST 25C48868 LEN(X'00000408') ASID(X'0020')
    25C48C70: Free storage cell. To display: IP LIST 25C48C70 LEN(X'00000408') ASID(X'0020')
  [1]Verifying free chain for pool: 5.5...
       No errors were found while processing free chain.
    Summary of analysis for Pool 5.5:
       Number of cells:  Unused:       1  Free:       3  Allocated:       0  Total Used:       4
       00000000 free cells were not accounted for.
       No errors were found while processing this Pool.
-
  Data for pool 6:
POOLDATA:  25C1F700
  +000000  POOL_INDEX:0000000A     INPUT_CELL_SIZE:00000800
  +000008  CELL_SIZE:00000808      INPUT_PERCENT:00000001
  +000010  CELL_POOL_SIZE:00002020       CELL_POOL_NUM:00000004
  +000018  POOL_LATCH_ADDR:25C54C38      POOL_EXTENTS:00000001
  +000020  LAST_CELL:25C452E8      NEXT_CELL:25C452E8
  +000028  Q_CONTROL_INFO:0000063E       Q_FIRST_CELL:25C442D8
  +000030  POOL_NUM_GET_TOTAL:00000321   POOL_NUM_FREE:00000002
  +000038  POOL_EXTENTS_ANCHOR:25C43AC8        POOL_INDEX_SAME_SIZE:01
  +00003D  POOL_INDEX_SIZE:06      POOL_NUM_SAME_SIZE:01
  +000040  POOL_TRACE_TABLE:25E06180
  [2]Heap Pool Extent Mapping
  EXTENT:  25C43AC8
  +000000  EYE_CATCHER:EX31  NEXT_EXTENT:00000000
    To display entire pool extent: IP LIST 25C43AC8 LEN(X'00002028') ASID(X'0020')
    25C43AD0: Allocated storage cell. To display: IP LIST 25C43AD0 LEN(X'00000808') ASID(X'0020')
    25C43AD8: 00000000 25C1F884 60004000 00000000 25C43AFC 00000000 00000000 00000000|.....A8d-. ......D.............|
    25C442D8: Free storage cell. To display: IP LIST 25C442D8 LEN(X'00000808') ASID(X'0020')
    25C44AE0: Free storage cell. To display: IP LIST 25C44AE0 LEN(X'00000808') ASID(X'0020')
  [1]Verifying free chain for pool: 6...
       No errors were found while processing free chain.
    Summary of analysis for Pool 6:
       Number of cells:  Unused:       1  Free:       2  Allocated:       1  Total Used:       4
       00000000 free cells were not accounted for.
       No errors were found while processing this Pool.
```

Figure 17. Example formatted detailed heappool report from LEDATA Verbexit (Part 4 of 4)

Heappool report sections of the LEDATA output

The Heappool report provides the information regarding the following items:

- Each cell pool.
- The free chain associated with every qpcb pool data area, and all the free and allocated cells in the extent chain.
- Errors found when the cells are validated.

[1]Free Chain Validation

Within each cell pool, Language Environment keeps track of unallocated cells by chaining them together.

The LEDATA HEAP option validates the free chain within each cell pool. It verifies that the cell pointer is within a valid extent and that the cell pool number is valid.

If the formatter finds a problem, it will place an error message describing the problem directly after the formatted line of the cell that failed validation.

[2]Heap Pool Extent Mapping Report

The LEDATA HEAP option produces a report that lists all of the cells within each pool extent, and identifies the cells as either allocated or freed. For each allocated cell, the contents of the first X'20' bytes of the area are displayed in order to identify the reason for the storage allocation.

The formatter validates if cell pool number in header is correct.

Understanding the HEAPPOOLS trace LEDATA output

The Language Environment IPCS Verbexit LEDATA generates a detailed HEAPPOOLS trace report when the HPT option is used. The argument *value* is the id of the pool to be formatted in the report.

```
    HPT(3)
    ********************************************************************************
                          LANGUAGE ENVIRONMENT DATA
    ********************************************************************************

    Language Environment Product 04 V01 R10.00

 [1] HEAPPOOLS Trace Table

 [2] POOLID: 3  ASID: 0024  AVAILABLE ENTRIES: 12 OF 12

 [3] Timestamp: 2008/03/14           14:10:22.614088
     Type: FREE  Cell Address: 25E91AC0  Cpuid: 01  Tcb: 008AFCF0
 [4] CALL NAME                           CALL ADDRESS       CALL OFFSET
     GetStorage::~GetStorage()           25E53360           00000088
     foo8()                              25E53598           000000B6
     foo7()                              25E53678           0000005A
     foo6()                              25E536F0           0000005A
     foo5()                              25E53768           0000005A
     foo4()                              25E537E0           0000005A
     foo3()                              25E53858           0000005A
     foo2()                              25E538D0           0000005A
     foo1()                              25E53948           0000005A
     thread                              25E53A50           00000000
```

Figure 18. Example formatted detailed HEAPPOOLS trace report from LEDATA Verbexit (Part 1 of 4)

```
Timestamp: 2008/03/14           14:10:22.614087
Type: FREE  Cell Address: 25E91B48  Cpuid: 01  Tcb: 008AFCF0
CALL NAME                           CALL ADDRESS       CALL OFFSET
GetStorage::~GetStorage()           25E53360           00000088
foo9()                              25E53430           000000B6
foo8()                              25E53598           0000009A
foo7()                              25E53678           0000005A
foo6()                              25E536F0           0000005A
foo5()                              25E53768           0000005A
foo4()                              25E537E0           0000005A
foo3()                              25E53858           0000005A
foo2()                              25E538D0           0000005A
foo1()                              25E53948           00000000

Timestamp: 2008/03/14           14:10:22.614034
Type: FREE  Cell Address: 25E91BD0  Cpuid: 01  Tcb: 008AFA60
CALL NAME                           CALL ADDRESS       CALL OFFSET
GetStorage::~GetStorage()           25E53360           00000088
foo8()                              25E53598           000000B6
foo7()                              25E53678           0000005A
foo6()                              25E536F0           0000005A
foo5()                              25E53768           0000005A
foo4()                              25E537E0           0000005A
foo3()                              25E53858           0000005A
foo2()                              25E538D0           0000005A
foo1()                              25E53948           0000005A
thread                              25E53A50           00000000

Timestamp: 2008/03/14           14:10:22.614032
Type: FREE  Cell Address: 25E91C58  Cpuid: 01  Tcb: 008AFA60
CALL NAME                           CALL ADDRESS       CALL OFFSET
GetStorage::~GetStorage()           25E53360           00000088
foo9()                              25E53430           000000B6
foo8()                              25E53598           0000009A
foo7()                              25E53678           0000005A
foo6()                              25E536F0           0000005A
foo5()                              25E53768           0000005A
foo4()                              25E537E0           0000005A
foo3()                              25E53858           0000005A
foo2()                              25E538D0           0000005A
foo1()                              25E53948           00000000

Timestamp: 2008/03/14           14:10:22.614030
Type: GET   Cell Address: 25E91C58  Cpuid: 01  Tcb: 008AFA60
CALL NAME                           CALL ADDRESS       CALL OFFSET
GetStorage::GetStorage(int)         25E53298           0000008C
foo9()                              25E53430           00000086
foo8()                              25E53598           0000009A
foo7()                              25E53678           0000005A
foo6()                              25E536F0           0000005A
foo5()                              25E53768           0000005A
foo4()                              25E537E0           0000005A
foo3()                              25E53858           0000005A
foo2()                              25E538D0           0000005A
foo1()                              25E53948           00000000
```

Figure 18. Example formatted detailed HEAPPOOLS trace report from LEDATA Verbexit (Part 2 of 4)

```
Timestamp: 2008/03/14           14:10:22.614029
Type: GET   Cell Address: 25E91BD0  Cpuid: 01  Tcb: 008AFA60
CALL NAME                           CALL ADDRESS       CALL OFFSET
GetStorage::GetStorage(int)         25E53298           0000008C
foo8()                              25E53598           00000086
foo7()                              25E53678           0000005A
foo6()                              25E536F0           0000005A
foo5()                              25E53768           0000005A
foo4()                              25E537E0           0000005A
foo3()                              25E53858           0000005A
foo2()                              25E538D0           0000005A
foo1()                              25E53948           0000005A
thread                              25E53A50           00000000

Timestamp: 2008/03/14           14:10:22.612412
Type: GET   Cell Address: 25E91B48  Cpuid: 01  Tcb: 008AFCF0
CALL NAME                           CALL ADDRESS       CALL OFFSET
GetStorage::GetStorage(int)         25E53298           0000008C
foo9()                              25E53430           00000086
foo8()                              25E53598           0000009A
foo7()                              25E53678           0000005A
foo6()                              25E536F0           0000005A
foo5()                              25E53768           0000005A
foo4()                              25E537E0           0000005A
foo3()                              25E53858           0000005A
foo2()                              25E538D0           0000005A
foo1()                              25E53948           00000000

Timestamp: 2008/03/14           14:10:22.612410
Type: GET   Cell Address: 25E91AC0  Cpuid: 01  Tcb: 008AFCF0
CALL NAME                           CALL ADDRESS       CALL OFFSET
GetStorage::GetStorage(int)         25E53298           0000008C
foo8()                              25E53598           00000086
foo7()                              25E53678           0000005A
foo6()                              25E536F0           0000005A
foo5()                              25E53768           0000005A
foo4()                              25E537E0           0000005A
foo3()                              25E53858           0000005A
foo2()                              25E538D0           0000005A
foo1()                              25E53948           0000005A
thread                              25E53A50           00000000

Timestamp: 2008/03/14           14:10:22.593976
Type: GET   Cell Address: 25E91A38  Cpuid: 01  Tcb: 008AFE88
CALL NAME                           CALL ADDRESS       CALL OFFSET
CEEOPMI                             0601F218           00000822
CEEOPC                              0600C2C8           00000CEE
pthread_create                      0658FE40           00000632
main                                25E53B00           000000EE
EDCZMINV                            064C2106           00000000
```

Figure 18. Example formatted detailed HEAPPOOLS trace report from LEDATA Verbexit (Part 3 of 4)

```
 Timestamp: 2008/03/14           14:10:22.557633
 Type: GET   Cell Address: 25E919B0  Cpuid: 01  Tcb: 008AFE88
 CALL NAME                           CALL ADDRESS       CALL OFFSET
 CEEOPMI                             0601F218           00000822
 pthread_mutex_init                  06428B90           00000094
 pthread_create                      0658FE40           000002FC
 main                                25E53B00           000000EE
 EDCZMINV                            064C2106           00000000

 Timestamp: 2008/03/14           14:10:22.551547
 Type: GET   Cell Address: 25E91928  Cpuid: 01  Tcb: 008AFE88
 CALL NAME                           CALL ADDRESS       CALL OFFSET
 CEEOPMI                             0601F218           00000822
 pthread_mutex_init                  06428B90           00000094
 pthread_create                      0658FE40           0000026C
 main                                25E53B00           000000EE
 EDCZMINV                            064C2106           00000000

 Timestamp: 2008/03/14           14:10:22.544328
 Type: GET   Cell Address: 25E918A0  Cpuid: 01  Tcb: 008AFE88
 CALL NAME                           CALL ADDRESS       CALL OFFSET
 dllinit                             0622FBF8           0000009E
 CEEZIDT                             060C4B08           00000000
Exiting Language Environment Data
```

Figure 18. Example formatted detailed HEAPPOOLS trace report from LEDATA Verbexit (Part 4 of 4)

[1] Trace Header

HEAPPOOLS trace header information.

[2] Pool Information

Information includes the number of the pool (POOLID) that is currently being formatted, the ASID, and the number of entries formatted and the total number of entries taken.

Note: The trace wraps for each poolid after a specific number of entries. The number of entries is controlled by the HEAPCHK run-time option.

[3] Timestamp

The time this trace entry was taken.

Note: The trace entries are formatted in reverse order (most recent trace entry first).

[4] Trace Table Entry contents

The individual trace entry:

- The TYPE - GET or FREE.
- The Cell within the pool being acted upon.
- The CPU and TCB which requested or freed the cell.
- A traceback at the time of the request. The number of entries in this traceback is limited by the HEAPCHK run-time option.

Understanding the C/C++-specific LEDATA output

The Language Environment IPCS Verbexit LEDATA generates formatted output of C/C++-specific control blocks from a system dump when the ALL parameter is specified and C/C++ is active in the dump. Figure 19 on page 124 illustrates the C/C++-specific output produced. The system dump being formatted was obtained by specifying the TERMTHDACT(UADUMP) run-time option when running the program CELSAMP Figure 5 on page 44. “C/C++-specific sections of the LEDATA output” on page 145 describes the information contained in the formatted output. Ellipses are used to summarize some sections of the dump.

For easy reference, the sections of the dump are numbered to correspond with the description of each section that follows.

```
*******************************************************************************
                            CRTL ENVIRONMENT DATA
*******************************************************************************
[1]CGEN:  20C13A10
   +00007C  OS_SPCTYPE:00000000     CGENE:20C10B90    CRENT:20C14FF8
   +0001F8  CFLTINIT:4E000000 00000000    CPRMS:20C127A8    TRACE:00000000
   +000208  CTHD:20C0E8A0     CURR_FECB:20C101D8      CEDCXV:A0DF66D8
   +000214  CGEN_CPCB:20C0DEA8      CGEN_CEDB:20C0F938      CFLG3:00
   +000220  CIO:20C0E098      FDSETFD:00000000        FCB_MUTEXOK:0000
   +00022C  T_C16:00000000    T_C17:00000000    CEDCOV:2117A9A8
   +000238  CTOFSV:00000000   TRTSPACE:20C0EE50

[2]CGENE:  20C10B90
   +000000  CGENEYE:GENE      CGENESIZE:000006E0      CGENEPTR:20C10B90
   +0000D0  CERRNO:00000000   TEMPLONG:00000000       AMRC:20C0E770
   +000104  STDINFILE:20C0F718      STDOUTFILE:20C0F2D8
   +00010C  STDERRFILE:20C0F4F8     CTYPE:21035412    LC_CTYPE:21035412
   +000124  LC_CHARMAP:21035F00
   +000500  MIN_FLT:00100000 00000000 00000000 00000000
   +000510  MAX_FLT:7FFFFFFF FFFFFFFF 71FFFFFF FFFFFFFF
   +000520  FLT_EPS:3C100000        DBL_EPS:34100000 00000000
   +000530  LDBL_EPS:26100000 00000000 18000000 00000000
   +000544  IMSPCBLIST:20C145A4     ADDRTBL:20C0EC28
   +0006D4  ABND_CODE:00000000      RSN_CODE:00000000
[3]CEDB:  20C0F938
   +000000  EYE:CEDB    SIZE:000007C0     PTR:20C0F938      CLLST:20C00568
   +000010  CEELANG:0003      CASWITCH:0000     CLWA:20C11270
   +000018  CALTLWA:20C115C0        CCADDR:20C00A10   CFLGS:00000080
   +000024  CEESTART:20C00000       CANCHOR:00000000        RPLLEN:00000000
   +000030  ACBLEN:00000000   LC:20C10100       VALID_HIGH:210306C0
   +00003C  _LOW:2102FBE8     HEAD_FECB:00000000      ATEXIT_COUNT:00000000
   +000048  _EMPTY_COUNT:20C0FA10   MAINPRMS:2132D768
   +000050  STDINFILE:20C0F718      STDOUTFILE:20C0F2D8
   +000058  STDERRFILE:20C0F4F8     CTYPE:21035412    TZDFLT:00003840
   +000064  CINFO:20C10190    CMS_WRITE_DISK:4040     _DISK_SET:00000000
   +000070  MIN_FLT:00100000 00000000 00000000 00000000
   +000080  MAX_FLT:7FFFFFFF FFFFFFFF 71FFFFFF FFFFFFFF
   +000090  FLT_EPS:3C100000        DBL_EPS:34100000 00000000
   +0000A0  LDBL_EPS:26100000 00000000 18000000 00000000    FLAGS1:02080000
   +0000B4  MTF_MAINTASK_BLK:00000000     EMSG_SETTING:00   DEPTH:00000000
   +0000C0  SCREEN_WIDTH:00000000   USERID:CHARUM .
   +0000CC  HEAP24_ANCHOR:00000000        TCIC:00000000     TKCLI:00000000
   +0000D8  ATEXIT_FUNCS01:20C0FA24 00000000 00000000 00000000 00000000
   +0000EC  ATEXIT_FUNCS02:20C0FA38 00000000 00000000 00000000 00000000
   +000100  ATEXIT_FUNCS03:20C0FA4C 00000000 00000000 00000000 00000000
   +000114  ATEXIT_FUNCS04:20C0FA60 00000000 00000000 00000000 00000000
   +000128  ATEXIT_FUNCS05:20C0FA74 00000000 00000000 00000000 00000000
   +00013C  ATEXIT_FUNCS06:20C0FA88 00000000 00000000 00000000 00000000
   +000150  ATEXIT_FUNCS07:20C0FA9C 00000000 00000000 00000000 00000000
   +000164  ATEXIT_FUNCS08:20C0FAB0 00000000 00000000 00000000 00000000
   +000178  ATEXIT_FUNCS09:20C0FAC4 00000000 00000000 00000000 00000000
   +00018C  ATEXIT_FUNCS10:20C0FAD8 00000000 00000000 00000000 00000000
   +0001A0  ATEXIT_FUNCS11:20C0FAEC 00000000 00000000 00000000 00000000
   +0001B4  ATEXIT_FUNCS12:20C0FB00 00000000 00000000 00000000 00000000
   +0001C8  ATEXIT_FUNCS13:20C0FB14 00000000 00000000 00000000 00000000
   +0001DC  ATEXIT_FUNCS14:20C0FB28 00000000 00000000 00000000 00000000
   +0001F0  ATEXIT_FUNCS15:20C0FB3C 00000000 00000000 00000000 00000000
   +000204  ATEXIT_FUNCS16:20C0FB50 00000000 00000000 00000000 00000000
   +000218  ATEXIT_FUNCS17:20C0FB64 00000000 00000000 00000000 00000000
   +00022C  ATEXIT_FUNCS18:20C0FB78 00000000 00000000 00000000 00000000
```

Figure 19. Example formatted C/C++ output from LEDATA Verbexit (Part 1 of 22)

```
+000240  ATEXIT_FUNCS19:20C0FB8C 00000000 00000000 00000000 00000000
+000254  ATEXIT_FUNCS20:20C0FBA0 00000000 00000000 00000000 00000000
+000268  ATEXIT_FUNCS21:20C0FBB4 00000000 00000000 00000000 00000000
+00027C  ATEXIT_FUNCS22:20C0FBC8 00000000 00000000 00000000 00000000
+000290  ATEXIT_FUNCS23:20C0FBDC 00000000 00000000 00000000 00000000
+0002A4  ATEXIT_FUNCS24:20C0FBF0 00000000 00000000 00000000 00000000
+0002B8  ATEXIT_FUNCS25:20C0FC04 00000000 00000000 00000000 00000000
+0002CC  ATEXIT_FUNCS26:20C0FC18 00000000 00000000 00000000 00000000
+0002E0  ATEXIT_FUNCS27:20C0FC2C 00000000 00000000 00000000 00000000
+0002F4  ATEXIT_FUNCS28:20C0FC40 00000000 00000000 00000000 00000000
+000308  ATEXIT_FUNCS29:20C0FC54 00000000 00000000 00000000 00000000
+00031C  ATEXIT_FUNCS30:20C0FC68 00000000 00000000 00000000 00000000
+000330  ATEXIT_FUNCS31:20C0FC7C 00000000 00000000 00000000 00000000
+000344  ATEXIT_FUNCS32:00000000 00000000 00000000 00000000 00000000
+000358  HEAD_FOREIGN_FECB:00000000    SNAP_DUMP_COUNT:00000000
+000360  ENVIRON:00000000        GETENV_BUF:00000000
+000368  _BUF_LEN:00000000       CDLL:21351CE0
+000370  INSPECT_GLOBALS:00000000       _JMP_BUFF:00000000
+000378  _BACK_END:00000000      _FLAGS:00000000   _TAB:00000000
+000384  INTOFFLIST:00000000     CGEN_CRENT:20C14FF8     _CPRMS:20C127A8
+000390  _CEDCXV:A0DF66D8        _CEDCOV:2117A9A8
+000398  _EPCBLIST:00000000      CAA_ADDR:20C13A10
+0003A0  CDLL_PENDING:00000000   USERIDLENGTH:00000006
+0003A8  TZSHR_1:20C102B8        TZSHR_2:20C102BC
+0003B0  MAXUNGETCOUNT:0004      DLL_DIAG_FLAG:04  RWSTATIC:20C14FF8
+0003B8  RWLEN:00000008    CSGDLLI:00000000        DLLISIZE:00000000
+0003C4  IOGET_ANY:213244E8      _BELOW:213240B8   IOFREE_ANY:21323D80
+0003D0  _BELOW:21323A48   CSGSTINIT:00000000      STINITSIZE:00000000
+0003DC  MTFMAINTASKBLK:00000000       SIGTABLE:20C103B8
+0003E4  INIT_STDIN:20C0F718     _STDOUT:20C0F2D8
+0003EC  _STDERR:20C0F4F8        TABNUM:00000008   FLAGS2:00000000
+000400  OPENMVS_FLAGS:00  MRPSTDR:2100AA80        MWPSTDR:2100A8A8
+00040C  MRPSTDC:21009EE0        MWPSTDC:21009D08        OWRP1:00000000
+000418  OWRP3:00000000    STATIC_EDCOV:00000000   GETENV_BUF2:00000000
+000424  _BUF2_LEN:00000000      DLCB_MUTEX:00000000     _CONDV:00000000
+000430  EDCOV:00000000    LCX:20C102B8      MUTEX_ATTR:00000000
+00043C  STOR_INIT_B:00001000    _INCR_B:00001000
+000444  STOR_INIT:00003000      _INCR:00002000    DEMANGLE:00000000
+000454  TEMPR15:00000000        TERMINATE:210FC578
+00045C  CXX_INV:00000000        D4_JOIN_MUTEX_ATTR:00000000
+000468  _MUTEX:00000000   _CONDV_ATTR:00000000    _CONDV:00000000
+000474  DLLANCHOR:00000000      DLLLAST:00000000        MEM24P:20C145A8
+000480  RTLMUTEX_ARRAYPTR:00000000    MSGCATLIST:00000000
+000488  SRCHP:00000000    ETOAP:00000000    ATOEP:00000000
+000494  NDMGMTP:00000000        POPENP:00000000   RND48P:00000000
+0004A0  BRK_HEAPID:00000000     _START:00000000   _CURRENT:00000000
+0004AC  _END:00000000     RESTARTTABLE:00000000   SYSLOGP:00000000
+0004BC  LOGIN_NAME:.........    PREV_UMASK_VAL:00000000
+0004D0  HFP_LDBL_LMS:00100000 00000000 00000000 00000000 7FFFFFFF FFFFFFFF 71FFFFFF FFFFFFFF 26
+000500  BFP_LDBL_LMS:00010000 00000000 00000000 00000000 7FFEFFFF FFFFFFFF FFFFFFFF FFFFFFFF 3F
+000590  HFP_DBL_LMS:00100000 00000000 7FFFFFFF FFFFFFFF 34100000 00000000
+0005A8  BFP_DBL_LMS:00100000 00000000 7FEFFFFF FFFFFFFF 3CB00000 00000000 7FF00000 00000000 FF
+0005F0  HFP_MHDC:412B7E15 1628AED3 41171547 652B82FE 406F2DEC 549B9439 40B17217 F7D1CF7A 41
+000660  BFP_MHDC:4005BF0A 8B145769 3FF71547 652B82FE 3FDBCB7B 1526E50E 3FE62E42 FEFA39EF 40
+0006D0  HFP_FLT_LMS:00100000 7FFFFFFF 3C100000
+0006DC  BFP_FLT_LMS:00800000 7F7FFFFF 34000000 7F800000 FF800000 7FA00000 FFA00000 7FC00000 FF
+000700  HFP_FHDC:00000010 0006000E 001C0006 000F0020 FFC0FFC0 FFC0FFB2 FFB2FFB2 003F003F 00
+000728  BFP_FHDC:00010002 00180035 00710006 000F0021 FF83FC03 C003FFDB FECDECBD 00800400 40
+000750  ASCII_CCSID:0333  EBCDIC_CCSID:0417       LOGIN_NAME_A:.........
+000760  CINFO_A:00000000        LC_C:20C108B0     _A:00000000
+00076C  LCX_A:00000000    CORRESTABLE:00000000
+000774  TZSHR_A:00000000 00000000     CGENVEC31:20EA8500
+000780  CEDBVEC31:00000000      FORKQ_HEAD:00000000
+000788  FORKQ_TAIL:00000000     PTHREAD_YIELD1:0001D100
+000790  PTHREAD_YIELD2:00002E80       ICONV_MODE:U      _TECH:LMREC....
+00079E  _USERSET:D
```

Figure 19. Example formatted C/C++ output from LEDATA Verbexit (Part 2 of 22)

```
[4]CTHD:  20C0E8A0
   +000000  CTHDEYE:CTHD      SIZE:00000380     CTHDPTR:20C0E8A0
   +00000C  STORPTR:00000000        TOKPTR:2102F210
   +000014  ASCTIME_RESULT:.........................
   +00002E  SNAP_DUMP_FLAG:00       GMTIME_BKDN:20C0EE28
   +000034  TIMECALLED:00000000     DATECALLED:00000000
   +00003C  DTCALLED:00000000       LOC_CALLED:00000000
   +000044  DOFMTO_DISCARDS:00000000      CERRNO:00000031   AMRC:20C0E770
   +000050  AMRC2:20C0E878    GDATE:00000000    OPTARGV:00000000
   +00005C  OPTERRV:00000001        OPTINDV:00000001
   +000064  OPTOPTV:00000000        OPTSIND:00000000        DLGHTV:00000000
   +000070  TZONEV:00000000   GTDTERRV:00000000       OPTARGP:20C0E8F8
   +00007C  OPTERRP:20C0E8FC        OPTINDP:20C0E900
   +000084  OPTOPTP:20C0E904        DLGHTP:20C0E90C   TZONEP:20C0E910
   +000090  GTDTERRP:20C0E914       RNDSTGP:00000000
   +000098  LOCNAME:00000000        ENCRYPTP:00000000       CRYPTP:00000000
   +0000A4  RND48P:00000000   L64AP:00000000    WCSTOKP:00000000
   +0000B0  CUSERP:00000000   GPASSP:00000000   UTMPXP:00000000
   +0000BC  NDMGMTP:00000000        RECOMP:00000000   STACKPTR:00000000
   +0000C8  STACKSIZE:00000000      STACKFLAGS:40     THREAD_CHARMODE:E
   +0000D0  MCVTP:00000000    H_ERRNO:00000000        SD:FFFFFFFF
   +0000DC  HOSTENT_DATA_P:00000000       HOSTENT_P:00000000
   +0000E4  NETENT_DATA_P:00000000        NETENT_P:00000000
   +0000EC  PROTOENT_DATA_P:00000000      PROTOENT_P:00000000
   +0000F4  SERVENT_DATA_P:00000000       SERVENT_P:00000000
   +0000FC  NTOA_BUF:..................   __LOC1V:00000000
   +000114  LOCS_V:00000000   HERRNOP:20C0E9B0         __LOC1P:00000000
   +000124  REXECP:00000000   CXXEXCEPTION:20C0E560   TEMPDCBE:00000000
   +000130  T_ERRNOV:20C0E9CC       T_ERRNOP:20C0E9E0       LOC1_P:20C0E9E4
   +00013C  LOC2_P:20C0E9B4   LOCS_P:00000000   LOC1_V:00000000
   +000148  LOC2_V:00000000   THD_STORAGE:00000000    CONTEXT_LINK:00000000
   +000154  FLAGS1:20C0EF50   LABEL_VAR:00000000      ABND_CODE:00000000
   +000160  RSN_CODE:00000000       STRFTIME_ERADTCALLED:00000000
   +000168  STRFTIME_ERADATECALLED:00000000
   +00016C  STRFTIME_ERATIMECALLED:00000000
   +000170  STRFTIME_ERAYEARCALLED:00000000     MBRLEN_STATE:0000
   +000176  MBRTOWC_STATE:0000      WCRTOMB_STATE:0000
   +00017A  MBSRTOWCS_STATE:0000    WCSRTOMBS_STATE:0000    MBLEN_STATE:F0F0
   +000180  MBTOWC_STATE:0000       SBCS:.      CPTYPE:.
   +000184  CURR_HEAP_ID:00000000   CURR_CAA:00000000
   +00018C  CURR_MOD_HANDLE:00000000      CURR_BMR:00000000
   +000194  CU_LIST:00024040        CURR_STATUS:00    CURR_CASE:00
   +00019C  RAND_NEXT:20C0E2D8      STRERRORBUF:00000000
   +0001A4  TMPAREA:20C0E638        IOWORKAREA:00012088
   +0001AC  TEMPDCB:000120E8        TEMPJFCB:20C0E598
   +0001B4  TEMPDSCB:00000000       NAMEBUF:C00B0641
   +0001BC  ERRNO_JR:00000000       RET_STRUCT:00000000
   +0001C4  BKDN_IS_LOCALTIME:00008000    SWPRINTF_SIZE:00000000
   +0001CC  SWPRINTF_BUF:20C0E540   S99P:20C0F1A8     MUTEXCTARRAY:00000000
   +0001D8  STRFTIME_ERANAMECALLED:00000000     HPJRTL_1:00000000
   +0001E0  HPJRTL_2:00000000       HPJRTL_3:00000000
   +0001E8  HPJRTL_4:00000000       HPJRTL_5:00000000
   +0001F0  HPJRTL_6:00000000       HPJRTL_7:00000000
   +0001F8  HPJRTL_8:00000000       DLL_LOADLEVEL:00000000
   +000200  DLL_CONSTLIST:00000000        FCB_MUTEX:20C0E280
   +000208  HSPABHWA:20C0F204       MUTEX_SAVE:00012198
   +000210  IO24WORKAREA:4D000000   INITIAL_CPU_TIME:0000F603 00000001
   +00021C  FCB_MUTEX_OK:00000000   FCB_MUTEX_SAVE:00000000
   +000224  ENTRY_ADDRTABLESIZE:00000000        ADDRESS:00000000
   +00022C  NUMBEROFNAMES:00000000        NAMES1:.........................
   +000249  NAMES2:.........................
   +000262  NAMES3:.........................
   +00027B  NAMES4:.........................
   +000294  NAMES5:.........................
   +0002AD  NAMES6:.........................
   +0002C8  ENTRY_SITETABLESIZE:00000000        KIND:00
   +0002D0  NUM_ADDRS:00000000      ADDRESSES_1:00000000
   +0002D8  ADDRESSES_2:00000000    ADDRESSES_3:00000000
   +0002E0  ADDRESSES_4:00000000    ADDRESSES_5:00000000
   +0002E8  ADDRESSES_6:00000000    NAME:.....................{U.
   +000304  T_STRERRORBUF:00000000        THD_OURFDSET:00000000
```

Figure 19. Example formatted C/C++ output from LEDATA Verbexit (Part 3 of 22)

```
   +00030C  IEEECWAP:00000000       FPC_SAVEAREA_TRAP:00
   +000311  FPC_SAVEAREA_XCP:00     FPC_SAVEAREA_DXC:00
   +000313  FPC_SAVEAREA_RMODE:00   LAST_YIELD_1:00000000
   +000318  LAST_YIELD_2:00000000   YIELD_COUNT:00000000
   +000320  RETVAL_P:00000000       CTHD_SETENV_FB:............
   +000338  LIBASCIIWAP:00000000    SETLOCALE_ACALLED:00
   +00033E  ASCIINAMEBUFL:0000      ASCIINAMEBUF:00000000
   +00034C  LOCNAME_A:00000000      EBCDICENTRY:00000000
   +000354  ASCIIENTRY:00000000     CTHD_NASCIIWAP:00000000
   +00035C  CTHD_PROCRESP:00000000        CTHD_OPTN_P:00000000
   +000364  CTHD_GAI_STRERROR_P:00000000
   +000368  CTHD_CKPATHDD_PARMS:00000000
[5]CPCB:  20C0DEA8
   +000000  CPCB_EYE:CPCB     CPCB_SIZE:00000080      CPCB_PTR:00000000
   +00000C  FLAGS1:40000000   TTKNHDR:00000000        TTKN:00000000
   +000018  FOOTPRINT:20C0F938      CODE370:00000000        CIO:20C0E098
   +000024  _Reuse:00000000   _RSAbove:20C0DEA8       _RSAbovelen:00003FF0
   +000030  _RSBelow:20C145A0       _RSBelowlen:00000010
[6]CIO:  20C0E098
   +000000  EYE:CIO     SIZE:00000090     PTR:00000000      FLG1:09
   +00000D  FLG2:E0     FLG3:00     FLG4:00     DUMMYF:20C0E128
   +000014  EDCZ24:00000000   FCBSTART:2135A040       DUMMYFCB:20C0E148
   +000020  MFCBSTART:2135A470      IOANYLIST:2135A000
   +000028  IOBELOWLIST:00014000    FCBDDLIST:00000000
   +000030  PERRORBUF:20C0DF60      TMPCOUNTER:00000000
   +000038  TEMPMEM:00000000        PROMPTBUF:00000000      IO24:000122D0
   +000044  IOEXITS:000127C8        TERMINALCHAIN:00000000
   +00004C  VANCHOR:00000000        XTI:00000000      ENOWP24:20F484A0
   +000058  MAXNUMDESCRPS:00000000        DESCARRAY:00000000
   +000064  TEMPFILENUM:00000000    CSS:00000000      DUMMY_NAME:........
   +000074  HOSTNAME_CACHE:00000000       HOSTADDR_CACHE:00000000
   +00007C  IO31:20E62508     LAST_FD_CLOSE:00000000 00000000
   +000088  IOGET64:213244E8        IOFREE64:21323D80

Exiting CRTL Environment Data

********************************************************************************
                           CRTL I/O CONTROL BLOCKS
********************************************************************************
      CIO:  20C0E098
   +000000  EYE:CIO     SIZE:00000090     PTR:00000000      FLG1:09
   +00000D  FLG2:E0     FLG3:00     FLG4:00     DUMMYF:20C0E128
   +000014  EDCZ24:00000000   FCBSTART:2135A040       DUMMYFCB:20C0E148
   +000020  MFCBSTART:2135A470      IOANYLIST:2135A000
   +000028  IOBELOWLIST:00014000    FCBDDLIST:00000000
   +000030  PERRORBUF:20C0DF60      TMPCOUNTER:00000000
   +000038  TEMPMEM:00000000        PROMPTBUF:00000000      IO24:000122D0
   +000044  IOEXITS:000127C8        TERMINALCHAIN:00000000
   +00004C  VANCHOR:00000000        XTI:00000000      ENOWP24:20F484A0
   +000058  MAXNUMDESCRPS:00000000        DESCARRAY:00000000
   +000064  TEMPFILENUM:00000000    CSS:00000000      DUMMY_NAME:........
   +000074  HOSTNAME_CACHE:00000000       HOSTADDR_CACHE:00000000
   +00007C  IO31:20E62508     LAST_FD_CLOSE:00000000 00000000
   +000088  IOGET64:213244E8        IOFREE64:21323D80

     FFIL:  2135A020
   +000000  MARKER1:AFCB      FILE:00000000      __FP:2135A040
   +00000C  MARKER2:AFCBAFCB        FF_FLAGS:01000000
   +000014  FCBMUTEX:00000000       THREADID:00000000 00000000

    File name: /u/charum/b235/in.txt
```

Figure 19. Example formatted C/C++ output from LEDATA Verbexit (Part 4 of 22)

```
[7]FCB:  2135A040
   +000000  BUFPTR:00000000   COUNTIN:00000000        COUNTOUT:00000000
   +00000C  READFUNC:2135A110       WRITEFUNC:2135A130      FLAGS1:0000
   +000016  DEPTH:0000  NAME:2135A1FC     _LENGTH:00000015
   +000020  _BUFSIZE:00000044       MEMBER:........   NEXT:2135A268
   +000030  PREV:00000000     PARENT:2135A040   CHILD:00000000
   +00003C  DDNAME:........   FD:00000000       DEVTYPE:09  FCBTYPE:007C
   +00004C  FSCE:2135A174     UNGETBUF:2135A174       REPOS:212FD080
   +000058  GETPOS:212FCF50   CLOSE:21318C78    FLUSH:212FCEE8
   +000064  UTILITY:21318870        USERBUF:00000000        LRECL:00000000
   +000070  BLKSIZE:00000000        REALBUFPTR:00000000
   +000078  UNGETCOUNT:00000000     BUFSIZE:00001000        BUF:00000000
   +000084  CURSOR:00000000   ENDOFDATA:00000000      SAVEDBUF:00000000
   +000090  REALCOUNTIN:00000000    REALCOUNTOUT:00000000
   +000098  POSMAJOR:FFFFFFFF       SAVEMAJOR:00000000
   +0000A0  POSMINOR:00000000       SAVEMINOR:00000000      STATE:0000
   +0000AA  SAVESTATE:0000    EXITFTELL:00000000      EXITUNGETC:00000000
   +0000B4  DBCSTART:00000000       UTILITYAREA:00000000
   +0000BC  INTERCEPT:00000000      FLAGS2:00190040 00001300
   +0000C8  DBCSSTATE:0000    FCB_CPCB:20C0DEA8
   +0000D0  READGLUE:58FF0008 07FF0000    READ:212FD418
   +0000DC  RADDR_WSA:00000000      _GETFN:00000000   RDLL_INDEX:00000000
   +0000E8  RCEESG003:00000000      RWSA:00000000
   +0000F0  WRITEGLUE:58FF0008 07FF0000   WRITE:212FD220
   +0000FC  WADDR_WSA:00000000      _GETFN:00000000   WDLL_INDEX:00000000
   +000108  WCEESG003:00000000      WWSA:00000000

     HFSF:  2135A174
   +000000  HFSF_EYE:HFSF     READ:2131A1F8     WRITE:213197A0
   +00000C  REPOS:21319198    GETPOS:21318EA8   FLUSH:21318A08
   +000018  READBUFLEN:00000000     OPENFLAG:00000403       FLAG1:00000000
   +000024  HFSF_ST_MODE:030001C0   HFSF_LAST_FSTAT:4DC12A2E C5C4ADF8

     FFIL:  2135A248
   +000000  MARKER1:AFCB      FILE:00000000      __FP:2135A268
   +00000C  MARKER2:AFCBAFCB        FF_FLAGS:01000000
   +000014  FCBMUTEX:00000000       THREADID:00000000 00000000

    File name: CHARUM.A.B

      FCB:  2135A268
   +000000  BUFPTR:00000000   COUNTIN:00000000        COUNTOUT:00000000
   +00000C  READFUNC:2135A338       WRITEFUNC:2135A358      FLAGS1:0000
   +000016  DEPTH:0000  NAME:2135A424     _LENGTH:0000000A
   +000020  _BUFSIZE:00000044       MEMBER:........   NEXT:2135A660
   +000030  PREV:2135A040     PARENT:2135A268   CHILD:00000000
   +00003C  DDNAME:........   FD:FFFFFFFF       DEVTYPE:08  FCBTYPE:0055
   +00004C  FSCE:2135A39C     UNGETBUF:2135A39C       REPOS:20F52B90
   +000058  GETPOS:20FDD460   CLOSE:20FDD058    FLUSH:20F52AF8
   +000064  UTILITY:20F3C030        USERBUF:00000000        LRECL:00000400
   +000070  BLKSIZE:00000400        REALBUFPTR:00000000
   +000078  UNGETCOUNT:00000000     BUFSIZE:00000400        BUF:00000000
   +000084  CURSOR:00000000   ENDOFDATA:00000000      SAVEDBUF:00000000
   +000090  REALCOUNTIN:00000000    REALCOUNTOUT:00000000
   +000098  POSMAJOR:00000000       SAVEMAJOR:00000000
   +0000A0  POSMINOR:00000000       SAVEMINOR:00000000      STATE:0000
   +0000AA  SAVESTATE:0000    EXITFTELL:00000000      EXITUNGETC:20F481E8
   +0000B4  DBCSTART:00000000       UTILITYAREA:00000000
   +0000BC  INTERCEPT:00000000      FLAGS2:02020008 40000100
   +0000C8  DBCSSTATE:0000    FCB_CPCB:20C0DEA8
   +0000D0  READGLUE:58FF0008 07FF0000    READ:20F48580
   +0000DC  RADDR_WSA:00000000      _GETFN:00000000   RDLL_INDEX:00000000
   +0000E8  RCEESG003:00000000      RWSA:00000000
   +0000F0  WRITEGLUE:58FF0008 07FF0000   WRITE:20F531A0
   +0000FC  WADDR_WSA:00000000      _GETFN:00000000   WDLL_INDEX:00000000
   +000108  WCEESG003:00000000      WWSA:00000000
```

Figure 19. Example formatted C/C++ output from LEDATA Verbexit (Part 5 of 22)

```
  MEMO:  2135A39C
+000000  MEMO_EYE:MEMO     MFCB:2135A470     NEBULA:2135A4E4
+00000C  NEBINDEX:0001     CURRDS:00000000   READ:20F48580
+000018  WRITE:20FDF820    REPOS:20FDD670    FLUSH:20FDCDE0

  FFIL:  2135A640
+000000  MARKER1:AFCB      FILE:00000000     __FP:2135A660
+00000C  MARKER2:AFCBAFCB        FF_FLAGS:01000000
+000014  FCBMUTEX:00000000       THREADID:00000000 00000000

 File name: CHARUM.B.C

   FCB:  2135A660
+000000  BUFPTR:00000000   COUNTIN:00000000        COUNTOUT:00000000
+00000C  READFUNC:2135A730       WRITEFUNC:2135A750      FLAGS1:0000
+000016  DEPTH:0000  NAME:2135A81C     _LENGTH:0000000A
+000020  _BUFSIZE:00000044       MEMBER:........   NEXT:2135AA60
+000030  PREV:2135A268     PARENT:2135A660   CHILD:00000000
+00003C  DDNAME:........   FD:FFFFFFFF       DEVTYPE:0A  FCBTYPE:0056
+00004C  FSCE:2135A794     UNGETBUF:2135A794       REPOS:21313E38
+000058  GETPOS:21313AF0   CLOSE:213150A8    FLUSH:21313A70
+000064  UTILITY:20F3C030        USERBUF:00000000        LRECL:00001000
+000070  BLKSIZE:00001000        REALBUFPTR:00000000
+000078  UNGETCOUNT:00000000     BUFSIZE:00001000        BUF:00000000
+000084  CURSOR:00000000   ENDOFDATA:00000000      SAVEDBUF:00000000
+000090  REALCOUNTIN:00000000    REALCOUNTOUT:00000000
+000098  POSMAJOR:00000000       SAVEMAJOR:00000000
+0000A0  POSMINOR:00000000       SAVEMINOR:00000000      STATE:0000
+0000AA  SAVESTATE:0000    EXITFTELL:00000000      EXITUNGETC:20F481E8
+0000B4  DBCSTART:00000000       UTILITYAREA:00000000
+0000BC  INTERCEPT:00000000      FLAGS2:02020028 40004100
+0000C8  DBCSSTATE:0000    FCB_CPCB:20C0DEA8
+0000D0  READGLUE:58FF0008 07FF0000    READ:20F48580
+0000DC  RADDR_WSA:00000000      _GETFN:00000000   RDLL_INDEX:00000000
+0000E8  RCEESG003:00000000      RWSA:00000000
+0000F0  WRITEGLUE:58FF0008 07FF0000   WRITE:21314110
+0000FC  WADDR_WSA:00000000      _GETFN:00000000   WDLL_INDEX:00000000
+000108  WCEESG003:00000000      WWSA:00000000

  HSPF:  2135A794
+000000  HSPF_EYE:HSPF     MFCB:2135A970     READ:20F48580
+00000C  WRITE:21316858    REPOS:21315650    GETPOS:21315470
+000018  FLUSH:21314A30    CURBUFSIZEUSED:00000000
+000020  LASTBLKOFFSET:00000000        HSPPARM:2135A868

  FFIL:  2135AA40
+000000  MARKER1:AFCB      FILE:00000000     __FP:2135AA60
+00000C  MARKER2:AFCBAFCB        FF_FLAGS:01000000
+000014  FCBMUTEX:00000000       THREADID:00000000 00000000

 File name: CHARUM.C.D

   FCB:  2135AA60
+000000  BUFPTR:00000000   COUNTIN:00000000        COUNTOUT:00000000
+00000C  READFUNC:2135AB30       WRITEFUNC:2135AB50      FLAGS1:0000
+000016  DEPTH:0000  NAME:2135AC1C     _LENGTH:0000000A
+000020  _BUFSIZE:00000044       MEMBER:........   NEXT:2135AD30
+000030  PREV:2135A660     PARENT:2135AA60   CHILD:00000000
+00003C  DDNAME:SYS00011   FD:FFFFFFFF       DEVTYPE:00  FCBTYPE:0027
+00004C  FSCE:2135AB94     UNGETBUF:2135AB94       REPOS:20F5F2A0
+000058  GETPOS:20F48330   CLOSE:20F7E1A0    FLUSH:20F5F3A8
+000064  UTILITY:20F5F160        USERBUF:00000000        LRECL:00000050
+000070  BLKSIZE:00000050        REALBUFPTR:00000000
+000078  UNGETCOUNT:00000000     BUFSIZE:00000051        BUF:00000000
+000084  CURSOR:00000000   ENDOFDATA:00000000      SAVEDBUF:00000000
+000090  REALCOUNTIN:00000000    REALCOUNTOUT:00000000
+000098  POSMAJOR:00000000       SAVEMAJOR:00000000
+0000A0  POSMINOR:00000000       SAVEMINOR:00000000      STATE:0000
```

Figure 19. Example formatted C/C++ output from LEDATA Verbexit (Part 6 of 22)

```
+0000AA  SAVESTATE:0000    EXITFTELL:20F482A8      EXITUNGETC:20F481E8
+0000B4  DBCSTART:00000000       UTILITYAREA:00000000
+0000BC  INTERCEPT:00000000      FLAGS2:02120020 40489100
+0000C8  DBCSSTATE:0000    FCB_CPCB:20C0DEA8
+0000D0  READGLUE:58FF0008 07FF0000    READ:20F48580
+0000DC  RADDR_WSA:00000000       _GETFN:00000000   RDLL_INDEX:00000000
+0000E8  RCEESG003:00000000      RWSA:00000000
+0000F0  WRITEGLUE:58FF0008 07FF0000   WRITE:20F7ED60
+0000FC  WADDR_WSA:00000000       _GETFN:00000000   WDLL_INDEX:00000000
+000108  WCEESG003:00000000      WWSA:00000000

  OSNS:  2135AB94
+000000  OSNS_EYE:OSNS     READ:20F48580     WRITE:20F7E640
+00000C  REPOS:20F5F588    GETPOS:20F48330   CLOSE:20F7E1A0
+000018  FLUSH:20F7E4C0    UTILITY:213126A0        EXITFTELL:20F482A8
+000024  EXITUNGETC:20F481E8     OSIOBLK:2135AC68
+00002C  NEWLINEPTR:00000000     RECLENGTH:00000050      FLAGS:81000000

  OSIO:  2135AC68
+000000  OSIO_EYE:OSIO     DCBW:00012020     DCBRU:00000000
+00000C  JFCB:000127E8     CURRMBUF:00000000       MBUFCOUNT:00000000
+000018  READMAX:00000000        CURBLKNUM:FFFFFFFF
+000020  LASTBLKNUM:FFFFFFFF     BLKSPERTRK:0000   OSIO_ACCESS_METHOD:02
+000027  OSIO_NOSEEK_TO_SEEK:00  FIRSTPOS:00000000
+00002C  LASTPOS:00000000        NEWPOS:00000000   READFUNCNUM:00000002
+000038  WRITEFUNCNUM:00000005   FCB:2135AA60      PARENT:2135AC68
+000044  FLAGS1:81000000   DCBERU:00000000   DCBEW:2135ACD0
+000050  OSIO_VOLSEQ:0000  OSIO_NEWVOLSEQ:0000     OSIO_EXT:00000000
+000058  OSIO_HIGHVOL:0000       APPENDEDLASTVOLSEQ:0000
+00005C  OSIO_JFCBX:00000000

   DCB:  00012020
+000000  DCBRELAD:2135ACD0       DCBFDAD:00000000 D2000300
+000014  DCBBUFNO:05       DCBSRG1:40  DCBEODAD:000000   DCBRECFM:80
+000025  DCBEXLSA:0127D0   DCBDDNAM:...&..'d       DCBMACR1:A0
+000033  DCBMACR2:58       DCBSYNAD:000000   DCBBLKSI:0050     DCBNCP:21
+000052  DCBLRECL:0050

  DCBE:  2135ACD0
+000000  DCBEID:DCBE       DCBELEN:0038      RESERVED0:0000
+000008  DCBEDCB:00012020        DCBERELA:00000000       DCBEFLG1:C0
+000011  DCBEFLG2:88       DCBENSTR:0000     DCBEFLG3:80
+000024  DCBESIZE:00000000       DCBEEODA:20E6269A
+00002C  DCBESYNA:20E6263C       MULTSDN:00

  JFCB:  000127E8
+000000  JFCBDSNM:CHARUM.C.D
+00002C  JFCBELNM:               JFCBTSDM:80       JFCBDSCB:01291C
+000046  JFCBVLSQ:0000     JFCBIND1:00       JFCBIND2:40
+000058  JFCBUFNO:00       JFCDSRG1:00       JFCDSRG2:00
+000064  JFCRECFM:00       JFCBLKSI:0000     JFCLRECL:0000     JFCNCP:00
+000075  JFCBNVOL:01       JFCBNVOLS:SL4A00
+000094  JFCBEXTL:00       JFCBEXAD:0009AF   JFCFLGS1:00
+0000AE  JFCBVLCT:01

  FFIL:  2135AD10
+000000  MARKER1:AFCB      FILE:00000000     __FP:2135AD30
+00000C  MARKER2:AFCBAFCB        FF_FLAGS:01000000
+000014  FCBMUTEX:00000000       THREADID:00000000 00000000

 File name: CHARUM.D.E

   FCB:  2135AD30
+000000  BUFPTR:2135AFE0   COUNTIN:00000007        COUNTOUT:00000000
+00000C  READFUNC:2135AE00       WRITEFUNC:2135AE20      FLAGS1:9000
+000016  DEPTH:0000  NAME:2135AEEC     _LENGTH:0000000A
+000020  _BUFSIZE:00000044       MEMBER:........   NEXT:2135B0A0
+000030  PREV:2135AA60     PARENT:2135AD30   CHILD:00000000
+00003C  DDNAME:SYS00012   FD:FFFFFFFF       DEVTYPE:00  FCBTYPE:002A
+00004C  FSCE:2135AE64     UNGETBUF:2135AE64       REPOS:20F87590
```

Figure 19. Example formatted C/C++ output from LEDATA Verbexit (Part 7 of 22)

```
+000058  GETPOS:20F89070   CLOSE:20F862E0    FLUSH:20F86D50
+000064  UTILITY:20F85D60        USERBUF:00000000        LRECL:00000050
+000070  BLKSIZE:00000050        REALBUFPTR:2135AFE0
+000078  UNGETCOUNT:00000000     BUFSIZE:00000051        BUF:2135AFE0
+000084  CURSOR:2135AFE0   ENDOFDATA:2135AFE0      SAVEDBUF:00000000
+000090  REALCOUNTIN:00000000    REALCOUNTOUT:00000050
+000098  POSMAJOR:00000000       SAVEMAJOR:00000000
+0000A0  POSMINOR:00000000       SAVEMINOR:00000000      STATE:0000
+0000AA  SAVESTATE:0000    EXITFTELL:00000000      EXITUNGETC:00000000
+0000B4  DBCSTART:00000000       UTILITYAREA:00000000
+0000BC  INTERCEPT:00000000      FLAGS2:021A0000 40440100
+0000C8  DBCSSTATE:0000    FCB_CPCB:20C0DEA8
+0000D0  READGLUE:58FF0008 07FF0000    READ:20F8C258
+0000DC  RADDR_WSA:00000000      _GETFN:00000000   RDLL_INDEX:00000000
+0000E8  RCEESG003:00000000      RWSA:00000000
+0000F0  WRITEGLUE:58FF0008 07FF0000   WRITE:20F89A10
+0000FC  WADDR_WSA:00000000      _GETFN:00000000   WDLL_INDEX:00000000
+000108  WCEESG003:00000000      WWSA:00000000

  OSFS:  2135AE64
+000000  OSFS_EYE:OSFS     READ:20F8C258     WRITE:20F89A10
+00000C  REPOS:20F87590    GETPOS:20F89070   CLOSE:20F862E0
+000018  FLUSH:20F86D50    UTILITY:20F85D60        EXITFTELL:00000000
+000024  EXITUNGETC:00000000     OSIOBLK:2135AF38        SAVECURSOR:21
+00002D  NEWLINEPTR:35AFE021     ENDOFBLOCK:35AFE600
+000035  CURRBLKSIZE:00000000    LASTBLKSIZE:00005000
+00003D  HIGHMAJOR:00000000      RELRECNUM:00000000
+000045  MAXFTELLBLK:00000001    RECBITS:FFFFFF00
+00004D  RECSPERBLOCK:00000700   SAVECHAR:00000140       FLAGS1:72000000

  OSIO:  2135AF38
+000000  OSIO_EYE:OSIO     DCBW:000128A0     DCBRU:000129F8
+00000C  JFCB:00012908     CURRMBUF:000129C0       MBUFCOUNT:00000001
+000018  READMAX:00000001        CURBLKNUM:00000000
+000020  LASTBLKNUM:00000257     BLKSPERTRK:0000   OSIO_ACCESS_METHOD:01
+000027  OSIO_NOSEEK_TO_SEEK:00  FIRSTPOS:00000100
+00002C  LASTPOS:00073600        NEWPOS:00000000   READFUNCNUM:00000003
+000038  WRITEFUNCNUM:00000005   FCB:2135AD30      PARENT:2135AF38
+000044  FLAGS1:B5020000   DCBERU:2135B040   DCBEW:2135AFA0
+000050  OSIO_VOLSEQ:0000  OSIO_NEWVOLSEQ:0000     OSIO_EXT:00000000
+000058  OSIO_HIGHVOL:0000       APPENDEDLASTVOLSEQ:0000
+00005C  OSIO_JFCBX:00000000

   DCB:  000128A0
+000000  DCBRELAD:2135AFA0       DCBFDAD:02000000 3B000236
+000014  DCBBUFNO:00       DCBSRG1:40  DCBEODAD:000000   DCBRECFM:80
+000025  DCBEXLSA:0127D0   DCBDDNAM:.u.....d       DCBMACR1:65
+000033  DCBMACR2:B8       DCBSYNAD:000000   DCBBLKSI:0050     DCBNCP:01
+000052  DCBLRECL:0050

   DCB:  000129F8
+000000  DCBRELAD:2135B040       DCBFDAD:00000000 1F000501
+000014  DCBBUFNO:00       DCBSRG1:40  DCBEODAD:000000   DCBRECFM:80
+000025  DCBEXLSA:0127D0   DCBDDNAM:.u....=u       DCBMACR1:0A
+000033  DCBMACR2:F0       DCBSYNAD:000000   DCBBLKSI:0050     DCBNCP:01
+000052  DCBLRECL:0050

  DCBE:  2135AFA0
+000000  DCBEID:DCBE       DCBELEN:0038      RESERVED0:0000
+000008  DCBEDCB:000128A0        DCBERELA:00000000       DCBEFLG1:C0
+000011  DCBEFLG2:88       DCBENSTR:0000     DCBEFLG3:00
+000024  DCBESIZE:00000000       DCBEEODA:20E6269A
+00002C  DCBESYNA:20E6263C       MULTSDN:00
```

Figure 19. Example formatted C/C++ output from LEDATA Verbexit (Part 8 of 22)

```
  DCBE:  2135B040
+000000  DCBEID:DCBE       DCBELEN:0038      RESERVED0:0000
+000008  DCBEDCB:000129F8        DCBERELA:00000000       DCBEFLG1:C0
+000011  DCBEFLG2:88       DCBENSTR:0000     DCBEFLG3:00
+000024  DCBESIZE:00000000       DCBEEODA:20E6269A
+00002C  DCBESYNA:20E6263C       MULTSDN:00

  JFCB:  00012908
+000000  JFCBDSNM:CHARUM.D.E
+00002C  JFCBELNM:               JFCBTSDM:80       JFCBDSCB:003E15
+000046  JFCBVLSQ:0000     JFCBIND1:00       JFCBIND2:40
+000058  JFCBUFNO:00       JFCDSRG1:00       JFCDSRG2:00
+000064  JFCRECFM:00       JFCBLKSI:0000     JFCLRECL:0000     JFCNCP:00
+000075  JFCBNVOL:01       JFCBNVOLS:SL621D
+000094  JFCBEXTL:00       JFCBEXAD:0009FF   JFCFLGS1:00
+0000AE  JFCBVLCT:01

  MBUF:  000129C0
+000000  NEXTMBUF:000129C0       BUFFER:2135AFE0   CHECKRESULT:00000000
+00000C  BLKSIZE:00000050
+000010  DECB:7F000000 80800000 000129F8 2135AFE0 00006AF8 00000000 00000000 00000000

  FFIL:  2135B080
+000000  MARKER1:AFCB      FILE:00000000      __FP:2135B0A0
+00000C  MARKER2:AFCBAFCB        FF_FLAGS:01000000
+000014  FCBMUTEX:00000000       THREADID:00000000 00000000

 File name: CHARUM.E.F

   FCB:  2135B0A0
+000000  BUFPTR:00000000   COUNTIN:00000000        COUNTOUT:00000000
+00000C  READFUNC:2135B170       WRITEFUNC:2135B190      FLAGS1:0000
+000016  DEPTH:0000  NAME:2135B25C     _LENGTH:0000000A
+000020  _BUFSIZE:00000044       MEMBER:........   NEXT:2135B370
+000030  PREV:2135AD30     PARENT:2135B0A0   CHILD:00000000
+00003C  DDNAME:SYS00013   FD:FFFFFFFF       DEVTYPE:00  FCBTYPE:0020
+00004C  FSCE:2135B1D4     UNGETBUF:2135B1D4       REPOS:20F7CAF0
+000058  GETPOS:20F7CEC0   CLOSE:20F77BE8    FLUSH:20F7CA78
+000064  UTILITY:213126A0        USERBUF:00000000        LRECL:00000404
+000070  BLKSIZE:00000408        REALBUFPTR:00000000
+000078  UNGETCOUNT:00000000     BUFSIZE:00000408        BUF:00000000
+000084  CURSOR:00000000   ENDOFDATA:00000000      SAVEDBUF:00000000
+000090  REALCOUNTIN:00000000    REALCOUNTOUT:00000000
+000098  POSMAJOR:00000000       SAVEMAJOR:00000000
+0000A0  POSMINOR:00000000       SAVEMINOR:00000000      STATE:0000
+0000AA  SAVESTATE:0000    EXITFTELL:00000000      EXITUNGETC:20F481E8
+0000B4  DBCSTART:00000000       UTILITYAREA:00000000
+0000BC  INTERCEPT:00000000      FLAGS2:02120020 20441100
+0000C8  DBCSSTATE:0000    FCB_CPCB:20C0DEA8
+0000D0  READGLUE:58FF0008 07FF0000    READ:20F48580
+0000DC  RADDR_WSA:00000000       _GETFN:00000000   RDLL_INDEX:00000000
+0000E8  RCEESG003:00000000      RWSA:00000000
+0000F0  WRITEGLUE:58FF0008 07FF0000   WRITE:20F7D260
+0000FC  WADDR_WSA:00000000       _GETFN:00000000   WDLL_INDEX:00000000
+000108  WCEESG003:00000000      WWSA:00000000

  OSVF:  2135B1D4
+000000  OSVF_EYE:OSVF     READ:20F48580     WRITE:20F7ADD8
+00000C  REPOS:20F786B0    GETPOS:20F7A5C8   CLOSE:00000000
+000018  FLUSH:20F77F38    UTILITY:213126A0        EXITFTELL:00000000
+000024  EXITUNGETC:20F481E8     OSIOBLK:2135B2A8
+00002C  SAVECURSOR:00000000     NEWLINEPTR:00000000
+000034  CURBLKSIZE:00000000     LASTBLKSIZE:00000000
+00003C  HIGHMAJOR:00000000      MAXFTELLBLK:001FFFFF
+000044  RECBITS:0000000B        FLAGS:72000000    RECLEN:00000000
+000050  CURRBLKNUM:00000000     LASTBLKNUM:00000000
+000058  OSWRITETOK:00000000     RECCOUNTOUT1:00000000
+000060  BLKCOUNTOUT1:00000000   SAVECOUNTOUT:00000000   SDWCODE:0000
+00006A  SAVECHAR:.  LASTTTRBLT:00000000     LASTWRTSIZE:00000000
+000073  LRECLUSED:00000000      OLDLRECLUSED:00000000
+00007B  READERCOUNT:00000000    UNWRITTENDATA:00000000
+000083  MINRECLEN:00000000
```

Figure 19. Example formatted C/C++ output from LEDATA Verbexit (Part 9 of 22)

```
  OSIO:  2135B2A8
+000000  OSIO_EYE:OSIO     DCBW:00012A60     DCBRU:00000000
+00000C  JFCB:00012AC8     CURRMBUF:00000000       MBUFCOUNT:00000001
+000018  READMAX:00000000        CURBLKNUM:FFFFFFFF
+000020  LASTBLKNUM:FFFFFFFF     BLKSPERTRK:0000   OSIO_ACCESS_METHOD:01
+000027  OSIO_NOSEEK_TO_SEEK:00  FIRSTPOS:00000100
+00002C  LASTPOS:00000100        NEWPOS:00000000   READFUNCNUM:00000002
+000038  WRITEFUNCNUM:00000005   FCB:2135B0A0      PARENT:2135B2A8
+000044  FLAGS1:81020000   DCBERU:00000000   DCBEW:2135B310
+000050  OSIO_VOLSEQ:0000  OSIO_NEWVOLSEQ:0000     OSIO_EXT:00000000
+000058  OSIO_HIGHVOL:0000       APPENDEDLASTVOLSEQ:0000
+00005C  OSIO_JFCBX:00000000

   DCB:  00012A60
+000000  DCBRELAD:2135B310       DCBFDAD:00000000 01000D00
+000014  DCBBUFNO:00       DCBSRG1:40  DCBEODAD:000000   DCBRECFM:40
+000025  DCBEXLSA:0127D0   DCBDDNAM:........       DCBMACR1:65
+000033  DCBMACR2:B8       DCBSYNAD:000000   DCBBLKSI:0408     DCBNCP:01
+000052  DCBLRECL:0404

  DCBE:  2135B310
+000000  DCBEID:DCBE       DCBELEN:0038      RESERVED0:0000
+000008  DCBEDCB:00012A60        DCBERELA:00000000       DCBEFLG1:C0
+000011  DCBEFLG2:88       DCBENSTR:0000     DCBEFLG3:00
+000024  DCBESIZE:00000000       DCBEEODA:20E6269A
+00002C  DCBESYNA:20E6263C       MULTSDN:00

  JFCB:  00012AC8
+000000  JFCBDSNM:CHARUM.E.F
+00002C  JFCBELNM:               JFCBTSDM:80       JFCBDSCB:004B17
+000046  JFCBVLSQ:0000     JFCBIND1:00       JFCBIND2:40
+000058  JFCBUFNO:00       JFCDSRG1:00       JFCDSRG2:00
+000064  JFCRECFM:00       JFCBLKSI:0000     JFCLRECL:0000     JFCNCP:00
+000075  JFCBNVOL:01       JFCBNVOLS:SL880B
+000094  JFCBEXTL:00       JFCBEXAD:000A4F   JFCFLGS1:00
+0000AE  JFCBVLCT:01

  FFIL:  2135B350
+000000  MARKER1:AFCB      FILE:00000000     __FP:2135B370
+00000C  MARKER2:AFCBAFCB        FF_FLAGS:01000000
+000014  FCBMUTEX:00000000       THREADID:00000000 00000000

 File name: CHARUM.F.G

   FCB:  2135B370
+000000  BUFPTR:00000000   COUNTIN:00000000        COUNTOUT:00000000
+00000C  READFUNC:2135B440       WRITEFUNC:2135B460      FLAGS1:0000
+000016  DEPTH:0000  NAME:2135B52C     _LENGTH:0000000A
+000020  _BUFSIZE:00000044       MEMBER:........   NEXT:2135B640
+000030  PREV:2135B0A0     PARENT:2135B370   CHILD:00000000
+00003C  DDNAME:SYS00014   FD:FFFFFFFF       DEVTYPE:00  FCBTYPE:0028
+00004C  FSCE:2135B4A4     UNGETBUF:2135B4A4       REPOS:20F590C0
+000058  GETPOS:20F59368   CLOSE:20F804A0    FLUSH:20F59048
+000064  UTILITY:20F58D70        USERBUF:00000000        LRECL:00000000
+000070  BLKSIZE:00001800        REALBUFPTR:00000000
+000078  UNGETCOUNT:00000000     BUFSIZE:00001800        BUF:00000000
+000084  CURSOR:00000000   ENDOFDATA:00000000      SAVEDBUF:00000000
+000090  REALCOUNTIN:00000000    REALCOUNTOUT:00000000
```

Figure 19. Example formatted C/C++ output from LEDATA Verbexit (Part 10 of 22)

```
+000098  POSMAJOR:00000000       SAVEMAJOR:00000000
+0000A0  POSMINOR:00000000       SAVEMINOR:00000000      STATE:0000
+0000AA  SAVESTATE:0000    EXITFTELL:00000000      EXITUNGETC:20F481E8
+0000B4  DBCSTART:00000000       UTILITYAREA:00000000
+0000BC  INTERCEPT:00000000      FLAGS2:02120000 60441100
+0000C8  DBCSSTATE:0000    FCB_CPCB:20C0DEA8
+0000D0  READGLUE:58FF0008 07FF0000    READ:20F48580
+0000DC  RADDR_WSA:00000000      _GETFN:00000000   RDLL_INDEX:00000000
+0000E8  RCEESG003:00000000      RWSA:00000000
+0000F0  WRITEGLUE:58FF0008 07FF0000   WRITE:20F595D8
+0000FC  WADDR_WSA:00000000      _GETFN:00000000   WDLL_INDEX:00000000
+000108  WCEESG003:00000000      WWSA:00000000

  OSFS:  2135B4A4
+000000  OSFS_EYE:OSFS     READ:20F48580     WRITE:20F83078
+00000C  REPOS:20F80CC0    GETPOS:20F826B8   CLOSE:00000000
+000018  FLUSH:20F808B0    UTILITY:213126A0        EXITFTELL:00000000
+000024  EXITUNGETC:20F481E8     OSIOBLK:2135B578        SAVECURSOR:00
+00002D  NEWLINEPTR:00000000     ENDOFBLOCK:00000000
+000035  CURRBLKSIZE:00000000    LASTBLKSIZE:00000000
+00003D  HIGHMAJOR:00000000      RELRECNUM:00000000
+000045  MAXFTELLBLK:00000000    RECBITS:07FFFF00
+00004D  RECSPERBLOCK:00000D00   SAVECHAR:00000000       FLAGS1:72000000

  OSIO:  2135B578
+000000  OSIO_EYE:OSIO     DCBW:00012B80     DCBRU:00000000
+00000C  JFCB:00012BE8     CURRMBUF:00000000       MBUFCOUNT:00000001
+000018  READMAX:00000000        CURBLKNUM:FFFFFFFF
+000020  LASTBLKNUM:FFFFFFFF     BLKSPERTRK:0000   OSIO_ACCESS_METHOD:01
+000027  OSIO_NOSEEK_TO_SEEK:00  FIRSTPOS:00000100
+00002C  LASTPOS:00000100        NEWPOS:00000000   READFUNCNUM:00000002
+000038  WRITEFUNCNUM:00000005   FCB:2135B370      PARENT:2135B578
+000044  FLAGS1:81020000   DCBERU:00000000   DCBEW:2135B5E0
+000050  OSIO_VOLSEQ:0000  OSIO_NEWVOLSEQ:0000     OSIO_EXT:00000000
+000058  OSIO_HIGHVOL:0000       APPENDEDLASTVOLSEQ:0000
+00005C  OSIO_JFCBX:00000000

   DCB:  00012B80
+000000  DCBRELAD:2135B5E0       DCBFDAD:00000000 EA000800
+000014  DCBBUFNO:00       DCBSRG1:40  DCBEODAD:000000   DCBRECFM:C0
+000025  DCBEXLSA:0127D0   DCBDDNAM:......fd       DCBMACR1:65
+000033  DCBMACR2:B8       DCBSYNAD:000000   DCBBLKSI:1800     DCBNCP:01
+000052  DCBLRECL:0000

  DCBE:  2135B5E0
+000000  DCBEID:DCBE       DCBELEN:0038      RESERVED0:0000
+000008  DCBEDCB:00012B80        DCBERELA:00000000       DCBEFLG1:C0
+000011  DCBEFLG2:88       DCBENSTR:0000     DCBEFLG3:00
+000024  DCBESIZE:00000000       DCBEEODA:20E6269A
+00002C  DCBESYNA:20E6263C       MULTSDN:00

  JFCB:  00012BE8
+000000  JFCBDSNM:CHARUM.F.G
+00002C  JFCBELNM:               JFCBTSDM:80       JFCBDSCB:01402A
+000046  JFCBVLSQ:0000     JFCBIND1:00       JFCBIND2:40
+000058  JFCBUFNO:00       JFCDSRG1:00       JFCDSRG2:00
+000064  JFCRECFM:00       JFCBLKSI:0000     JFCLRECL:0000     JFCNCP:00
+000075  JFCBNVOL:01       JFCBNVOLS:SL4C06
+000094  JFCBEXTL:00       JFCBEXAD:000A9F   JFCFLGS1:00
+0000AE  JFCBVLCT:01

  FFIL:  2135B620
+000000  MARKER1:AFCB      FILE:00000000      __FP:2135B640
+00000C  MARKER2:AFCBAFCB        FF_FLAGS:01000000
+000014  FCBMUTEX:00000000       THREADID:00000000 00000000
```

Figure 19. Example formatted C/C++ output from LEDATA Verbexit (Part 11 of 22)

```
 File name: CHARUM.G.H

   FCB:  2135B640
+000000  BUFPTR:00000000   COUNTIN:00000000        COUNTOUT:00000000
+00000C  READFUNC:2135B710       WRITEFUNC:2135B730      FLAGS1:8000
+000016  DEPTH:0000  NAME:2135B7FC     _LENGTH:0000000A
+000020  _BUFSIZE:00000044       MEMBER:........   NEXT:2135B910
+000030  PREV:2135B370     PARENT:2135B640   CHILD:00000000
+00003C  DDNAME:SYS00015   FD:FFFFFFFF       DEVTYPE:00  FCBTYPE:0041
+00004C  FSCE:2135B774     UNGETBUF:2135B774       REPOS:20F5F2A0
+000058  GETPOS:20F48330   CLOSE:20FB8930    FLUSH:20F5F3A8
+000064  UTILITY:20F5F160        USERBUF:00000000        LRECL:00000050
+000070  BLKSIZE:00000050        REALBUFPTR:00000000
+000078  UNGETCOUNT:00000000     BUFSIZE:00000051        BUF:00000000
+000084  CURSOR:00000000   ENDOFDATA:00000000      SAVEDBUF:00000000
+000090  REALCOUNTIN:00000000     REALCOUNTOUT:00000000
+000098  POSMAJOR:00000000       SAVEMAJOR:00000000
+0000A0  POSMINOR:00000000       SAVEMINOR:00000000      STATE:0000
+0000AA  SAVESTATE:0000    EXITFTELL:20F482A8      EXITUNGETC:20F481E8
+0000B4  DBCSTART:00000000       UTILITYAREA:00000000
+0000BC  INTERCEPT:00000000      FLAGS2:02120020 40488100
+0000C8  DBCSSTATE:0000    FCB_CPCB:20C0DEA8
+0000D0  READGLUE:58FF0008 07FF0000    READ:20F48580
+0000DC  RADDR_WSA:00000000      _GETFN:00000000   RDLL_INDEX:00000000
+0000E8  RCEESG003:00000000      RWSA:00000000
+0000F0  WRITEGLUE:58FF0008 07FF0000   WRITE:20FBA568
+0000FC  WADDR_WSA:00000000      _GETFN:00000000   WDLL_INDEX:00000000
+000108  WCEESG003:00000000      WWSA:00000000

  OSNS:  2135B774
+000000  OSNS_EYE:OSNS     READ:20F48580     WRITE:20FB8D88
+00000C  REPOS:20F5F588    GETPOS:20F48330   CLOSE:20FB8930
+000018  FLUSH:20FB8CC0    UTILITY:20FB8600        EXITFTELL:20F482A8
+000024  EXITUNGETC:20F481E8     OSIOBLK:2135B848
+00002C  NEWLINEPTR:00000000     RECLENGTH:00000050      FLAGS:81000000

  OSIO:  2135B848
+000000  OSIO_EYE:OSIO     DCBW:00012CA0     DCBRU:00000000
+00000C  JFCB:00012D08     CURRMBUF:00000000       MBUFCOUNT:00000001
+000018  READMAX:00000000        CURBLKNUM:FFFFFFFF
+000020  LASTBLKNUM:FFFFFFFF     BLKSPERTRK:0000   OSIO_ACCESS_METHOD:02
+000027  OSIO_NOSEEK_TO_SEEK:00  FIRSTPOS:00000000
+00002C  LASTPOS:00000000        NEWPOS:00000000   READFUNCNUM:00000002
+000038  WRITEFUNCNUM:00000005   FCB:2135B640      PARENT:2135B848
+000044  FLAGS1:81000000   DCBERU:00000000   DCBEW:2135B8B0
+000050  OSIO_VOLSEQ:0000  OSIO_NEWVOLSEQ:0000     OSIO_EXT:00000000
+000058  OSIO_HIGHVOL:0000       APPENDEDLASTVOLSEQ:0000
+00005C  OSIO_JFCBX:00000000

   DCB:  00012CA0
+000000  DCBRELAD:2135B8B0       DCBFDAD:00000000 F1000200
+000014  DCBBUFNO:05       DCBSRG1:40  DCBEODAD:000000   DCBRECFM:80
+000025  DCBEXLSA:0127D0   DCBDDNAM:.\.&..a.       DCBMACR1:A0
+000033  DCBMACR2:58       DCBSYNAD:000000   DCBBLKSI:0050     DCBNCP:21
+000052  DCBLRECL:0050

  DCBE:  2135B8B0
+000000  DCBEID:DCBE       DCBELEN:0038      RESERVED0:0000
+000008  DCBEDCB:00012CA0        DCBERELA:00000000       DCBEFLG1:C0
+000011  DCBEFLG2:88       DCBENSTR:0000     DCBEFLG3:80
+000024  DCBESIZE:00000000       DCBEEODA:20E6269A
+00002C  DCBESYNA:20E6263C       MULTSDN:00

  JFCB:  00012D08
+000000  JFCBDSNM:CHARUM.G.H
+00002C  JFCBELNM:               JFCBTSDM:80       JFCBDSCB:01391F
+000046  JFCBVLSQ:0000     JFCBIND1:00       JFCBIND2:40
+000058  JFCBUFNO:00       JFCDSRG1:00       JFCDSRG2:00
+000064  JFCRECFM:00       JFCBLKSI:0000     JFCLRECL:0000     JFCNCP:00
+000075  JFCBNVOL:01       JFCBNVOLS:SL4A04
+000094  JFCBEXTL:00       JFCBEXAD:000AEF   JFCFLGS1:00
+0000AE  JFCBVLCT:01
```

Figure 19. Example formatted C/C++ output from LEDATA Verbexit (Part 12 of 22)

```
  FFIL:  2135B8F0
+000000  MARKER1:AFCB      FILE:00000000      __FP:2135B910
+00000C  MARKER2:AFCBAFCB         FF_FLAGS:01000000
+000014  FCBMUTEX:00000000        THREADID:00000000 00000000

 File name: CHARUM.H.I

   FCB:  2135B910
+000000  BUFPTR:00000000   COUNTIN:00000000         COUNTOUT:00000000
+00000C  READFUNC:2135B9E0        WRITEFUNC:2135BA00       FLAGS1:8000
+000016  DEPTH:0000  NAME:2135BACC     _LENGTH:0000000A
+000020  _BUFSIZE:00000044        MEMBER:........    NEXT:2135BBE0
+000030  PREV:2135B640     PARENT:2135B910   CHILD:00000000
+00003C  DDNAME:SYS00016   FD:FFFFFFFF        DEVTYPE:00  FCBTYPE:002A
+00004C  FSCE:2135BA44     UNGETBUF:2135BA44        REPOS:20F5A418
+000058  GETPOS:20F5AAC8   CLOSE:20F862E0    FLUSH:20F5A3A0
+000064  UTILITY:20F85D60         USERBUF:00000000         LRECL:00000050
+000070  BLKSIZE:00000050         REALBUFPTR:00000000
+000078  UNGETCOUNT:00000000     BUFSIZE:00000051         BUF:00000000
+000084  CURSOR:00000000   ENDOFDATA:00000000       SAVEDBUF:00000000
+000090  REALCOUNTIN:00000000    REALCOUNTOUT:00000000
+000098  POSMAJOR:00000000        SAVEMAJOR:00000000
+0000A0  POSMINOR:00000000        SAVEMINOR:00000000       STATE:0000
+0000AA  SAVESTATE:0000    EXITFTELL:00000000       EXITUNGETC:20F481E8
+0000B4  DBCSTART:00000000        UTILITYAREA:00000000
+0000BC  INTERCEPT:00000000       FLAGS2:02120020 40440100
+0000C8  DBCSSTATE:0000    FCB_CPCB:20C0DEA8
+0000D0  READGLUE:58FF0008 07FF0000    READ:20F48580
+0000DC  RADDR_WSA:00000000       _GETFN:00000000   RDLL_INDEX:00000000
+0000E8  RCEESG003:00000000       RWSA:00000000
+0000F0  WRITEGLUE:58FF0008 07FF0000   WRITE:20F5B168
+0000FC  WADDR_WSA:00000000       _GETFN:00000000   WDLL_INDEX:00000000
+000108  WCEESG003:00000000       WWSA:00000000

  OSFS:  2135BA44
+000000  OSFS_EYE:OSFS     READ:20F48580     WRITE:20F89A10
+00000C  REPOS:20F87590    GETPOS:20F89070   CLOSE:20F862E0
+000018  FLUSH:20F86D50    UTILITY:20F85D60         EXITFTELL:00000000
+000024  EXITUNGETC:20F481E8     OSIOBLK:2135BB18         SAVECURSOR:00
+00002D  NEWLINEPTR:00000000     ENDOFBLOCK:00000000
+000035  CURRBLKSIZE:00000000    LASTBLKSIZE:00000000
+00003D  HIGHMAJOR:00000000       RELRECNUM:00000000
+000045  MAXFTELLBLK:00000001    RECBITS:FFFFFF00
+00004D  RECSPERBLOCK:00000700   SAVECHAR:00000100        FLAGS1:72000000

  OSIO:  2135BB18
+000000  OSIO_EYE:OSIO     DCBW:00012DC0     DCBRU:00000000
+00000C  JFCB:00012E28     CURRMBUF:00000000        MBUFCOUNT:00000001
+000018  READMAX:00000000         CURBLKNUM:FFFFFFFF
+000020  LASTBLKNUM:FFFFFFFF     BLKSPERTRK:0000   OSIO_ACCESS_METHOD:01
+000027  OSIO_NOSEEK_TO_SEEK:00  FIRSTPOS:00000100
+00002C  LASTPOS:00000100         NEWPOS:00000000   READFUNCNUM:00000002
+000038  WRITEFUNCNUM:00000005   FCB:2135B910       PARENT:2135BB18
+000044  FLAGS1:85020000   DCBERU:00000000   DCBEW:2135BB80
+000050  OSIO_VOLSEQ:0000  OSIO_NEWVOLSEQ:0000     OSIO_EXT:00000000
+000058  OSIO_HIGHVOL:0000        APPENDEDLASTVOLSEQ:0000
+00005C  OSIO_JFCBX:00000000

  DCB:  00012DC0
+000000  DCBRELAD:2135BB80        DCBFDAD:00000000 09000D00
+000014  DCBBUFNO:00       DCBSRG1:40  DCBEODAD:000000   DCBRECFM:80
+000025  DCBEXLSA:0127D0   DCBDDNAM:.4....a.       DCBMACR1:65
+000033  DCBMACR2:B8       DCBSYNAD:000000   DCBBLKSI:0050     DCBNCP:01
+000052  DCBLRECL:0050
```

Figure 19. Example formatted C/C++ output from LEDATA Verbexit (Part 13 of 22)

```
   DCBE:  2135BB80
+000000  DCBEID:DCBE       DCBELEN:0038      RESERVED0:0000
+000008  DCBEDCB:00012DC0        DCBERELA:00000000       DCBEFLG1:C0
+000011  DCBEFLG2:88       DCBENSTR:0000     DCBEFLG3:00
+000024  DCBESIZE:00000000       DCBEEODA:20E6269A
+00002C  DCBESYNA:20E6263C       MULTSDN:00

  JFCB:  00012E28
+000000  JFCBDSNM:CHARUM.H.I
+00002C  JFCBELNM:               JFCBTSDM:80       JFCBDSCB:002214
+000046  JFCBVLSQ:0000     JFCBIND1:00       JFCBIND2:40
+000058  JFCBUFNO:00       JFCDSRG1:00       JFCDSRG2:00
+000064  JFCRECFM:00       JFCBLKSI:0000     JFCLRECL:0000     JFCNCP:00
+000075  JFCBNVOL:01       JFCBNVOLS:SL8B14
+000094  JFCBEXTL:00       JFCBEXAD:000B3F   JFCFLGS1:00
+0000AE  JFCBVLCT:01

  FFIL:  2135BBC0
+000000  MARKER1:AFCB      FILE:00000000     __FP:2135BBE0
+00000C  MARKER2:AFCBAFCB        FF_FLAGS:01000000
+000014  FCBMUTEX:00000000       THREADID:00000000 00000000

 File name: CHARUM.I.J

   FCB:  2135BBE0
+000000  BUFPTR:00000000   COUNTIN:00000000        COUNTOUT:00000000
+00000C  READFUNC:2135BCB0       WRITEFUNC:2135BCD0      FLAGS1:8000
+000016  DEPTH:0000  NAME:2135BD9C     _LENGTH:0000000A
+000020  _BUFSIZE:00000044       MEMBER:........   NEXT:2135BEB0
+000030  PREV:2135B910     PARENT:2135BBE0   CHILD:00000000
+00003C  DDNAME:SYS00017   FD:FFFFFFFF       DEVTYPE:00  FCBTYPE:0036
+00004C  FSCE:2135BD14     UNGETBUF:2135BD14       REPOS:20F5BFD0
+000058  GETPOS:20F5C2E0   CLOSE:20FA16C0    FLUSH:20F5BF58
+000064  UTILITY:20FA0550        USERBUF:00000000        LRECL:00000404
+000070  BLKSIZE:00000408        REALBUFPTR:00000000
+000078  UNGETCOUNT:00000000     BUFSIZE:00000409        BUF:00000000
+000084  CURSOR:00000000   ENDOFDATA:00000000      SAVEDBUF:00000000
+000090  REALCOUNTIN:00000000    REALCOUNTOUT:00000000
+000098  POSMAJOR:00000000       SAVEMAJOR:00000000
+0000A0  POSMINOR:00000000       SAVEMINOR:00000000      STATE:0000
+0000AA  SAVESTATE:0000    EXITFTELL:00000000      EXITUNGETC:20F481E8
+0000B4  DBCSTART:00000000       UTILITYAREA:00000000
+0000BC  INTERCEPT:00000000      FLAGS2:02120020 20440100
+0000C8  DBCSSTATE:0000    FCB_CPCB:20C0DEA8
+0000D0  READGLUE:58FF0008 07FF0000    READ:20F48580
+0000DC  RADDR_WSA:00000000      _GETFN:00000000   RDLL_INDEX:00000000
+0000E8  RCEESG003:00000000      RWSA:00000000
+0000F0  WRITEGLUE:58FF0008 07FF0000   WRITE:20F5C620
+0000FC  WADDR_WSA:00000000      _GETFN:00000000   WDLL_INDEX:00000000
+000108  WCEESG003:00000000      WWSA:00000000

  OSVF:  2135BD14
+000000  OSVF_EYE:OSVF     READ:20F48580     WRITE:20FA8D58
+00000C  REPOS:20FA4BD8    GETPOS:20FA84E0   CLOSE:20FA16C0
+000018  FLUSH:20FA3FD0    UTILITY:20FA0550        EXITFTELL:00000000
+000024  EXITUNGETC:20F481E8     OSIOBLK:2135BDE8
+00002C  SAVECURSOR:00000000     NEWLINEPTR:7FFFFFFF
+000034  CURBLKSIZE:00000000     LASTBLKSIZE:00000000
+00003C  HIGHMAJOR:00000000      MAXFTELLBLK:001FFFFF
+000044  RECBITS:0000000B        FLAGS:73100000    RECLEN:00000000
+000050  CURRBLKNUM:00000000     LASTBLKNUM:00000000
+000058  OSWRITETOK:00000000     RECCOUNTOUT1:00000000
+000060  BLKCOUNTOUT1:00000000   SAVECOUNTOUT:00000000   SDWCODE:0000
+00006A  SAVECHAR:.  LASTTTRBLT:00000000     LASTWRTSIZE:00000000
+000073  LRECLUSED:00000000      OLDLRECLUSED:00000000
+00007B  READERCOUNT:00000000    UNWRITTENDATA:00000000
+000083  MINRECLEN:00000000
```

Figure 19. Example formatted C/C++ output from LEDATA Verbexit (Part 14 of 22)

```
  OSIO:  2135BDE8
+000000  OSIO_EYE:OSIO     DCBW:00012EE0     DCBRU:00000000
+00000C  JFCB:00012F48     CURRMBUF:00000000       MBUFCOUNT:00000001
+000018  READMAX:00000000        CURBLKNUM:FFFFFFFF
+000020  LASTBLKNUM:FFFFFFFF     BLKSPERTRK:0000   OSIO_ACCESS_METHOD:01
+000027  OSIO_NOSEEK_TO_SEEK:00  FIRSTPOS:00000100
+00002C  LASTPOS:00000100        NEWPOS:00000000   READFUNCNUM:00000002
+000038  WRITEFUNCNUM:00000005   FCB:2135BBE0      PARENT:2135BDE8
+000044  FLAGS1:81020000   DCBERU:00000000   DCBEW:2135BE50
+000050  OSIO_VOLSEQ:0000  OSIO_NEWVOLSEQ:0000     OSIO_EXT:00000000
+000058  OSIO_HIGHVOL:0000       APPENDEDLASTVOLSEQ:0000
+00005C  OSIO_JFCBX:00000000

   DCB:  00012EE0
+000000  DCBRELAD:2135BE50       DCBFDAD:00000000 23000300
+000014  DCBBUFNO:00       DCBSRG1:40  DCBEODAD:000000   DCBRECFM:40
+000025  DCBEXLSA:0127D0   DCBDDNAM:......bm       DCBMACR1:65
+000033  DCBMACR2:B8       DCBSYNAD:000000   DCBBLKSI:0408     DCBNCP:01
+000052  DCBLRECL:0404

  DCBE:  2135BE50
+000000  DCBEID:DCBE       DCBELEN:0038      RESERVED0:0000
+000008  DCBEDCB:00012EE0        DCBERELA:00000000       DCBEFLG1:C0
+000011  DCBEFLG2:88       DCBENSTR:0000     DCBEFLG3:00
+000024  DCBESIZE:00000000       DCBEEODA:20E6269A
+00002C  DCBESYNA:20E6263C       MULTSDN:00

  JFCB:  00012F48
+000000  JFCBDSNM:CHARUM.I.J
+00002C  JFCBELNM:               JFCBTSDM:80       JFCBDSCB:002C16
+000046  JFCBVLSQ:0000     JFCBIND1:00       JFCBIND2:40
+000058  JFCBUFNO:00       JFCDSRG1:00       JFCDSRG2:00
+000064  JFCRECFM:00       JFCBLKSI:0000     JFCLRECL:0000     JFCNCP:00
+000075  JFCBNVOL:01       JFCBNVOLS:SL8D1E
+000094  JFCBEXTL:00       JFCBEXAD:000B8F   JFCFLGS1:00
+0000AE  JFCBVLCT:01

  FFIL:  2135BE90
+000000  MARKER1:AFCB      FILE:00000000     __FP:2135BEB0
+00000C  MARKER2:AFCBAFCB        FF_FLAGS:01000000
+000014  FCBMUTEX:00000000       THREADID:00000000 00000000

 File name: CHARUM.J.K

   FCB:  2135BEB0
+000000  BUFPTR:00000000   COUNTIN:00000000        COUNTOUT:00000000
+00000C  READFUNC:2135BF80       WRITEFUNC:2135BFA0      FLAGS1:8000
+000016  DEPTH:0000  NAME:2135C06C     _LENGTH:0000000A
+000020  _BUFSIZE:00000044       MEMBER:........   NEXT:2135C180
+000030  PREV:2135BBE0     PARENT:2135BEB0   CHILD:00000000
+00003C  DDNAME:SYS00018   FD:FFFFFFFF       DEVTYPE:00  FCBTYPE:0042
+00004C  FSCE:2135BFE4     UNGETBUF:2135BFE4       REPOS:20F5D0A0
+000058  GETPOS:20F5D2D0   CLOSE:20FBBBE0    FLUSH:20F5D028
+000064  UTILITY:20FBB708        USERBUF:00000000        LRECL:00000000
+000070  BLKSIZE:00001800        REALBUFPTR:00000000
+000078  UNGETCOUNT:00000000     BUFSIZE:00001801        BUF:00000000
```

Figure 19. Example formatted C/C++ output from LEDATA Verbexit (Part 15 of 22)

```
+000084  CURSOR:00000000   ENDOFDATA:00000000      SAVEDBUF:00000000
+000090  REALCOUNTIN:00000000    REALCOUNTOUT:00000000
+000098  POSMAJOR:00000000       SAVEMAJOR:00000000
+0000A0  POSMINOR:00000000       SAVEMINOR:00000000      STATE:0000
+0000AA  SAVESTATE:0000    EXITFTELL:00000000      EXITUNGETC:20F481E8
+0000B4  DBCSTART:00000000       UTILITYAREA:00000000
+0000BC  INTERCEPT:00000000      FLAGS2:02220020 60440100
+0000C8  DBCSSTATE:0000    FCB_CPCB:20C0DEA8
+0000D0  READGLUE:58FF0008 07FF0000    READ:20F48580
+0000DC  RADDR_WSA:00000000      _GETFN:00000000   RDLL_INDEX:00000000
+0000E8  RCEESG003:00000000      RWSA:00000000
+0000F0  WRITEGLUE:58FF0008 07FF0000   WRITE:20F5D4E8
+0000FC  WADDR_WSA:00000000      _GETFN:00000000   WDLL_INDEX:00000000
+000108  WCEESG003:00000000      WWSA:00000000

  OSUT:  2135BFE4
+000000  OSUT_EYE:OSUT     READ:20F48580     WRITE:20FBE8B0
+00000C  REPOS:20FBCAD0    GETPOS:20FBDEC8   CLOSE:00000000
+000018  FLUSH:20FBC5C0    UTILITY:20FBB708        EXITFTELL:00000000
+000024  EXITUNGETC:20F481E8     OSIOBLK:2135C0B8
+00002C  NEWLINEPTR:00000000     MAXFTELLBLK:0007FFFF
+000034  RECBITS:0000000D        FLAGS:E0000000

  OSIO:  2135C0B8
+000000  OSIO_EYE:OSIO     DCBW:00014020     DCBRU:00000000
+00000C  JFCB:00014088     CURRMBUF:00000000       MBUFCOUNT:00000001
+000018  READMAX:00000000         CURBLKNUM:FFFFFFFF
+000020  LASTBLKNUM:FFFFFFFF     BLKSPERTRK:0000   OSIO_ACCESS_METHOD:01
+000027  OSIO_NOSEEK_TO_SEEK:00  FIRSTPOS:00000100
+00002C  LASTPOS:00000100        NEWPOS:00000000   READFUNCNUM:00000002
+000038  WRITEFUNCNUM:00000005   FCB:2135BEB0      PARENT:2135C0B8
+000044  FLAGS1:81020000   DCBERU:00000000   DCBEW:2135C120
+000050  OSIO_VOLSEQ:0000  OSIO_NEWVOLSEQ:0000     OSIO_EXT:00000000
+000058  OSIO_HIGHVOL:0000       APPENDEDLASTVOLSEQ:0000
+00005C  OSIO_JFCBX:00000000

   DCB:  00014020
+000000  DCBRELAD:2135C120       DCBFDAD:00000000 10000C00
+000014  DCBBUFNO:00       DCBSRG1:40  DCBEODAD:000000   DCBRECFM:C0
+000025  DCBEXLSA:0127D0   DCBDDNAM:......c.       DCBMACR1:65
+000033  DCBMACR2:B8       DCBSYNAD:000000   DCBBLKSI:1800     DCBNCP:01
+000052  DCBLRECL:0000

  DCBE:  2135C120
+000000  DCBEID:DCBE       DCBELEN:0038      RESERVED0:0000
+000008  DCBEDCB:00014020        DCBERELA:00000000       DCBEFLG1:C0
+000011  DCBEFLG2:88       DCBENSTR:0000     DCBEFLG3:00
+000024  DCBESIZE:00000000       DCBEEODA:20E6269A
+00002C  DCBESYNA:20E6263C       MULTSDN:00

  JFCB:  00014088
+000000  JFCBDSNM:CHARUM.J.K
+00002C  JFCBELNM:               JFCBTSDM:80       JFCBDSCB:002B0D
+000046  JFCBVLSQ:0000     JFCBIND1:00       JFCBIND2:40
+000058  JFCBUFNO:00       JFCDSRG1:00       JFCDSRG2:00
+000064  JFCRECFM:00       JFCBLKSI:0000     JFCLRECL:0000     JFCNCP:00
+000075  JFCBNVOL:01       JFCBNVOLS:SL8D1C
+000094  JFCBEXTL:00       JFCBEXAD:000BDF   JFCFLGS1:00
+0000AE  JFCBVLCT:01
```

Figure 19. Example formatted C/C++ output from LEDATA Verbexit (Part 16 of 22)

```
  FFIL:  2135C160
+000000  MARKER1:AFCB      FILE:00000000      __FP:2135C180
+00000C  MARKER2:AFCBAFCB        FF_FLAGS:01000000
+000014  FCBMUTEX:00000000       THREADID:00000000 00000000

 File name: CHARUM.K.L

   FCB:  2135C180
+000000  BUFPTR:00000000   COUNTIN:00000000        COUNTOUT:00000000
+00000C  READFUNC:2135C250       WRITEFUNC:2135C270      FLAGS1:0000
+000016  DEPTH:0000  NAME:2135C33C     _LENGTH:0000000A
+000020  _BUFSIZE:00000044       MEMBER:........   NEXT:2135C450
+000030  PREV:2135BEB0     PARENT:2135C180   CHILD:00000000
+00003C  DDNAME:SYS00019   FD:FFFFFFFF       DEVTYPE:00  FCBTYPE:0053
+00004C  FSCE:2135C2B4     UNGETBUF:2135C2B4       REPOS:20F5F2A0
+000058  GETPOS:20F48330   CLOSE:20FD8658    FLUSH:20F5F3A8
+000064  UTILITY:20F5F160        USERBUF:00000000        LRECL:00000050
+000070  BLKSIZE:00000050        REALBUFPTR:00000000
+000078  UNGETCOUNT:00000000     BUFSIZE:00000051        BUF:00000000
+000084  CURSOR:00000000   ENDOFDATA:00000000      SAVEDBUF:00000000
+000090  REALCOUNTIN:00000000    REALCOUNTOUT:00000000
+000098  POSMAJOR:00000000       SAVEMAJOR:00000000
+0000A0  POSMINOR:00000000       SAVEMINOR:00000000      STATE:0000
+0000AA  SAVESTATE:0000    EXITFTELL:20F482A8      EXITUNGETC:20F481E8
+0000B4  DBCSTART:00000000       UTILITYAREA:00000000
+0000BC  INTERCEPT:00000000      FLAGS2:02120020 404A9100
+0000C8  DBCSSTATE:0000    FCB_CPCB:20C0DEA8
+0000D0  READGLUE:58FF0008 07FF0000    READ:20F48580
+0000DC  RADDR_WSA:00000000      _GETFN:00000000   RDLL_INDEX:00000000
+0000E8  RCEESG003:00000000      RWSA:00000000
+0000F0  WRITEGLUE:58FF0008 07FF0000   WRITE:20FD8E88
+0000FC  WADDR_WSA:00000000      _GETFN:00000000   WDLL_INDEX:00000000
+000108  WCEESG003:00000000      WWSA:00000000

  OSNS:  2135C2B4
+000000  OSNS_EYE:OSNS     READ:20F48580     WRITE:20FD88B8
+00000C  REPOS:20F5F588    GETPOS:20F48330   CLOSE:20FD8658
+000018  FLUSH:20FD87F0    UTILITY:213126A0        EXITFTELL:20F482A8
+000024  EXITUNGETC:20F481E8     OSIOBLK:2135C388
+00002C  NEWLINEPTR:00000000     RECLENGTH:00000050      FLAGS:81000000

  OSIO:  2135C388
+000000  OSIO_EYE:OSIO     DCBW:00014140     DCBRU:00000000
+00000C  JFCB:000141A8     CURRMBUF:00000000       MBUFCOUNT:00000000
+000018  READMAX:00000000        CURBLKNUM:FFFFFFFF
+000020  LASTBLKNUM:FFFFFFFF     BLKSPERTRK:0000   OSIO_ACCESS_METHOD:02
+000027  OSIO_NOSEEK_TO_SEEK:00  FIRSTPOS:00000000
+00002C  LASTPOS:00000000        NEWPOS:00000000   READFUNCNUM:00000002
+000038  WRITEFUNCNUM:00000005   FCB:2135C180      PARENT:2135C388
+000044  FLAGS1:81000000   DCBERU:00000000   DCBEW:2135C3F0
+000050  OSIO_VOLSEQ:0000  OSIO_NEWVOLSEQ:0000     OSIO_EXT:00000000
+000058  OSIO_HIGHVOL:0000       APPENDEDLASTVOLSEQ:0000
+00005C  OSIO_JFCBX:00000000

  DCB:  00014140
+000000  DCBRELAD:2135C3F0       DCBFDAD:00000000 0A000A00
+000014  DCBBUFNO:05       DCBSRG1:40  DCBEODAD:000000   DCBRECFM:80
+000025  DCBEXLSA:0127D0   DCBDDNAM:...&..gM       DCBMACR1:A0
+000033  DCBMACR2:58       DCBSYNAD:000000   DCBBLKSI:0050     DCBNCP:21
+000052  DCBLRECL:0050
```

Figure 19. Example formatted C/C++ output from LEDATA Verbexit (Part 17 of 22)

```
  DCBE:  2135C3F0
+000000  DCBEID:DCBE       DCBELEN:0038      RESERVED0:0000
+000008  DCBEDCB:00014140        DCBERELA:00000000       DCBEFLG1:C0
+000011  DCBEFLG2:88       DCBENSTR:0000     DCBEFLG3:80
+000024  DCBESIZE:00000000       DCBEEODA:20E6269A
+00002C  DCBESYNA:20E6263C       MULTSDN:00

  JFCB:  000141A8
+000000  JFCBDSNM:CHARUM.K.L
+00002C  JFCBELNM:               JFCBTSDM:80       JFCBDSCB:004610
+000046  JFCBVLSQ:0000     JFCBIND1:00       JFCBIND2:40
+000058  JFCBUFNO:00       JFCDSRG1:00       JFCDSRG2:00
+000064  JFCRECFM:00       JFCBLKSI:0000     JFCLRECL:0000     JFCNCP:00
+000075  JFCBNVOL:01       JFCBNVOLS:SL8818
+000094  JFCBEXTL:00       JFCBEXAD:000C2F   JFCFLGS1:00
+0000AE  JFCBVLCT:01

  FFIL:  2135C430
+000000  MARKER1:AFCB      FILE:00000000     __FP:2135C450
+00000C  MARKER2:AFCBAFCB        FF_FLAGS:01000000
+000014  FCBMUTEX:00000000       THREADID:00000000 00000000

 File name: CHARUM.L.M

   FCB:  2135C450
+000000  BUFPTR:00000000   COUNTIN:00000000        COUNTOUT:00000000
+00000C  READFUNC:2135C520       WRITEFUNC:2135C540      FLAGS1:0000
+000016  DEPTH:0000  NAME:2135C60C     _LENGTH:0000000A
+000020  _BUFSIZE:00000044       MEMBER:........   NEXT:2135C720
+000030  PREV:2135C180     PARENT:2135C450   CHILD:00000000
+00003C  DDNAME:SYS00020   FD:FFFFFFFF       DEVTYPE:00  FCBTYPE:0046
+00004C  FSCE:2135C584     UNGETBUF:2135C584       REPOS:20FD0D10
+000058  GETPOS:20FD1240   CLOSE:20FCD070    FLUSH:20FD0CB0
+000064  UTILITY:20FD07B0        USERBUF:00000000        LRECL:00000050
+000070  BLKSIZE:00000050        REALBUFPTR:00000000
+000078  UNGETCOUNT:00000000     BUFSIZE:00000050        BUF:00000000
+000084  CURSOR:00000000   ENDOFDATA:00000000      SAVEDBUF:00000000
+000090  REALCOUNTIN:00000000    REALCOUNTOUT:00000000
+000098  POSMAJOR:00000000       SAVEMAJOR:00000000
+0000A0  POSMINOR:00000000       SAVEMINOR:00000000      STATE:0000
+0000AA  SAVESTATE:0000    EXITFTELL:00000000      EXITUNGETC:20F481E8
+0000B4  DBCSTART:00000000       UTILITYAREA:00000000
+0000BC  INTERCEPT:00000000      FLAGS2:00120020 40461100
+0000C8  DBCSSTATE:0000    FCB_CPCB:20C0DEA8
+0000D0  READGLUE:58FF0008 07FF0000    READ:20F48580
+0000DC  RADDR_WSA:00000000      _GETFN:00000000   RDLL_INDEX:00000000
+0000E8  RCEESG003:00000000      RWSA:00000000
+0000F0  WRITEGLUE:58FF0008 07FF0000   WRITE:20FD16E0
+0000FC  WADDR_WSA:00000000      _GETFN:00000000   WDLL_INDEX:00000000
+000108  WCEESG003:00000000      WWSA:00000000

  OSFS:  2135C584
+000000  OSFS_EYE:OSFS     READ:20F48580     WRITE:20FCFA28
+00000C  REPOS:20FCD838    GETPOS:20FCF4C8   CLOSE:00000000
+000018  FLUSH:20FCD3E8    UTILITY:213126A0        EXITFTELL:00000000
+000024  EXITUNGETC:20F481E8     OSIOBLK:2135C658        SAVECURSOR:00
+00002D  NEWLINEPTR:00000000     ENDOFBLOCK:00000000
+000035  CURRBLKSIZE:00000000    LASTBLKSIZE:00000000
+00003D  HIGHMAJOR:00000000      RELRECNUM:00000000
+000045  MAXFTELLBLK:00000000    RECBITS:00000000
+00004D  RECSPERBLOCK:00000000   SAVECHAR:00000100       FLAGS1:72000000

  OSIO:  2135C658
+000000  OSIO_EYE:OSIO     DCBW:00014260     DCBRU:00000000
+00000C  JFCB:000142C8     CURRMBUF:00000000       MBUFCOUNT:00000001
+000018  READMAX:00000000        CURBLKNUM:FFFFFFFF
+000020  LASTBLKNUM:FFFFFFFF     BLKSPERTRK:0000   OSIO_ACCESS_METHOD:01
+000027  OSIO_NOSEEK_TO_SEEK:00  FIRSTPOS:00000100
```

Figure 19. Example formatted C/C++ output from LEDATA Verbexit (Part 18 of 22)

```
+00002C  LASTPOS:00000100        NEWPOS:00000000   READFUNCNUM:00000002
+000038  WRITEFUNCNUM:00000005   FCB:2135C450      PARENT:2135C658
+000044  FLAGS1:85020000   DCBERU:00000000   DCBEW:2135C6C0
+000050  OSIO_VOLSEQ:0000  OSIO_NEWVOLSEQ:0000     OSIO_EXT:00000000
+000058  OSIO_HIGHVOL:0000       APPENDEDLASTVOLSEQ:0000
+00005C  OSIO_JFCBX:00000000

   DCB:  00014260
+000000  DCBRELAD:2135C6C0       DCBFDAD:00000000 22000100
+000014  DCBBUFNO:00       DCBSRG1:40  DCBEODAD:000000   DCBRECFM:80
+000025  DCBEXLSA:0127D0   DCBDDNAM:......g<       DCBMACR1:65
+000033  DCBMACR2:B8       DCBSYNAD:000000   DCBBLKSI:0050     DCBNCP:01
+000052  DCBLRECL:0050

  DCBE:  2135C6C0
+000000  DCBEID:DCBE       DCBELEN:0038      RESERVED0:0000
+000008  DCBEDCB:00014260        DCBERELA:00000000       DCBEFLG1:C0
+000011  DCBEFLG2:88       DCBENSTR:0000     DCBEFLG3:00
+000024  DCBESIZE:00000000       DCBEEODA:20E6269A
+00002C  DCBESYNA:20E6263C       MULTSDN:00

  JFCB:  000142C8
+000000  JFCBDSNM:CHARUM.L.M
+00002C  JFCBELNM:               JFCBTSDM:80       JFCBDSCB:004309
+000046  JFCBVLSQ:0000     JFCBIND1:00       JFCBIND2:40
+000058  JFCBUFNO:00       JFCDSRG1:00       JFCDSRG2:00
+000064  JFCRECFM:00       JFCBLKSI:0000     JFCLRECL:0000     JFCNCP:00
+000075  JFCBNVOL:01       JFCBNVOLS:SL620C
+000094  JFCBEXTL:00       JFCBEXAD:000C7F   JFCFLGS1:00
+0000AE  JFCBVLCT:01

  FFIL:  2135C700
+000000  MARKER1:AFCB      FILE:00000000     __FP:2135C720
+00000C  MARKER2:AFCBAFCB        FF_FLAGS:01000000
+000014  FCBMUTEX:00000000       THREADID:00000000 00000000

 File name: CHARUM.M.N

   FCB:  2135C720
+000000  BUFPTR:00000000   COUNTIN:00000000        COUNTOUT:00000000
+00000C  READFUNC:2135C7F0       WRITEFUNC:2135C810      FLAGS1:0000
+000016  DEPTH:0000  NAME:2135C8DC     _LENGTH:0000000A
+000020  _BUFSIZE:00000044       MEMBER:........   NEXT:2135C9F0
+000030  PREV:2135C450     PARENT:2135C720   CHILD:00000000
+00003C  DDNAME:SYS00021   FD:FFFFFFFF       DEVTYPE:00  FCBTYPE:004C
+00004C  FSCE:2135C854     UNGETBUF:2135C854       REPOS:20F5E880
+000058  GETPOS:20F5EA80   CLOSE:20FD3118    FLUSH:20F5E818
+000064  UTILITY:213126A0        USERBUF:00000000        LRECL:00000404
+000070  BLKSIZE:00000408        REALBUFPTR:00000000
+000078  UNGETCOUNT:00000000     BUFSIZE:00000408        BUF:00000000
+000084  CURSOR:00000000   ENDOFDATA:00000000      SAVEDBUF:00000000
+000090  REALCOUNTIN:00000000    REALCOUNTOUT:00000000
+000098  POSMAJOR:00000000       SAVEMAJOR:00000000
+0000A0  POSMINOR:00000000       SAVEMINOR:00000000      STATE:0000
+0000AA  SAVESTATE:0000    EXITFTELL:00000000      EXITUNGETC:20F481E8
+0000B4  DBCSTART:00000000       UTILITYAREA:00000000
+0000BC  INTERCEPT:00000000      FLAGS2:02120000 20461100
+0000C8  DBCSSTATE:0000    FCB_CPCB:20C0DEA8
+0000D0  READGLUE:58FF0008 07FF0000    READ:20F48580
+0000DC  RADDR_WSA:00000000      _GETFN:00000000   RDLL_INDEX:00000000
+0000E8  RCEESG003:00000000      RWSA:00000000
+0000F0  WRITEGLUE:58FF0008 07FF0000   WRITE:20F5EC68
+0000FC  WADDR_WSA:00000000      _GETFN:00000000   WDLL_INDEX:00000000
+000108  WCEESG003:00000000      WWSA:00000000
```

Figure 19. Example formatted C/C++ output from LEDATA Verbexit (Part 19 of 22)

```
  OSFS:  2135C854
+000000  OSFS_EYE:OSFS     READ:20F48580     WRITE:20FD5EC0
+00000C  REPOS:20FD3788    GETPOS:20FD5890   CLOSE:00000000
+000018  FLUSH:20FD3428    UTILITY:213126A0        EXITFTELL:00000000
+000024  EXITUNGETC:20F481E8     OSIOBLK:2135C928        SAVECURSOR:00
+00002D  NEWLINEPTR:00000000     ENDOFBLOCK:00000000
+000035  CURRBLKSIZE:00000000    LASTBLKSIZE:00000000
+00003D  HIGHMAJOR:00000000      RELRECNUM:00000000
+000045  MAXFTELLBLK:00000000    RECBITS:00000000
+00004D  RECSPERBLOCK:00000000   SAVECHAR:00000000       FLAGS1:72000000

  OSIO:  2135C928
+000000  OSIO_EYE:OSIO     DCBW:00014380     DCBRU:00000000
+00000C  JFCB:000143E8     CURRMBUF:00000000       MBUFCOUNT:00000001
+000018  READMAX:00000000         CURBLKNUM:FFFFFFFF
+000020  LASTBLKNUM:FFFFFFFF     BLKSPERTRK:0000   OSIO_ACCESS_METHOD:01
+000027  OSIO_NOSEEK_TO_SEEK:00  FIRSTPOS:00000100
+00002C  LASTPOS:00000100        NEWPOS:00000000   READFUNCNUM:00000002
+000038  WRITEFUNCNUM:00000005   FCB:2135C720      PARENT:2135C928
+000044  FLAGS1:81020000   DCBERU:00000000   DCBEW:2135C990
+000050  OSIO_VOLSEQ:0000  OSIO_NEWVOLSEQ:0000     OSIO_EXT:00000000
+000058  OSIO_HIGHVOL:0000       APPENDEDLASTVOLSEQ:0000
+00005C  OSIO_JFCBX:00000000

   DCB:  00014380
+000000  DCBRELAD:2135C990       DCBFDAD:00000000 D9000200
+000014  DCBBUFNO:00       DCBSRG1:40  DCBEODAD:000000   DCBRECFM:40
+000025  DCBEXLSA:0127D0   DCBDDNAM:......h.       DCBMACR1:65
+000033  DCBMACR2:B8       DCBSYNAD:000000   DCBBLKSI:0408     DCBNCP:01
+000052  DCBLRECL:0404

  DCBE:  2135C990
+000000  DCBEID:DCBE       DCBELEN:0038      RESERVED0:0000
+000008  DCBEDCB:00014380         DCBERELA:00000000       DCBEFLG1:C0
+000011  DCBEFLG2:88       DCBENSTR:0000     DCBEFLG3:00
+000024  DCBESIZE:00000000       DCBEEODA:20E6269A
+00002C  DCBESYNA:20E6263C       MULTSDN:00

  JFCB:  000143E8
+000000  JFCBDSNM:CHARUM.M.N
+00002C  JFCBELNM:               JFCBTSDM:80       JFCBDSCB:013609
+000046  JFCBVLSQ:0000     JFCBIND1:00       JFCBIND2:40
+000058  JFCBUFNO:00       JFCDSRG1:00       JFCDSRG2:00
+000064  JFCRECFM:00       JFCBLKSI:0000     JFCLRECL:0000     JFCNCP:00
+000075  JFCBNVOL:01       JFCBNVOLS:SL4A05
+000094  JFCBEXTL:00       JFCBEXAD:000CCF   JFCFLGS1:00
+0000AE  JFCBVLCT:01

  FFIL:  2135C9D0
+000000  MARKER1:AFCB      FILE:00000000     __FP:2135C9F0
+00000C  MARKER2:AFCBAFCB        FF_FLAGS:01000000
+000014  FCBMUTEX:00000000       THREADID:00000000 00000000
 File name: CHARUM.N.O

   FCB:  2135C9F0
+000000  BUFPTR:00000000   COUNTIN:00000000        COUNTOUT:00000000
+00000C  READFUNC:2135CAC0       WRITEFUNC:2135CAE0      FLAGS1:0000
+000016  DEPTH:0000  NAME:2135CBAC     _LENGTH:0000000A
+000020  _BUFSIZE:00000044       MEMBER:........   NEXT:20C0E148
+000030  PREV:2135C720     PARENT:2135C9F0   CHILD:00000000
+00003C  DDNAME:SYS00022   FD:FFFFFFFF       DEVTYPE:00  FCBTYPE:0054
+00004C  FSCE:2135CB24     UNGETBUF:2135CB24       REPOS:20FDB888
+000058  GETPOS:20FDBAA0   CLOSE:20FD9EC0    FLUSH:20FDB828
+000064  UTILITY:20FDB5D8        USERBUF:00000000        LRECL:00000000
+000070  BLKSIZE:00001800        REALBUFPTR:00000000
+000078  UNGETCOUNT:00000000     BUFSIZE:00001800        BUF:00000000
+000084  CURSOR:00000000   ENDOFDATA:00000000      SAVEDBUF:00000000
+000090  REALCOUNTIN:00000000    REALCOUNTOUT:00000000
+000098  POSMAJOR:00000000       SAVEMAJOR:00000000
```

Figure 19. Example formatted C/C++ output from LEDATA Verbexit (Part 20 of 22)

```
+0000A0  POSMINOR:00000000       SAVEMINOR:00000000      STATE:0000
+0000AA  SAVESTATE:0000    EXITFTELL:00000000      EXITUNGETC:20F481E8
+0000B4  DBCSTART:00000000       UTILITYAREA:00000000
+0000BC  INTERCEPT:00000000      FLAGS2:02120020 60461100
+0000C8  DBCSSTATE:0000    FCB_CPCB:20C0DEA8
+0000D0  READGLUE:58FF0008 07FF0000    READ:20F48580
+0000DC  RADDR_WSA:00000000      _GETFN:00000000   RDLL_INDEX:00000000
+0000E8  RCEESG003:00000000      RWSA:00000000
+0000F0  WRITEGLUE:58FF0008 07FF0000   WRITE:20FDBC88
+0000FC  WADDR_WSA:00000000      _GETFN:00000000   WDLL_INDEX:00000000
+000108  WCEESG003:00000000      WWSA:00000000

  OSFS:  2135CB24
+000000  OSFS_EYE:OSFS     READ:20F48580     WRITE:20FDAF60
+00000C  REPOS:20FDA1A0    GETPOS:20FDAC30   CLOSE:00000000
+000018  FLUSH:20FDA078    UTILITY:213126A0        EXITFTELL:00000000
+000024  EXITUNGETC:20F481E8     OSIOBLK:2135CBF8        SAVECURSOR:00
+00002D  NEWLINEPTR:00000000     ENDOFBLOCK:00000000
+000035  CURRBLKSIZE:00000000    LASTBLKSIZE:00000000
+00003D  HIGHMAJOR:00000000      RELRECNUM:00000000
+000045  MAXFTELLBLK:00000000    RECBITS:00000000
+00004D  RECSPERBLOCK:00000000   SAVECHAR:00000000       FLAGS1:72000000

  OSIO:  2135CBF8
+000000  OSIO_EYE:OSIO     DCBW:000144A0     DCBRU:00000000
+00000C  JFCB:00014508     CURRMBUF:00000000       MBUFCOUNT:00000001
+000018  READMAX:00000000        CURBLKNUM:FFFFFFFF
+000020  LASTBLKNUM:FFFFFFFF     BLKSPERTRK:0000   OSIO_ACCESS_METHOD:01
+000027  OSIO_NOSEEK_TO_SEEK:00  FIRSTPOS:00000100
+00002C  LASTPOS:00000100        NEWPOS:00000000   READFUNCNUM:00000002
+000038  WRITEFUNCNUM:00000005   FCB:2135C9F0      PARENT:2135CBF8
+000044  FLAGS1:81020000   DCBERU:00000000   DCBEW:2135CC60
+000050  OSIO_VOLSEQ:0000  OSIO_NEWVOLSEQ:0000     OSIO_EXT:00000000
+000058  OSIO_HIGHVOL:0000       APPENDEDLASTVOLSEQ:0000
+00005C  OSIO_JFCBX:00000000

   DCB:  000144A0
+000000  DCBRELAD:2135CC60       DCBFDAD:00000000 22000600
+000014  DCBBUFNO:00       DCBSRG1:40  DCBEODAD:000000   DCBRECFM:C0
+000025  DCBEXLSA:0127D0   DCBDDNAM:.%....im       DCBMACR1:65
+000033  DCBMACR2:B8       DCBSYNAD:000000   DCBBLKSI:1800     DCBNCP:01
+000052  DCBLRECL:0000

  DCBE:  2135CC60
+000000  DCBEID:DCBE       DCBELEN:0038      RESERVED0:0000
+000008  DCBEDCB:000144A0        DCBERELA:00000000       DCBEFLG1:C0
+000011  DCBEFLG2:88       DCBENSTR:0000     DCBEFLG3:00
+000024  DCBESIZE:00000000       DCBEEODA:20E6269A
+00002C  DCBESYNA:20E6263C       MULTSDN:00

  JFCB:  00014508
+000000  JFCBDSNM:CHARUM.N.O
+00002C  JFCBELNM:               JFCBTSDM:80       JFCBDSCB:00471E
+000046  JFCBVLSQ:0000     JFCBIND1:00       JFCBIND2:40
+000058  JFCBUFNO:00       JFCDSRG1:00       JFCDSRG2:00
+000064  JFCRECFM:00       JFCBLKSI:0000     JFCLRECL:0000     JFCNCP:00
+000075  JFCBNVOL:01       JFCBNVOLS:SL6206
+000094  JFCBEXTL:00       JFCBEXAD:000D1F   JFCFLGS1:00
+0000AE  JFCBVLCT:01
```

Figure 19. Example formatted C/C++ output from LEDATA Verbexit (Part 21 of 22)

```
Dummy FCB encountered at location 20C0E148

     AMRC:  20C0E770
   +000000  CODE:00021708     RBA:00000000      LASTOP:00000032
   +00000C  FILL_LEN:00000000       MSG_LEN:00000000
   +000014  STR1:............................................................
   +000050  STR1_CONT:........................................................
   +00008C  PARM0R0:00000000        PARMR1:00000000
   +00009C  STR2:............................................................
   +0000DC  RPLFDBWD:00000000       XRBA:00000000 00000000
   +0000E8  AMRC_NOSEEK_TO_SEEK:00

    AMRC2:  20C0E878
   +000000  __ERROR2:00000000       __FILEPTR:00000000

    File name: CHARUM.A.B

[8]MFCB:  2135A470
   +000000  FIRSTNEBULA:2135A4E4    REFCNT:00000001   NEXTMFCB:2135A970
   +000010  WRITEFCB:2135A268       FLAG1:0001  DEPTH:0000  NAME:2135A5F0
   +00001C  NAMELENGTH:0000000A     NAMEBUFSIZE:00000044    MEMBER:........
   +00002C  NEXTFCB:00000000        PREVFCB:00000000
   +000034  PARENTFCB:2135A268      CHILDFCB:00000000
   +00003C  PREVMFCB:00000000       PARENTMFCB:2135A470
   +000044  CHILDMFCB:00000000      HIPERKEY:00000000 00000000
   +000050  CURHSPBYTES:00000000    LASTBYTE:0000     CREATELEVEL:0000
   +000058  FLAG2:00000000    LASTNEBULA:2135A4E4     LASTNEBINDEX:0001
   +000064  LASTDS:00000000   MAXHSPBYTES:00000000
   +00006C  LASTBLKOFFSET:00000000        MFCB_CPCB:20C0DEA8

    File name: CHARUM.B.C

     MFCB:  2135A970
   +000000  FIRSTNEBULA:00000000    REFCNT:00000001   NEXTMFCB:00000000
   +000010  WRITEFCB:2135A660       FLAG1:0001  DEPTH:0000  NAME:2135A9F0
   +00001C  NAMELENGTH:0000000A     NAMEBUFSIZE:00000044    MEMBER:........
   +00002C  NEXTFCB:00000000        PREVFCB:00000000
   +000034  PARENTFCB:2135A660      CHILDFCB:00000000
   +00003C  PREVMFCB:2135A470       PARENTMFCB:2135A970
   +000044  CHILDMFCB:00000000      HIPERKEY:80007400 00011F4C
   +000050  CURHSPBYTES:00020000    LASTBYTE:0000     CREATELEVEL:0000
   +000058  FLAG2:40000000    LASTNEBULA:00000000     LASTNEBINDEX:0000
   +000064  LASTDS:00000000   MAXHSPBYTES:80000000
   +00006C  LASTBLKOFFSET:00000000        MFCB_CPCB:20C0DEA8

Exiting CRTL I/O Control Blocks
Exiting Language Environment Data
```

Figure 19. Example formatted C/C++ output from LEDATA Verbexit (Part 22 of 22)

C/C++-specific sections of the LEDATA output

For the LEDATA output:

[1] CGEN

This section formats the C/C++-specific portion of the Language Environment common anchor area (CAA).

[2] CGENE

This section formats the extension to the C/C++-specific portion of the Language Environment common anchor area (CAA).

[3] CEDB

This section formats the C/C++-specific portion of the Language Environment enclave data block (EDB).

[4] CTHD

This section formats the C/C++ thread-level control block (CTHD).

[5] CPCB

This section formats the C/C++-specific portion of the Language Environment process control block (PCB).

[6] CIO

This section formats the C/C++ IO control block (CIO).

[7] File Control Blocks

This section formats the C/C++ file control block (FCB). The FCB and its related control blocks represent the information needed by each open stream.

Related Control Blocks

FFIL This section formats the header of the C/C++ file control block (FCB).

FSCE The file specific category extension control block. The FSCE represents the specific type of IO being performed. The following is a list of FSCEs that may be formatted.

HFSF — UNIX file system file

HSPF — Hiper-Space file

INTC — Intercept file

MEMF — Memory file

OSNS — OS no seek

OSFS — OS fixed text

OSVF — OS variable text

OSUT — OS undefined format text

TDQF — CICS Transient Data Queue file

TERM — Terminal file

VSAM — VSAM file

Other FSCEs will be displayed using a generic overlay.

OSIO The OS IO interface control block.

OSIOE
The OS IO extended interface control block.

DCB The data control block. For more information about the DCB, see *z/OS DFSMS Macro Instructions for Data Sets*.

DCBE The data control block extension. For more information about the DCBE, see *z/OS DFSMS Macro Instructions for Data Sets*.

JFCB The job file control block (JFCB). For more information about the JFCB, see *z/OS MVS Data Areas, Vol 3 (IVT-RCWK)*.

JFCBX
The job file control block extension (JFCBX).

MBUF
The message buffer control block (MBUF).

[8] Memory File Control Blocks

This section formats the C/C++ memory file control block (MFCB).

Understanding the COBOL-specific LEDATA output

The Language Environment IPCS Verbexit LEDATA generates formatted output of COBOL-specific control blocks from a system dump when the ALL parameter is specified and COBOL is active in the dump. Figure 20 on page 148 illustrates the COBOL-specific output produced. The system dump being formatted was obtained by specifying the TERMTHDACT(UADUMP) run-time option. “COBOL-specific sections of the LEDATA Output” on page 149 describes the information contained in the formatted output.

For easy reference, the sections of the dump are numbered to correspond with the description of each section that follows.

```
********************************************************************************
                            COBOL ENVIRONMENT DATA
********************************************************************************


[1]RUNCOM:  00049038
   +000000  IDENT:C3RUNCOM    LENGTH:000002D8   FLAGS:00860000
   +000010  RU_ID:000178B0    INVK_RSA:00005F80
   +000024  MAIN_PGM_ADDR:00007DE8        MAIN_PGM_CLLE:00049328
   +00002C  ITBNAB:00000000   PARM_ADDR:000179D0      NEXT_RUNCOM:00000000
   +000040  THDCOM:0001AA80   COBVEC:0001A1BC   SUBCOM:00000000
   +00004C  COBVEC2:0001A7FC        CAA:00018920      UPSI_SWITCHES:00000000
   +00007C  DUM_CLLE:0BF15BA8       1ST_FREE_CLLE:00000000
   +000088  HAT:0BF157A8      1ST_CLLE:00049488
   +000090  SORT_CONTROL_DCB:00000000     COBOL_ACTIVE:00000000
   +0000A4  IO_FLAGS:00000000       UNSTR_WRK:00000000
   +00011C  INSP_WRK:00000000       INSP_WRK1:00000000
   +00012C  DDNAME_SORT_CONTROL:.........  LEN_UNSTR_WRK:00000000
   +000138  UNSTR_DELIMS:0000
   +000154  CEEINT_PLIST:000491B0 00000008 00000006 000491B4 00000000 00000000
   +00016C  ----------->:00000005 00000000 00000000 00000000 00000000
   +0001C8  MAIN_ID:CALLSUBX
   +000204  ------>:
   +000240  ------>:

[2]THDCOM:  0001AA80
   +000000  IDENT:C3THDCOM    LENGTH:000001E8   FLAGS:81000000 00000100
   +000018  COBCOM:0001A108   COBVEC:0001A1BC   1ST_RUNCOM:00049038
   +000028  1ST_PROGRAM:CALLSUBX    SUBCOM:00000000
   +000034  CEEINT_PLIST:00000000 00000000 00000000 00000000 00000000 00000000
   +00004C  ----------->:00000000 00000000 00000000 00000000 00000000
   +000084  COBVEC2:0001A7FC        ITBLK:00000000    STT_BST:00000000
   +000098  CICS_EIB:00000000       SIBLING:00000000
   +0000AC  SORT_RETURN:00000000    INFO_MSG_LIMIT:0000
   +0000C8  R12_SAVE:00000000       STP_DUM_TGT:00000000
   +000180  LRR_COBCOM:00000000     CAA:00018920      DUM_THDCOM:00000000
   +00019C  ITBLK_TRAP_RSA:00000000       ITBLK_PLFPARMS:00000000
   +0001A4  ITBLK_BS2PARMS:00000000       ITBLK_NAB:00000000
   +0001AC  DUM_MAIN_DSA:00000000   BDY_RSA:00000000
   +0001D0  RRE_TAIL_RSA:00000000   ESTUB_TGT:00000000

[3]COBCOM:  0001A108
   +000000  IDENT:C3COBCOM    LENGTH:00000978   VERSION:010900
   +000058  FLAGS:906000      ESM_ID:O    COBVEC:0001A1BC
   +000060  COBVEC2:0001A7FC
   +000064  LOADFG:00000100 00000000 80000000 00008000 00000000
   +000078  THDCOM:0001AA80   INSH:00000000     LRR_THDCOM:00000000
   +00009C  LRR_ITBLK:00000000      LRR_SUBCOM:00000000
   +0000A4  LRR_EPLF:00000000

[4]  CLLE:  00049488
   +000000  PGMNAME:PARM5     OPEN_NON_EXT_FILES:0000       TGT_FLAGS:00
   +00000C  LANG_LST:00050F98       INFO_FLAGS:8891   LOAD_ADDR:8004FF88
   +000018  TGT_ADDR:00050248       LE_TOKEN:0BF150BC       FLAGS2:00
```

Figure 20. Example formatted COBOL output from LEDATA Verbexit (Part 1 of 2)

```
[5]   TGT:  00050248
   +000048  IDENT:3TGT  LVL:05      FLAGS:40020220    RUNCOM:00049038
   +00005C  COBVEC:0001A7FC   #FCBS:00000000    WS_LEN:00000000
   +000070  SMG_WRK:00000000        CAA:00018920      LEN:00000154
   +00008C  EXT_FCBS:00000000       OUTDD:SYSOUT
   +0000AC  CALC_RSA:00000000 00000000 00000000 00000000 00000000 00000000
   +0000C4  ------->:00000000 00000000 00000000 00000000 00000000 00000000
   +0000DC  ------->:00000000       ABINF:000500A5    TESTINF:00000000
   +000100  PGMADDR:0004FF88        1STFCB:00000000   WS_ADDR:00000000
   +000118  1STEXTFCB:00000000

     CLLE:  00049440
   +000000  PGMNAME:PARM1     OPEN_NON_EXT_FILES:0000       TGT_FLAGS:00
   +00000C  LANG_LST:0004EF98       INFO_FLAGS:8891   LOAD_ADDR:8004DFE0
   +000018  TGT_ADDR:0004E258       LE_TOKEN:0BF150A0       FLAGS2:00

      TGT:  0004E258
   +000048  IDENT:3TGT  LVL:05      FLAGS:40020220    RUNCOM:00049038
   +00005C  COBVEC:0001A7FC   #FCBS:00000000    WS_LEN:00000000
   +000070  SMG_WRK:00000000        CAA:00018920      LEN:00000144
   +00008C  EXT_FCBS:00000000       OUTDD:SYSOUT
   +0000AC  CALC_RSA:00000000 00000000 00000000 00000000 00000000 00000000
   +0000C4  ------->:00000000 00000000 00000000 00000000 00000000 00000000
   +0000DC  ------->:00000000       ABINF:0004E0FD    TESTINF:00000000
   +000100  PGMADDR:0004DFE0        1STFCB:00000000   WS_ADDR:00000000
   +000118  1STEXTFCB:00000000

     CLLE:  00049370
   +000000  PGMNAME:PARM0     OPEN_NON_EXT_FILES:0000       TGT_FLAGS:00
   +00000C  LANG_LST:0004CF98       INFO_FLAGS:8891   LOAD_ADDR:8004BFF8
   +000018  TGT_ADDR:0004C260       LE_TOKEN:0BF15084       FLAGS2:00

      TGT:  0004C260
   +000048  IDENT:3TGT  LVL:05      FLAGS:40020220    RUNCOM:00049038
   +00005C  COBVEC:0001A7FC   #FCBS:00000000    WS_LEN:00000000
   +000070  SMG_WRK:00000000        CAA:00018920      LEN:00000140
   +00008C  EXT_FCBS:00000000       OUTDD:SYSOUT
   +0000AC  CALC_RSA:00000000 00000000 00000000 00000000 00000000 00000000
   +0000C4  ------->:00000000 00000000 00000000 00000000 00000000 00000000
   +0000DC  ------->:00000000       ABINF:0004C115    TESTINF:00000000
   +000100  PGMADDR:0004BFF8        1STFCB:00000000   WS_ADDR:00000000
   +000118  1STEXTFCB:00000000

     CLLE:  00049328
   +000000  PGMNAME:CALLSUBX  OPEN_NON_EXT_FILES:0000       TGT_FLAGS:00
   +00000C  LANG_LST:00000000       INFO_FLAGS:9881   LOAD_ADDR:80007DE8
   +000018  TGT_ADDR:00008220       LE_TOKEN:00000000       FLAGS2:00

      TGT:  00008220
   +000048  IDENT:3TGT  LVL:05      FLAGS:60020220    RUNCOM:00049038
   +00005C  COBVEC:0001A7FC   #FCBS:00000000    WS_LEN:0000002C
   +000070  SMG_WRK:00000000        CAA:00018920      LEN:00000150
   +00008C  EXT_FCBS:00000000       OUTDD:SYSOUT
   +0000AC  CALC_RSA:00000000 00000000 00000000 00000000 00000000 00000000
   +0000C4  ------->:00000000 00000000 00000000 00000000 00000000 00000000
   +0000DC  ------->:00000000       ABINF:00007F34    TESTINF:00000000
   +000100  PGMADDR:00007DE8        1STFCB:00000000   WS_ADDR:000083C0
   +000118  1STEXTFCB:00000000

Exiting COBOL Environment Data
```

Figure 20. Example formatted COBOL output from LEDATA Verbexit (Part 2 of 2)

COBOL-specific sections of the LEDATA Output

For the LEDATA output:

[1] RUNCOM

This section formats the COBOL enclave-level control block (RUNCOM).

[2] THDCOM

This section formats the COBOL process-level control block (THDCOM).

[3] COBCOM

This section formats the COBOL region-level control block (COBCOM).

[4] CLLE

This section formats the COBOL loaded program control blocks (CLLE).

[5] TGT

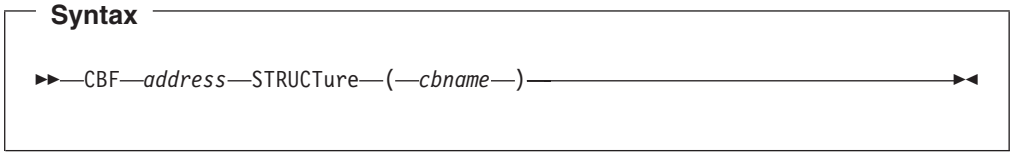
This section formats the COBOL TGT control blocks.

Formatting individual control blocks

In addition to the full LEDATA output which contains many formatted control blocks, the IPCS Control block formatter can also format individual Language Environment control blocks.

The IPCS cbf command can be invoked from the ″IPCS Subcommand Entry″ screen, option 6 of the ″IPCS PRIMARY OPTION MENU″.

Syntax



address
The address of the control block in the dump. This is determined by browsing the dump or running the LEDATA verb exit.

cbname
The name of the control block to be formatted. The control blocks that can be individually formatted are listed in Table 8 on page 151. In general, the name of each control block is similar to that used by the LEDATA verb exit and is generally found in the control block's eyecatcher field. However, all control block names are prefixed with CEE in order to uniquely define the Language Environment control block names to IPCS.

For an example of the display which is the result of the command, see Figure 21 on page 151 :

```
CBF 15890 struct(CEECAA)
```

```
CEECAA:  00015890
+000000  FLAG0:00    LANGP:08      BOS:00023000          EOS:00043000
+000044  TORC:00000000     TOVF:8000B5A0       ATTN:06412AF8
+00015C  HLLEXIT:00000000        HOOK:50C0D064  05C058C0  C00605CC
+0001A4  DIMA:0000D176     ALLOC:0700C198      STATE:0700C198
+0001B0  ENTRY:0700C198    EXIT:0700C198       MEXIT:0700C198
+0001BC  LABEL:0700C198    BCALL:0700C198      ACALL:0700C198
+0001C8  DO:0700C198       IFTRUE:0700C198     IFFALSE:0700C198
+0001D4  WHEN:0700C198     OTHER:0700C198      CGOTO:0700C198
+0001F4  CRENT:00000000    EDCV:864D9170       TCASRV_USERWORD:00000000
+00025C  TCASRV_WORKAREA:06412448      TCASRV_GETMAIN:00000000
+000264  TCASRV_FREEMAIN:00000000      TCASRV_LOAD:8000E738
+00026C  TCASRV_DELETE:8000E428        TCASRV_EXCEPTION:00000000
+000274  TCASRV_ATTENTION:00000000     TCASRV_MESSAGE:00000000
+000280  LWS:000174B0      SAVR:00000000     SYSTM:03      HRDWR:03
+0002AE  SBSYS:02    FLAG2:00    LEVEL:08    PM:04         GETLS:00011CA0
+0002B8  CELV:00018038     GETS:00011BB0     LBOS:00021000
+0002C4  LEOS:00023000     LNAB:00022E98     DMC:00000000
+0002D0  ABCODE:00000000   RSNCODE:00000000  ERR:00021480
+0002DC  GETSX:00011930    DDSA:00016128     SECTSIZ:00000000
+0002E8  PARTSUM:00000000        SSEXPNT:00000000        EDB:000148B0
+0002F4  PCB:00014558      EYEPTR:00015878   PTR:00015890
+000300  GETS1:00012730    SHAB:00000000     PRGCK:00000004    FLAG1:00
+000310  URC:00000000      ESS:00042F00      LESS:00022F00
+00031C  OGETS:000120F8    OGETLS:00000000   PICICB:00000000
+000328  GETSX:00000000    GOSMR:0000  LEOV:00000000
+000334  SIGSCTR:00000000        SIGSFLG:00000000
+00033C  THDID:80000000  00000000      DCRENT:00000000
+000348  DANCHOR:00000000        CTOC:00000000     RCB:00013918
+000354  CICSRSN:00000000        MEMBR:000161C8
+00035C  SIGNAL_STATUS:00000000        FOR1:00000000    FOR2:00000000
+000378  THREADHEAPID:00000000    SIGNGPTR:00015C24           SIGNG:00000001
+000398  FORDBG:00000000   AB_STATUS:00      AB_GR0:00000000
+0003A4  AB_ICD1:00000000        AB_ABCC:00000000             AB_CRC:00000000
+0003D4  SMCB:00015F70     ERRCM:06412AB0    MIB_PTR:00000000
+000434  THDSTATUS:00000000      TICB_PTR:06413840
+00047C  FWD_CHAIN:00015890      BKWD_CHAIN:00015890
```

Figure 21. The CAA formatted by the CBFORMAT IPCS command

For more information on using the IPCS CBF command refer to the ″CBFORMAT subcommand″ section in *z/OS MVS IPCS Commands*, SA22-7594.

Table 8. Language Environment Control blocks that can be individually formatted

Control Block	Description
CEEADHP	Additional Heap Control Block
CEECAA	Common Anchor Area
CEECIB	Condition Information Block
CEECIBH	Condition Information Block Header
CEECMXB	Message Services Block
CEEDSA	Dynamic Storage Area
CEEDLLF	DLL Failure Control Block
CEEDSATR	XPLINK Transition Area
CEEDSAX	Dynamic Storage Area (XPLINK style)
CEEEDB	Enclave Data Block
CEEENSM	Enclave Level Storage Management

Table 8. Language Environment Control blocks that can be individually formatted (continued)

Control Block	Description
CEEHANC	Heap Anchor Node
CEEHCOM	CEL Exception Manager Communications Area
CEEHPCB	Thread Level Heap Control Block
CEEHPSB	Heap Statistics Block
CEEMDST	Message Destination
CEEMGF	Mapping of the Message Formatter (IBM1MGF)
CEEPCB	Process Control Block
CEEPMCB	Program Management Control Block
CEERCB	Region Control Block
CEESKSB	Stack Statistics Block
CEESMCB	Storage Management Control Block
CEESTKH	Stack Header Block
CEESTKHX	Stack Header Block (xplink style)
CEESTSB	Storage Report Statistics Block
CEETMXB	Thread Level Messages Extension Block

Requesting a Language Environment trace for debugging

Language Environment provides an in-storage, wrapping trace facility that can reconstruct the events leading to the point where a dump is taken. The trace facility can record two types of events: entry and exit library calls and, if the POSIX run-time option is set to ON, user mutex and condition variable activity such as init, lock/unlock, and wait. Language Environment produces a trace table in its dump report under the following conditions:

- The CEE3DMP callable service is invoked with the BLOCKS option and the TRACE run-time option is set to ON.
- The TRACE run-time option is set to NODUMP and the TERMTHDACT run-time option is set to DUMP, UADUMP, TRACE, or UATRACE.
- The TRACE run-time option is set to DUMP (the default).

For more information about the CEE3DMP callable service, the TERMTHDACT run-time option, or the TRACE run-time option, see *z/OS Language Environment Programming Reference*.

The TRACE run-time option activates Language Environment run-time library tracing and controls the size of the trace buffer, the type of trace events to record, and it determines whether a dump containing only the trace table should be unconditionally taken when the application (enclave) terminates. The trace table contents can be written out either upon demand or at the termination of an enclave.

The contents of the Language Environment dump depend on the values set in the TERMTHDACT run-time option. Under abnormal termination, the following dump contents are generated:

- TERMTHDACT(QUIET) generates a Language Environment dump containing the trace table only

- TERMTHDACT(MSG) generates a Language Environment dump containing the trace table only
- TERMTHDACT(TRACE) generates a Language Environment dump containing the trace table and the traceback
- TERMTHDACT(DUMP) generates a Language Environment dump containing thread/enclave/process storage and control blocks (the trace table is included as an enclave control block)
- TERMTHDACT(UAONLY) generates a system dump of the user address space
- TERMTHDACT(UATRACE) generates a Language Environment dump that contains traceback information, and a system dump of the user address space
- TERMTHDACT(UADUMP) generates a Language Environment dump containing thread/enclave/process storage and control blocks (the trace table is included as an enclave control block), and a user address space dump
- TERMTHDACT(UAIMM) generates a system dump of the user address space of the original abend or program interrupt that occurred prior to the Language Environment condition manager processing the condition.

Note: Under CICS, UAIMM yields UAONLY behavior. Under non-CICS, TRAP(ON,NOSPIE) must be in effect. When TRAP(ON,SPIE) is in effect, UAIMM yields UAONLY behavior. For software raised conditions or signals, UAIMM behaves the same as UAONLY.

Under normal termination, the following dump contents are generated:

- Independent of the TERMTHDACT setting, Language Environment generates a dump containing the trace table only based on the TRACE run-time option

Language Environment quiesces all threads that are currently running except for the thread that issued the call to CEE3DMP. When you call CEE3DMP in a multithread environment, only the current thread is dumped. Enclave- and process-related storage could have changed from the time the dump request was issued.

Locating the trace dump

If your application calls CEE3DMP, the Language Environment dump is written to the file specified in the FNAME parameter of CEE3DMP (the default is CEEDUMP).

If your application is running under TSO or batch, and a CEEDUMP DD is not specified, Language Environment writes the CEEDUMP to the batch log (SYSOUT=* by default). You can change the SYSOUT class by specifying a CEEDUMP DD, or by setting the environment variable, *_CEE_DMPTARG=SYSOUT(x)*, where x is the preferred SYSOUT class.

If your application is running under z/OS UNIX and is either running in an address space you issued a `fork()` to, or if it is invoked by one of the `exec` family of functions, the dump is written to the hierarchical file system (HFS). Language Environment writes the CEEDUMP to one of the following directories in the specified order:

1. The directory found in environment variable *_CEE_DMPTARG*, if found
2. The current working directory, if the directory is not the root directory (/), the directory is writable, and the CEEDUMP path name does not exceed 1024 characters
3. The directory found in environment variable *TMPDIR* (an environment variable that indicates the location of a temporary directory if it is not /tmp)
4. The **/tmp** directory

The name of this file changes with each dump and uses the following format:
`/path/Fname.Date.Time.Pid`

path The path determined from the above algorithm.

Fname The name specified in the FNAME parameter on the call to CEE3DMP (default is CEEDUMP).

Date The date the dump is taken, appearing in the format `YYYYMMDD` (such as 20040918 for September 18, 2004).

Time The time the dump is taken, appearing in the format `HHMMSS` (such as 175501 for 05:55:01 p.m.).

Pid The process ID the application is running in when the dump is taken.

Using the Language Environment trace table format in a dump report

The Language Environment trace table is established unconditionally at enclave initialization time if the TRACE run-time option is set to ON. All threads in the enclave share the trace table; there is no thread-specific table, nor can the table be dynamically extended or enlarged.

Understanding the trace table entry (TTE)

Each trace table entry is a fixed-length record consisting of a fixed-format portion (containing such items as the timestamp, thread ID, and member ID) and a member-specific portion. The member-specific portion has a fixed length, of which some (or all) can be unused. For information about how participating products use the trace table entry, see the product-specific documentation. The format of the trace table entry is as follows:

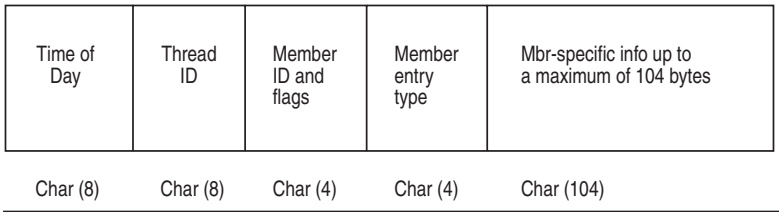


Figure 22. Format of the trace table entry

Following is a definition of each field:

Time The 64-bit value obtained from a store clock (STCK).

Thread ID The 8-byte thread ID of the thread that is adding the trace table entry.

Member ID and Flags
Contains 2 fields:

Member ID The 1-byte member ID of the member making the trace table entry, as follows:

ID	Name
01	CEL
03	C/C++
05	COBOL
07	Fortran

08	DCE
10	PL/I
12	Sockets

Flags 24 flags reserved for internal use.

Member Entry Type
A number that indicates the type of the member-specific trace information that follows the field.

To uniquely identify the information contained in a specific TTE, you must consider Member ID as well as Member Entry Type.

Member-Specific Information
Based on the member ID and the member entry type, this field contains the specific information for the entry, up to 104 bytes.

For C/C++, the entry type of 1 is a record that records an invocation of a base C run-time library function. The entry consists of the name of the invoking function and the name of the invoked function. Entry type 2 is a record that records the return from the base library function. It contains the returned value and the value of errno.

Member-specific information in the trace table entry

Global tracing is activated by using the LE=n suboption of the TRACE run-time option. This requests all Language Environment members to generate trace records in the trace table.

The settings for the global trace events are:

Level	Description
0	No global trace
1	Trace all run-time library (RTL) function entry and exits
2	Trace all RTL mutex init/destroy and lock/unlock
3	Trace all RTL function entry and exits, and all mutex init/destroy and lock/unlock
8	Trace all RTL storage allocation/deallocation
20	Trace all XPLINK/non-XPLINK transitions for AMODE 31 only. If `#pragma` linkage (xxxxxxxx, OS_UPSTACK) is specified, no transitions are recorded.

When LE=1 is specified: The following C/C++ records may be generated.

Table 9. LE=1 entry records

Member ID	Record Type	Description
03	00000001	Base C Library function Entry
03	00000002	Base C Library function Exit
03	00000003	Posix C Library function Entry
03	00000004	Posix C Library function Exit
03	00000005	XPLINK Base or Posix C Library function Entry
03	00000006	XPLINK Base or Posix C Library function Exit

For a detailed description of these records, see “C/C++ contents of the Language Environment trace tables” on page 207.

When LE=2 is specified: The following Language Environment records may be generated.

Table 10. LE=2 entry records

Member ID	Record Type	Class	Event	Description
01	00000101	LT	A	Latch Acquire
01	00000102	LT	R	Latch Release
01	00000103	LT	W	Latch Wait
01	00000104	LT	AW	Latch Acquire after Wait
01	00000106	LT	I	Latch Increment (Recursive)
01	00000107	LT	D	Latch Decrement (Recursive)
01	000002FC	LE	EUO	Latch unowned (not released)
01	000002FD	LE	EO	Latch already owned (not acquired)
01	00000301	MX	A	Mutex acquire
01	00000302	MX	R	Mutex release
01	00000303	MX	W	Mutex wait
01	00000304	MX	AW	Mutex acquire after wait
01	00000305	MX	B	Mutex busy (Trylock failed)
01	00000306	MX	I	Mutex increment (recursive)
01	00000307	MX	D	Mutex decrement (recursive)
01	00000315	MX	IN	Mutex initialize
01	00000316	MX	DS	Mutex destroy
01	0000031D	MX	BI	Shared memory lock init
01	0000031E	MX	BD	Shared memory lock destroy
01	0000031F	MX	BO	shared memory lock obtain
01	00000320	MX	BC	Shared memory lock obtain on condition
01	00000321	MX	BR	Shared memory lock release
01	00000324	MX	CIN	Call to SMC_INIT
01	00000325	MX	CSD	Call to SMC_DESTROY
01	00000326	MX	CSO	Shared resource obtain
01	00000327	MX	CSR	Shared resource release
01	00000328	MX	CST	Call to SMC_SetupToWait
01	00000329	MX	CSP	Call to SMC_POST
01	000004CC	ME	FFR	Error - Forced release (shared mutex)
01	000004CD	ME	FFD	Error - Forced decrement (shared mutex)
01	000004CE	ME	FBD	Error - BPX_SMC(DESTROY) error return
01	000004CF	ME	FBU	Error - BPX_SMC(fail) returns EBUSY
01	000004D0	ME	FIV	Error - BPX_SMC(fail) returns EINVAL
01	000004D4	ME	FDU	Error - Destroy failed (uninitialized) (shared mutex/CV)
01	000004D5	ME	FP	Error - Program check (shared mutex/CV)
01	000004DB	ME	ESC	Error - BPX1SMC error return

Table 10. LE=2 entry records (continued)

Member ID	Record Type	Class	Event	Description
01	000004DE	ME	EDL	Shared memory lock returns deadlock
01	000004DF	ME	EIV	Shared memory lock returns invalid
01	000004E0	ME	EPM	Shared memory lock returns eperm
01	000004E1	ME	EAG	Shared memory lock returns eagain
01	000004E2	ME	EBU	Shared memory lock returns ebusy
01	000004E3	ME	ENM	Shared memory lock returns enomem
01	000004E4	ME	EBR	Shared memory lock release error
01	000004E5	ME	EBC	Shared memory lock obtain condition error
01	000004E6	ME	EBO	Shared memory lock obtain error
01	000004E7	ME	EBD	Shared memory lock destroy error
01	000004E8	ME	EBI	Shared memory lock initialize error
01	000004E9	ME	EFR	Mutex forced release
01	000004EA	ME	EFD	Mutex forced decrement
01	000004EB	ME	EDD	Mutex destroy failed (damage)
01	000004EC	ME	EDB	Mutex destroy failed (busy)
01	000004ED	ME	EIA	Mutex initialize failed (attribute)
01	000004EE	ME	EIS	Mutex initialize failed (storage)
01	000004EF	ME	EF	Mutex release (forced by quiesce)
01	000004F0	ME	EP	Mutex program check
01	000004FA	ME	EDU	Mutex destroy failed (uninitialized)
01	000004FB	ME	EUI	Mutex uninitialized
01	000004FC	ME	EUO	Mutex unowned (not released)
01	000004FD	E	EO	Mutex already owned (not acquired)
01	000004FE	ME	EIN	Mutex initialization failed (duplicate)
01	00000508	CV	MR	CV release mutex
01	00000509	CV	MA	CV reacquire mutex
01	0000050A	CV	MW	CV mutex wait
01	0000050B	CV	MAW	CV reacquire mutex after wait
01	0000050C	CV	CW	CV condition wait
01	0000050D	CV	CTW	CV condition timeout
01	0000050E	CV	CWP	CV wait posted
01	0000050F	CV	CWI	CV wait interrupted
01	00000510	CV	CTO	CV wait timeout
01	00000511	CV	CSS	CV condition signal success
01	00000512	CV	CSM	CV condition signal miss
01	00000513	CV	CBS	CV condition broadcast success
01	00000514	CV	CBM	CV condition broadcast miss
01	00000515	CV	IN	CV initialize
01	00000516	CV	DS	CV destroy

Table 10. LE=2 entry records (continued)

Member ID	Record Type	Class	Event	Description
01	00000522	CV	CIN	Call to SMC_INIT
01	00000523	CV	CSD	Call to SMC_DESTROY
01	00000529	CV	CSP	Call to SMC_POST
01	0000052A	CV	CSB	Call to SMC_POSTALL
01	0000052B	CV	CSW	Call to SMC_WAIT
01	0000052C	CV	DBM	Shared condition broadcast - miss
01	0000052D	CV	DBS	Shared condition broadcast - success
01	0000052E	CV	DDS	Destroy (shared mutex/CV)
01	0000052F	CV	DIN	Initialize (shared mutex/CV)
01	00000530	CV	DSM	Condition signal - miss (shared CV)
01	00000531	CV	DSS	Condition signal - success (shared CV)
01	00000532	CV	DWI	Wait interrupted (shared CV)
01	00000533	CV	DTO	Wait timeout (shared CV)
01	00000534	CV	DWP	Wait posted (shared CV)
01	000006CB	CE	FBT	Error - Invalid system TOD (shared)
01	000006D1	CE	FRM	Error - Recursive mutex (shared)
01	000006D2	CE	FUO	Error - Shared mutex unowned
01	000006D3	CE	FDB	Error - Destroy failed (busy) (shared mutex/CV)
01	000006D4	CE	FDU	Error - Destroy failed (unitialized) (shared mutex/CV)
01	000006D5	CE	FP	Error - Program check (shared mutex/CV)
01	000006D6	CE	FUI	Error - Shared mutex or CV unitialized
01	000006D7	CE	ENV	Error - BPX1SMC(fail) returns EINVAL
01	000006D8	CE	EPE	Error - BPX1SMC(fail) returns EPERM
01	000006D9	CE	EAN	Error - BPX1SMC(fail) returns EAGAIN
01	000006DA	CE	EIB	Error - BPX1SMC failed (EBUSY)
01	000006DB	CE	ESC	Error - BPX1SMC failed
01	000006EB	CE	EDD	CV destroy failed (damage)
01	000006EC	CE	EDB	CV destroy failed (busy)
01	000006ED	CE	EIA	CV initialization failed (attribute)
01	000006EE	CE	EIS	CV initialization failed (storage)
01	000006EF	CE	EF	CV forced by quiesce
01	000006F0	CE	EP	CV program check
01	000006F1	CE	EBT	CV invalid system TOD
01	000006F2	CE	EBN	CV invalid timespec (nanoseconds)
01	000006F3	CE	EBS	CV invalid timespec (seconds)
01	000006F4	CE	EPO	CV condition post callable service fail
01	000006F5	CE	ETW	CV condition timed wait callable service fail
01	000006F6	CE	EWA	CV condition wait callable service fail

Table 10. LE=2 entry records (continued)

Member ID	Record Type	Class	Event	Description
01	000006F7	CE	ESE	CV condition setup callable service fail
01	000006F8	CE	ERM	CV recursive mutex
01	000006F9	CE	EWM	CV wrong mutex
01	000006FA	CE	EDU	CV destroy failed (uninitialized)
01	000006FB	CE	EUI	CV mutex or CV uninitialized
01	000006FC	CE	EUO	CV mutex unowned
01	000006FE	CE	EIN	CV initialization failed (duplicate)
01	00000702	RW	R	Release
01	00000704	RW	AW	Acquire after wait
01	00000706	RW	I	Increment (recursive)
01	00000707	RW	D	Decrement (recursive)
01	00000715	RW	IN	Initialize
01	00000716	RW	DS	Destroy
01	00000717	RW	RA	Read acquire
01	00000718	RW	WA	Write acquire
01	00000719	RW	RB	Read busy (tryread failed)
01	0000071A	RW	WB	Write busy (trywrite failed)
01	0000071B	RW	RW	Read wait
01	0000071C	RW	WW	Write wait
01	0000071D	RW	BI	Call to SLK_INIT
01	0000071E	RW	BD	Call to SLK_DESTROY
01	0000071F	RW	BO	Call to SLK_OBTAIN
01	00000720	RW	BC	Call to SLK_OBTAIN_COND
01	00000721	RW	BR	Call to SLK_RELEASE
01	000008DC	RE	EOW	Error - Already owned for write (not acquired)
01	000008DD	RE	EOR	Error - Already owned for read (not acquired)
01	000008DE	RE	EDL	Error - BPX1SLK(fail) returns EDEADLK
01	000008DF	RE	EIV	Error - BPX1SLK(fail) returns EINVAL
01	000008E0	RE	EPM	Error - BPX1SLK(fail) returns EPERM
01	000008E1	RE	EAG	Error - BPX1SLK(fail) returns EAGAIN
01	000008E2	RE	EBS	Error - BPX1SLK(fail) returns EBUSY
01	000008E3	RE	ENM	Error - BPX1SLK(fail) returns ENOMEM
01	000008E4	RE	EBR	Error - BPX1SLK(RELEASE) error return
01	000008E5	RE	EBC	Error - BPX1SLK(OBTAIN_COND) error return
01	000008E6	RE	EBO	Error - BPX1SLK(OBTAIN) error return
01	000008E7	RE	EBD	Error - BPX1SLK(DESTROY) error return
01	000008E8	RE	EBI	Error - BPX1SLK(INIT) error return
01	000008E9	RE	EFR	Error - Forced release
01	000008EA	RE	EFD	Error - Forced decrement

Table 10. LE=2 entry records (continued)

Member ID	Record Type	Class	Event	Description
01	000008ED	RE	EIA	Error - Initialization failed (attribute)
01	000008EE	RE	EIS	Error - Initialization failed (storage)
01	000008EF	RE	EF	Error - Forced by quiesce
01	000008F0	RE	EP	Error - Program check
01	000008FB	RE	EUI	Error - Uninitialized
01	000008FC	RE	EUO	Error - Unowned (not released)
01	000008FD	RE	EO	Error - Already owned (not acquired)
01	000008FE	RE	EIN	Error - Initialization failed (duplicate)

The format for the Mutex – Condition Variable – Latch entries in the trace table is:

Table 11. Format of the mutex/CV/latch records

Class	Source		Event		Object Addr	Name1	Name2
unused							

Where each field represents:

Class Two character EBCDIC representation of the trace class.

- **LT** Latch
- **LE** Latch Exception
- **MX** Mutex
- **ME** Mutex Exception
- **CV** Condition Variable
- **CE** Condition Variable Exception

Source
One character EBCDIC representation of the event.

- **C** C/C++
- **D** DCE
- **S** Sockets

Blank Blank character

Event Two character EBCDIC representation of the event. See Table 10 on page 156.

Object address
Fullword address of the mutex object.

Name 1
Optional eight character field containing the name of the function or object to be recorded.

Name 2
Optional eight character field containing the name of the function or object to be recorded.

When LE=3 is specified: The trace table will include the records generated by both LE=1 and LE=2.

When LE=8 is specified: The trace table will contain only storage allocation records. Currently this is only supported by C/C++.

Table 12. LE=8 entry records

Member ID	Record Type	Description
03	00000001	Storage allocation entry
03	00000001	Storage allocation exit

For a detailed description of these records, see “C/C++ contents of the Language Environment trace tables” on page 207.

When LE=20 is specified: The following C/C++ records might be generated.

Table 13. LE=20 entry records

Member ID	Record Type	Description
03	00000007	XPLINK calls non-XPLINK entry
03	00000008	non-XPLINK calls XPLINK entry

For a detailed description of these records, see “C/C++ contents of the Language Environment trace tables” on page 207.

Sample dump for the trace table entry

The following is an example of a dump of the trace table when you specify the LE=1 suboption (the library call/return trace):

```
⋮
 Enclave Control Blocks:
   EDB: 0001E920
     +000000 0001E920  C3C5C5C5 C4C24040 C5000001 00020E68  0001F040 00000000 00000000 00000000  |CEEEDB  E.........0 ............|

⋮
   MEML: 00020E68
     +000000 00020E68  00000000 00000000 0007C5B8 00000000  00000000 00000000 0007C5B8 00000000  |..........E..............E.....|

⋮
   Language Environment Trace Table:
    Most recent trace entry is at displacement: 001B80

        Displacement                      Trace Entry in Hexadecimal                                    Trace Entry in EBCDIC
        ------------ ------------------------------------------------------------------------  --------------------------------
          +000000    Time 21.41.57.595359    Date 2001.08.26    Thread ID... 8000000000000000
          +000010    Member ID.... 03    Flags..... 000000    Entry Type..... 00000001
          +000018    6D6DA289 9589A3F6 F46D6D83 82836D83  938296A2 F2F46D89 96A2A399 8581946D  |__sinit64__cbc_clbos24_iostream_|
          +000038    60606E4D F1F9F35D 406D6D87 85A38382  4D5D4040 40404040 40404040 40404040  |-->(193) __getcb()              |
          +000058    40404040 40404040 40404040 40404040  40404040 40404040 40404040 40404040  |                                |
          +000078    40404040 40404040                                                         |                                |

          +000080    Time 21.41.57.595367    Date 2001.08.26    Thread ID... 8000000000000000
          +000090    Member ID.... 03    Flags..... 000000    Entry Type..... 00000002
          +000098    4C60604D F1F9F35D 40D9F1F5 7EF0F0F0  F0F0F0F0 F040C5D9 D9D5D67E F0F0F0F0  |<--(193) R15=00000000 ERRNO=0000|
          +0000B8    F0F0F0F0 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |0000............................|
          +0000D8    00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
          +0000F8    00000000 00000000                                                         |........                        |

          +000100    Time 21.41.57.595374    Date 2001.08.26    Thread ID... 8000000000000000
          +000110    Member ID.... 03    Flags..... 000000    Entry Type..... 00000003
          +000118    6D6DA289 9589A3F6 F46D6D83 82836D83  938296A2 F2F46D89 96A2A399 8581946D  |__sinit64__cbc_clbos24_iostream_|
          +000138    60606E4D F1F1F35D 406D6D89 A2D796A2  89A7D695 4D5D4040 40404040 40404040  |-->(113) __isPosixOn()          |
          +000158    40404040 40404040 40404040 40404040  40404040 40404040 40000000 00000000  |                          .......|
          +000178    00000000 00000000                                                         |........                        |
          +000180    Time 21.41.57.595380    Date 2001.08.26    Thread ID... 8000000000000000
          +000190    Member ID.... 03    Flags..... 000000    Entry Type..... 00000004
          +000198    4C60604D F1F1F35D 40D9F1F5 7EF0F0F0  F0F0F0F0 F040C5D9 D9D5D67E F0F0F0F0  |<--(113) R15=00000000 ERRNO=0000|
          +0001B8    F0F0F0F0 40C5D9D9 D5D6F27E F0F0F0F0  F0F0F0F0 00000000 00000000 00000000  |0000 ERRNO2=00000000............|
          +0001D8    00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
          +0001F8    00000000 00000000                                                         |........                        |

          +000200    Time 21.41.57.595638    Date 2001.08.26    Thread ID... 8000000000000000
          +000210    Member ID.... 03    Flags..... 000000    Entry Type..... 00000001
          +000218    D3968392 A27A7AC9 95A2A381 9583854D  5D404040 40404040 40404040 40404040  |Locks::Instance()               |
          +000238    60606E4D F1F2F45D 40948193 9396834D  F1F6F0F0 5D404040 40404040 40404040  |-->(124) malloc(1600)           |
          +000258    40404040 40404040 40404040 40404040  40404040 40404040 40404040 40404040  |                                |
          +000278    40404040 40404040                                                         |                                |

          +000280    Time 21.41.57.595690    Date 2001.08.26    Thread ID... 8000000000000000
          +000290    Member ID.... 03    Flags..... 000000    Entry Type..... 00000002
          +000298    4C60604D F1F2F45D 40D9F1F5 7EF2F4C2  F6C4F8C5 F840C5D9 D9D5D67E F0F0F0F0  |<--(124) R15=24B6D8E8 ERRNO=0000|
          +0002B8    F0F0F0F0 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |0000............................|
          +0002D8    00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
          +0002F8    00000000 00000000                                                         |........                        |

          +000300    Time 21.41.57.595743    Date 2001.08.26    Thread ID... 8000000000000000
          +000310    Member ID.... 03    Flags..... 000000    Entry Type..... 00000001
          +000318    8785A394 9684856D 86999694 6D86844D  8995A35D 40404040 40404040 40404040  |getmode_from_fd(int)            |
          +000338    60606E4D F1F9F35D 406D6D87 85A38382  4D5D4040 40404040 40404040 40404040  |-->(193) __getcb()              |
          +000358    40404040 40404040 40404040 40404040  40404040 40404040 40404040 40404040  |                                |
          +000378    40404040 40404040                                                         |                                |

          +000380    Time 21.41.57.595746    Date 2001.08.26    Thread ID... 8000000000000000
          +000390    Member ID.... 03    Flags..... 000000    Entry Type..... 00000002
          +000398    4C60604D F1F9F35D 40D9F1F5 7EF0F0F0  F0F0F0F0 F040C5D9 D9D5D67E F0F0F0F0  |<--(193) R15=00000000 ERRNO=0000|
          +0003B8    F0F0F0F0 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |0000............................|
          +0003D8    00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
          +0003F8    00000000 00000000                                                         |........                        |

⋮
```

Figure 23. Trace table in dump output

Requesting a UNIX System Services syscall trace for debugging

Signal SIGTRACE can be sent to a process or process group to start or stop a trace of the z/OS UNIX System Services syscalls made by the application. The signal is implemented as a toggle. With the trace turned on, the z/OS UNIX System Services kernel gathers the syscall trace records for the targeted processes. A system dump of the user address space can be generated by sending signal SIGDUMP to the same processes in order to capture the trace output. See *z/OS UNIX System Services Command Reference* for more information about the SIGTRACE signal.

Part 2. Debugging language-specific routines

This part provides specific information for debugging applications written in C/C++, COBOL, Fortran, and PL/I. It also discusses techniques for debugging under CICS.

© Copyright IBM Corp. 1991, 2009

Chapter 4. Debugging C/C++ routines

This chapter provides specific information to help you debug applications that contain one or more C/C++ routines. It also provides information about debugging C/C++ applications compiled with XPLINK. It includes the following topics:

- Debugging C/C++ I/O routines
- Using C/C++ compiler listings
- Generating a Language Environment dump of a C/C++ routine
- Generating a Language Environment dump of a C/C++ routine with XPLINK
- Finding C/C++ information in a Language Environment dump
- Debugging example of C/C++ routines
- Debugging example of C/C++ routines with XPLINK

There are several debugging features that are unique to C/C++ routines. Before examining the C/C++ techniques to find errors, you might want to consider the following areas of potential problems:

- If you suspect that you are using uninitialized storage, you may want to use the `STORAGE` run-time option.
- If you are using the `fetch()` function, see *z/OS XL C/C++ Programming Guide* to ensure that you are creating the fetchable module correctly.
- If you are using `DLL`s, see *z/OS XL C/C++ Programming Guide* to ensure that you are using the DLL correctly.
- For non-System Programming C routines, ensure that the entry point of the load module is CEESTART.
- You should avoid:
  - Incorrect casting
  - Referencing an array element with a subscript outside the declared bounds
  - Copying a string to a target with a shorter length than the source string
  - Declaring but not initializing a pointer variable, or using a pointer to allocated storage that has already been freed

  If a routine exception occurred and you need more information than the condition handler provided, run your routine with the following run-time options, TRAP(ON, NOSPIE) and TERMTHDACT(UAIMM). Setting these run-time options generates a system dump of the user address space of the original abend or program interrupt prior to the Language Environment condition manager processing the condition. After the system dump is taken by the operating system the Language Environment condition manager continues processing.

Debugging C/C++ programs

You can use C/C++ conventions such as `__amrc` and `perror()` when you debug C/C++ programs.

Using the __amrc and __amrc2 structures to debug input/output

`__amrc`, a structure defined in **stdio.h**, can help you determine the cause of errors resulting from an I/O operation, because it contains diagnostic information (for example, the return code from a failed VSAM operation).

There are two structures:

- `__amrc` (defined by type `__amrc_type`
- `__amrc2` (defined by type `__amrc2_type`)

© Copyright IBM Corp. 1991, 2009

The __amrc2_type structure contains secondary information that C can provide.

Because any I/O function calls, such as printf(), can change the value of __amrc or __amrc2, make sure you save the contents into temporary structures of __amrc_type and __amrc2_type respectively, before dumping them.

Figure 24 shows the structure as it appears in **stdio.h**.

```
    typedef struct __amrctype {

[1]    union {

[2]       long int __error;
          struct {
            unsigned short __syscode,
                           __rc;
[3]       } __abend;
          struct {
             unsigned char __fdbk_fill,
                           __rc,
                           __ftncd,
                           __fdbk;
[4]       } __feedback;
          struct {
             unsigned short __svc99_info,
                            __svc99_error;
[5]       } __alloc;
[1]    } __code;
[6]    unsigned long __RBA;
[7]    unsigned int      __last_op;
       struct {
        unsigned long  __len_fill; /* __len + 4       */
        unsigned long  __len;
        char           __str[120];
        unsigned long  __parmr0;
        unsigned long  __parmr1;
        unsigned long  __fill2[2];
        char           __str2[64];
[8]    } __msg;
[9]  #if __EDC_TARGET >= 0x22080000
 unsigned char        __rplfdbwd[4];
 #endif
 [10] #if __EDC_TARGET >= 0x41080000
   #ifdef  __LP64
     unsigned long __XRBA;
   #elif defined(__LL)
     unsigned long long __XRBA;
   #else
     unsigned int __XRBA1;
     unsigned int __XRBA2;
   #endif
 unsigned char        __amrc_noseek_to_seek;
 char                 __amrc_pad[23];
 #endif
 } __amrc_type;
```

Figure 24. __amrc structure

Figure 25 on page 169 shows the __amrc2 structure as it appears in **stdio.h**.

```
    struct {
[11]       long int   __error2;
                            char       __pad__error2[4];
[12]      FILE      *__fileptr;
[13]      long int   __reserved{6};
    }
```

Figure 25. __amrc2 structure

[1] union { ... } __code
The error or warning value from an I/O operation is in __error, __abend, __feedback, or __alloc. Look at __last_op to determine how to interpret the __code union.

[2] __error A structure that contains error codes for certain macros or services your application uses. Look at __last_op to determine the error codes. __syscode is the system abend code.

[3] __abend A structure that contains the abend code when errno is set to indicate a recoverable I/O abend. __rc is the return code. For more information on abend codes, see *z/OS MVS System Codes*.

[4] __feedback A structure that is used for VSAM only. The __rc stores the VSAM register 15, __fdbk stores the VSAM error code or reason code, and __RBA stores the RBA after some operations.

[5] __alloc A structure that contains errors during fopen or freopen calls when defining files to the system using SVC 99.

[6] __RBA The RBA value returned by VSAM after an ESDS or KSDS record is written out. For an RRDS, it is the calculated value from the record number. It can be used in subsequent calls to flocate.

[7] __last_op A field containing a value that indicates the last I/O operation being performed by C/C++ at the time the error occurred. These values are shown in Table 14 on page 170.

[8] __msg May contain the system error messages from read or write operations emitted from the DFSMS/MVS™ SYNADAF macro instruction. Because the message can start with a hexadecimal address followed by a short integer, it is advisable to start printing at MSG+6 or greater so the message can be printed as a string. Because the message is not null-terminated, a maximum of 114 characters should be printed. This can be accomplished by specifying a printf format specifier as %.114s.

[9] __amrc_noseek_to_seek
This field contains the reason for the switch from QSAM (noseek) to BSAM with NOTE and POINT macros requested (seek) by the XL C/C++ Run-Time Library. This field is set when system-level I/O macro processing triggers an ABEND condition. The macro name values (defined in stdio.h) for this field are as follows:

Macro	Definition
__AM_BSAM_NOSWITCH	No switch was made.
__AM_BSAM_UPDATE	The data set is open for update

Macro	Definition
__AM_BSAM_BSAMWRITE	The data set is already open for write (or update) in the same C process.
__AM_BSAM_FBS_APPEND	The data set is recfm=FBS and open for append
__AM_BSAM_LRECLX	The data set is recfm=LRECLX (used for VBS data sets where records span the largest blocksize allowed on the device)
__AM_BSAM_PARTITIONED_DIRECTORY	The data set is the directory for a regular or extended partitioned data set
__AM_BSAM_PARTITIONED_INDIRECT	The data set is a member of a partitioned data set, and the member name was not specified at allocation

[10] __XRBA This is the 8 byte relative byte address returned by VSAM after an ESDS or KSDS record is written out. For an RRDS, it is the calculated value from the record number. It may be used in subsequent calls to `flocate()`.

[11] __error2 A secondary error code. For example, an unsuccessful rename or remove operation places its reason code here.

[12] __fileptr A pointer to the file that caused a SIGIOERR to be raised. Use an `fldata()` call to get the actual name of the file.

[13] __reserved
Reserved for future use.

__last_op values

The `__last_op` field is the most important of the `__amrc` fields. It defines the last I/O operation C/C++ was performing at the time of the I/O error. You should note that the structure is neither cleared nor set by non-I/O operations, so querying this field outside of a `SIGIOERR` handler should only be done immediately after I/O operations. Table 14 lists `__last_op` values you could receive and where to look for further information.

Table 14. __last_op values and diagnosis information

Value	Further Information
`__IO_INIT`	Will never be seen by `SIGIOERR` exit value given at initialization.
`__BSAM_OPEN`	Sets __error with return code from OS OPEN macro.
`__BSAM_CLOSE`	Sets __error with return code from OS CLOSE macro.
`__BSAM_READ`	No return code (either __abend (errno == 92) or __msg (errno == 66) filled in).
`__BSAM_NOTE`	NOTE returned 0 unexpectedly, no return code.
`__BSAM_POINT`	This will not appear as an error lastop.
`__BSAM_WRITE`	No return code (either __abend (errno == 92) or __msg (errno == 65) filled in).
`__BSAM_CLOSE_T`	Sets __error with return code from OS CLOSE TYPE=T.
`__BSAM_BLDL`	Sets __error with return code from OS BLDL macro.
`__BSAM_STOW`	Sets __error with return code from OS STOW macro.
`__TGET_READ`	Sets __error with return code from TSO TGET macro.
`__TPUT_WRITE`	Sets __error with return code from TSO TPUT macro.

Table 14. __last_op values and diagnosis information (continued)

Value	Further Information
__IO_DEVTYPE	Sets __error with return code from I/O DEVTYPE macro.
__IO_RDJFCB	Sets __error with return code from I/O RDJFCB macro.
__IO_TRKCALC	Sets __error with return code from I/O TRKCALC macro.
__IO_OBTAIN	Sets __error with return code from I/O CAMLST OBTAIN.
__IO_LOCATE	Sets __error with return code from I/O CAMLST LOCATE.
__IO_CATALOG	Sets __error with return code from I/O CAMLST CAT. The associated macro is CATALOG.
__IO_UNCATALOG	Sets __error with return code from I/O CAMLST UNCAT. The associated macro is CATALOG.
__IO_RENAME	Sets __error with return code from I/O CAMLST RENAME.
__SVC99_ALLOC	Sets __alloc structure with info and error codes from SVC 99 allocation.
__SVC99_ALLOC_NEW	Sets __alloc structure with info and error codes from SVC 99 allocation of NEW file.
__SVC99_UNALLOC	Sets __unalloc structure with info and error codes from SVC 99 unallocation.
__C_TRUNCATE	Set when C or C++ truncates output data. Usually this is data written to a text file with no newline such that the record fills up to capacity and subsequent characters cannot be written. For a record I/O file this refers to an `fwrite()` writing more data than the record can hold. Truncation is always rightmost data. There is no return code.
__C_FCBCHECK	Set when C or C++ FCB is corrupted. This is due to a pointer corruption somewhere. File cannot be used after this.
__C_DBCS_TRUNCATE	This occurs when writing DBCS data to a text file and there is no room left in a physical record for anymore double byte characters. A new-line is not acceptable at this point. Truncation will continue to occur until an SI is written or the file position is moved. Cannot happen if MB_CUR_MAX is 1.
__C_DBCS_SO_TRUNCATE	This occurs when there is not enough room in a record to start any DBCS string or else when a redundant SO is written to the file before an SI. Cannot happen if MB_CUR_MAX is 1.
__C_DBCS_SI_TRUNCATE	This occurs only when there was not enough room to start a DBCS string and data was written anyways, with an SI to end it. Cannot happen if MB_CUR_MAX is 1.
__C_DBCS_UNEVEN	This occurs when an SI is written before the last double byte character is completed, thereby forcing C or C++ to fill in the last byte of the DBCS string with a padding byte X'FE'. Cannot happen if MB_CUR_MAX is 1.
__C_CANNOT_EXTEND	This occurs when an attempt is made to extend a file that allows writing, but cannot be extended. Typically this is a member of a partitioned data set being opened for update.
__VSAM_OPEN_FAIL	Set when a low level VSAM OPEN fails, sets __rc and __fdbk fields in the __amrc struct.
__VSAM_OPEN_ESDS	Does not indicate an error; set when the low level VSAM OPEN succeeds, and the file type is ESDS.
__VSAM_OPEN_RRDS	Does not indicate an error; set when the low level VSAM OPEN succeeds, and the file type is ESDS.

Table 14. __last_op values and diagnosis information (continued)

Value	Further Information
__VSAM_OPEN_KSDS	Does not indicate an error; set when the low level VSAM OPEN succeeds, and the file type is ESDS.
__VSAM_OPEN_ESDS_PATH	Does not indicate an error; set when the low level VSAM OPEN succeeds, and the file type is ESDS.
__VSAM_OPEN_KSDS_PATH	Does not indicate an error; set when the low level VSAM OPEN succeeds, and the file type is ESDS.
__VSAM_MODCB	Set when a low level VSAM MODCB macro fails, sets __rc and __fdbk fields in the __amrc struct.
__VSAM_TESTCB	Set when a low level VSAM TESTCB macro fails, sets __rc and __fdbk fields in the __amrc struct.
__VSAM_SHOWCB	Set when a low level VSAM SHOWCB macro fails, sets __rc and __fdbk fields in the __amrc struct.
__VSAM_GENCB	Set when a low level VSAM GENCB macro fails, sets __rc and __fdbk fields in the __amrc struct.
__VSAM_GET	Set when the last op was a low level VSAM GET; if the GET fails, sets __rc and __fdbk in the __amrc struct.
__VSAM_PUT	Set when the last op was a low level VSAM PUT; if the PUT fails, sets __rc and __fdbk in the __amrc struct.
__VSAM_POINT	Set when the last op was a low level VSAM POINT; if the POINT fails, sets __rc and __fdbk in the __amrc struct.
__VSAM_ERASE	Set when the last op was a low level VSAM ERASE; if the ERASE fails, sets __rc and __fdbk in the __amrc struct.
__VSAM_ENDREQ	Set when the last op was a low level VSAM ENDREQ; if the ENDREQ fails, sets __rc and __fdbk in the __amrc struct.
__VSAM_CLOSE	Set when the last op was a low level VSAM CLOSE; if the CLOSE fails, sets __rc and __fdbk in the __amrc struct.
__QSAM_GET	__error is not set (if abend (errno == 92), __abend is set, otherwise if read error (errno == 66), look at __msg.
__QSAM_PUT	__error is not set (if abend (errno == 92), __abend is set, otherwise if write error (errno == 65), look at __msg.
__QSAM_TRUNC	This is an intermediate operation. You will only see this if an I/O abend occurred.
__QSAM_FREEPOOL	This is an intermediate operation. You will only see this if an I/O abend occurred.
__QSAM_CLOSE	Sets __error to result of OS CLOSE macro.
__QSAM_OPEN	Sets __error to result of OS OPEN macro.
__CMS_OPEN	Sets __error to result of FSOPEN.
__CMS_CLOSE	Sets __error to result of FSCLOSE.
__CMS_READ	Sets __error to result of FSREAD.
__CMS_WRITE	Sets __error to result of FSWRITE.
__CMS_STATE	Sets __error to result of FSSTATE.
__CMS_ERASE	Sets __error to result of FSERASE.
__CMS_RENAME	Sets __error to result of CMS RENAME command.
__CMS_EXTRACT	Sets __error to result of DMS EXTRACT call.
__CMS_LINERD	Sets __error to result of LINERD macro.

Table 14. __last_op values and diagnosis information (continued)

Value	Further Information
__CMS_LINEWRT	Sets __error to result of LINEWRT macro.
__CMS_QUERY	__error is not set.
__HSP_CREATE	Indicates last op was a DSPSERV CREATE to create a hiperspace for a hiperspace memory file. If CREATE fails, stores abend code in __amrc__code__abend__syscode, reason code in __amrc__code__abend__rc.
__HSP_DELETE	Indicates last op was a DSPSERV DELETE to delete a hiperspace for a hiperspace memory file during termination. If DELETE fails, stores abend code in __amrc__code__abend__syscode, reason code in __amrc__code__abend__rc.
__HSP_READ	Indicates last op was a HSPSERV READ from a hiperspace. If READ fails, stores abend code in __amrc__code__abend__syscode, reason code in __amrc__code__abend__rc.
__HSP_WRITE	Indicates last op was a HSPSERV WRITE to a hiperspace. If WRITE fails, stores abend code in __amrc__code__abend__syscode, reason code in __amrc__code__abend__rc.
__HSP_EXTEND	Indicates last op was a HSPSERV EXTEND during a write to a hiperspace. If EXTEND fails, stores abend code in __amrc__code__abend__syscode, reason code in __amrc__code__abend__rc.
__CICS_WRITEQ_TD	Sets __error with error code from EXEC CICS WRITEQ TD.
__LFS_OPEN	Sets __error with reason code from HFS services. Reason code from HFS services must be broken up. The low order 2 bytes can be looked up in *z/OS UNIX System Services Programming: Assembler Callable Services Reference*.
__LFS_CLOSE	Sets __error with reason code from HFS services. Reason code from HFS services must be broken up. The low order 2 bytes can be looked up in *z/OS UNIX System Services Programming: Assembler Callable Services Reference*.
__LFS_READ	Sets __error with reason code from HFS services. Reason code from HFS services must be broken up. The low order 2 bytes can be looked up in *z/OS UNIX System Services Programming: Assembler Callable Services Reference*.
__LFS_WRITE	Sets __error with reason code from HFS services. Reason code from HFS services must be broken up. The low order 2 bytes can be looked up in *z/OS UNIX System Services Programming: Assembler Callable Services Reference*.
__LFS_LSEEK	Sets __error with reason code from HFS services. Reason code from HFS services must be broken up. The low order 2 bytes can be looked up in *z/OS UNIX System Services Programming: Assembler Callable Services Reference*.
__LFS_FSTAT	Sets __error with reason code from HFS services. Reason code from HFS services must be broken up. The low order 2 bytes can be looked up in *z/OS UNIX System Services Programming: Assembler Callable Services Reference*.

Using file I/O tracing to debug C/C++ file I/O problems

You can use file I/O tracing to debug C/C++ file I/O problems. For more information, see Debugging I/O programs in *z/OS XL C/C++ Programming Guide*.

Displaying an error message with the perror() function

To find a failing routine, check the return code of all function calls. After you have found the failing routine, use the `perror()` function after the routine to display the error message. `perror()` displays the string that you pass to it and an error message corresponding to the value of `errno`. `perror()` writes to the standard error stream (`stderr`). By default, the errno2 value will be appended to the end of the perror() string.

If you do not want the errno2 value appended to the `perror()` string, set the _EDC_ADD_ERRNO2 environment variable to 0.

Figure 26 is an example of a routine using `perror()`.

```
#include <stdio.h>
int main(void){
   FILE *fp;

   fp = fopen("myfile.dat", "w");
   if (fp == NULL)
      perror("fopen error");
}
```

Figure 26. Example of a routine using perror()

Using __errno2() to diagnose application problems

Use the __errno2() function when diagnosing problems in an application program. This function enables z/OS XL C/C++ application programs to access additional diagnostic information, `errno2` (`errnojr`), associated with `errno`. The `__errno2` may be set by the z/OS XL C/C++ run-time library, z/OS UNIX callable services, or other callable services. The `errno2` is intended for diagnostic display purposes only and is not a programming interface.

Note: Not all functions set `errno2` when `errno` is set. In the cases where `errno2` is not set, the __errno2() function may return a residual value. You may use the __err2ad() function to clear `errno2` to reduce the possibility of a residual value being returned.

Figure 27 on page 175 is an example of a routine using `__errno2()` and Figure 28 on page 175 shows the sample output from that routine.

```
#pragma runopts(posix(on))
#define _EXT
#include <stdio.h>
#include <errno.h>

int main(void) {
  FILE *f;
  f = fopen("testfile.dat", "r")
  if (f==NULL) {
      perror("fopen() failed");
      printf("__errno2 = %08x\n", __errno2());
   }
   return 0;
}
```

Figure 27. Example of a routine using __errno2()

```
fopen() failed: EDC5129I No such file or directory. (errno2=0x05620062)
__errno2 = 05620062
```

Figure 28. Sample output of a routine using __errno2()

Figure 29 is an example of a routine using the environment variable _EDC_ADD_ERRNO2 and Figure 30 shows the sample output from that routine.

```
#pragma runopts(posix(on))
#define _EXT
#include <stdio.h>
#include <errno.h>
#include <stdlib.h>

int main(void) {
  FILE *fp;
  /* do NOT add errno2 to perror message */
  setenv("_EDC_ADD_ERRNO2", "0", 1);
  fp = fopen("testfile.dat", "r");
  if (fp == NULL)
      perror("fopen() failed");
  return 0;
}
```

Figure 29. Example of a routine using _EDC_ADD_ERRNO2

```
fopen() failed: EDC5129I No such file or directory.
```

Figure 30. Sample output of a routine using _EDC_ADD_ERRNO2

Figure 31 on page 176 is an example of a routine using __err2ad() in combination with __errno2() and Figure 32 on page 176 shows the sample output from that routine.

```
#pragma runopts(posix(on))
#define _EXT
#include <stdio.h>
#include <errno.h>
#include <stdlib.h>

int main(void) {
  FILE *f;
  setenv("_EDC_ADD_ERRNO2", "0", 1);
  f = fopen("testfile.dat", "r");
  if (f == NULL) {
    perror("fopen() failed");
    printf("__errno2 = %08x\n", __errno2());
  }
  /* reset errno2 to zero */
  *__err2ad() = 0x0;
  printf("__errno2 = %08x\n", __errno2());
  f = fopen(*testfile.dat", "r");

  if (fp == NULL) {
    perror("fopen() failed");
    printf(*__errno2 = %08x\n", __errno2());
  }
  return 0;
}
```

Figure 31. Example of a routine using __err2ad() in combination with __errno2()

```
fopen() failed: EDC5129I  No such file or directory.
__errno2 = 05620062
__errno2 = 00000000
fopen() failed: EDC5129I  No such file or directory.
__errno2 = 05620062
```

Figure 32. Sample output of routine using __err2ad() in combination with __errno2()

For more information about _EDC_ADD_ERRNO2, see *z/OS XL C/C++ Programming Guide*.

For more information about __errno2() and __err2ad(), see *z/OS XL C/C++ Run-Time Library Reference*.

Diagnosing DLL problems

Use the _EDC_DLL_DIAG environment variable to diagnose DLL problems. For more information, see *z/OS XL C/C++ Programming Guide*

You can also see the diagnosis output in CEEDUMP and Verbexit LEDATA reports. For more information, see “Using the DLL failure control block” on page 78.

Using C/C++ listings

For a detailed description of available listings, see *z/OS XL C/C++ User’s Guide*.

Finding variables

You can determine the value of a variable in the routine at the point of interrupt by using the compiled code listing as a guide to its address, then finding this address in the Language Environment dump. The method you use depends on the storage class of variable.

This method is generally used when no symbolic variables have been dumped (by using the TEST compiler option).

It is possible for the routine to be interrupted before the value of the variable is placed in the location provided for it. This can explain unexpected values in the dump.

Steps for finding automatic variables

Perform the following steps to find automatic variables in the Language Environment dump:

1. Identify the start of the stack frame. If a dump has been taken, each stack frame is dumped. The stack frames can be cross-referenced to the function name in the traceback.
2. Determine the value of the base register (in this example, GPR13) in the Saved Registers section for the function you are interested in.
3. Find the offset of the variable (which is given in decimal) in the storage offset listing.

   Example:

   ```
   aa1    85-0:85   Class = automatic, Offset = 164(r13),    Length = 40
   ```

4. Add this base address to the offset of the variable.

When you are done, the contents of the variable can be read in the DSA Frame section corresponding to the function the variable is contained in.

Locating the Writable Static Area (WSA)

The Writable Static Area (WSA) address is the base address of the writable static area which is available for all C and C++ programs except C programs compiled with the NORENT compiler option. If you have C code compiled with the RENT option or C++ code (hereafter called RENT code) you must determine the base address of the WSA if you want to calculate the address of a static or external variable. Use the following table to determine where to find the WSA base address:

Table 15. Finding the WSA base address

If you want the WSA base address for:	Locate the WSA base address in:
application code	the WSA address field in the Enclave Control Blocks section
a fetched module	the WSA address field of the Fetch() Information section for the fetch() function pointer for which you are interested
a DLL	the corresponding WSA address in the DLL Information section

Use the WSA base address to locate the WSA in the Enclave Storage section.

Steps for finding the static storage area

If you have C code compiled with the NORENT option (hereafter called `NORENT` code) you must determine the base address of the static storage area if you want to calculate the address of a static or external variable.

Perform the following steps to find the static storage area:

1. Name the static storage area CSECT by using the `pragma csect` directive. Once this is done, a CSECT is generated for the static storage area for each source file.
2. Determine the origin and length of the CSECT from the linker map.
3. Locate the external variables corresponding to the CSECT with the same name.
4. Determine the origin and length of the external variable CSECT from the linker map.

Notes:

1. Address calculation for static and external variables uses the static storage area as a base address with 1 or more offsets added to this address.
2. The storage associated with these CSECTs is not dumped when an exception occurs. It is dumped when `cdump` or CEE3DMP is called, but it is written to a separate ddname called CEESNAP. For information about `cdump`, CEE3DMP, and enabling the CEESNAP ddname, see “Generating a Language Environment dump of a C/C++ routine” on page 185.

Steps for finding RENT static variables

Before you begin: You need to know the WSA. To find this information, see “Locating the Writable Static Area (WSA)” on page 177. For this procedure’s example, assume that the address of writable static is X'02D66E40'.

Perform the following steps to find RENT static variables:

1. Find the offset of `@STATIC` (associated with the file where the static variable is located) in the Writable Static Map section of the prelinker map.

   Example:

```
=========================================================================
|                        Writable Static Map                            |
=========================================================================

  OFFSET    LENGTH  FILE ID  INPUT NAME

       0         1   00001   DFHC0011
       4         1   00001   DFHC0010
       8         2   00001   DFHDUMMY
       C         2   00001   DFHB0025
      10         2   00001   DFHB0024
      14         2   00001   DFHB0023
      18         2   00001   DFHB0022
      1C         2   00001   DFHB0021
      20         2   00001   DFHB0020
      24         2   00001   DFHEIB0
      28         4   00001   DFHEIPTR
      2C         4   00001   DFHCP011
      30         4   00001   DFHCP010
      34         4   00001   DFHBP025
      38         4   00001   DFHBP024
      3C         4   00001   DFHBP023
      40         4   00001   DFHBP022
      44         4   00001   DFHBP021
      48         4   00001   DFHBP020
      4C         4   00001   DFHEICB
      50         4   00001   DFHEID0
      54         4   00001   DFHLDVER
      58       278   00001   @STATIC
     720        30   00002   @STATIC
```

Figure 33. Writable static map produced by prelinker

In this Writable Static Map section of a prelinker map the offset is X'58'.

2. Add the offset to the WSA to get the base address of static variables.

   Example: X'02D66E40' + X'58' = X'2D66E98'

3. Find the offset of the static variable in the partial storage offset compiler listing.

   Example:

   ```
   sa0  66-0:66 Class = static, Location = WSA + @STATIC + 96, Length = 4
   ```

   The offset is 96 (X'60').

4. Add the offset of the static variable in the partial storage offset compiler listing (found in step 3) to the base address of static variables (calculated in step 2).

   Example: X'2D66E98' + X'60' = X'2D66EF8'

When you are done, you have the address of the value of the static variable in the Language Environment dump.

Figure 34 on page 180 shows the path to locate RENT C++ and C static variables by adding the address of writable static, the offset of @STATIC, and the variable offset.

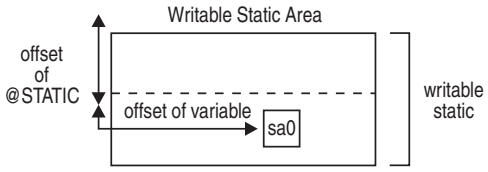


Figure 34. Location of RENT static variable in storage

Steps for finding external RENT variables

Before you begin: You need to know the WSA. To find this information see “Locating the Writable Static Area (WSA)” on page 177. For this procedure’s example, the address of writable static is X'02D66E40'.

Perform the following steps to find external RENT variables:

1. Find the offset of the external variable in the Prelinker Writable Static Map.

   Example:
   In this example, the offset for `DFHEIPTR` is X'28'.

```
================================================================================
|                          Writable Static Map                                 |
================================================================================

  OFFSET    LENGTH  FILE ID  INPUT NAME

       0         1   00001   DFHC0011
       4         1   00001   DFHC0010
       8         2   00001   DFHDUMMY
       C         2   00001   DFHB0025
      10         2   00001   DFHB0024
      14         2   00001   DFHB0023
      18         2   00001   DFHB0022
      1C         2   00001   DFHB0021
      20         2   00001   DFHB0020
      24         2   00001   DFHEIB0
      28         4   00001   DFHEIPTR
      2C         4   00001   DFHCP011
      30         4   00001   DFHCP010
      34         4   00001   DFHBP025
      38         4   00001   DFHBP024
      3C         4   00001   DFHBP023
      40         4   00001   DFHBP022
      44         4   00001   DFHBP021
      48         4   00001   DFHBP020
      4C         4   00001   DFHEICB
      50         4   00001   DFHEID0
      54         4   00001   DFHLDVER
      58       420   00001   @STATIC
```

Figure 35. Writable static map produced by prelinker

2. Add the offset of the external variable to the address of writable static.

   Example: X'02D66E40' + X'28' = X'2D66E68'

When you are done, you have the address of the value of the external variable in the Language Environment dump.

Steps for finding NORENT static variables

Before you begin: You need to know the name and address of the static storage area. To find this information see “Steps for finding the static storage area” on page 178. For this procedure’s example, the static storage area is called **STATSTOR** and has an address of X'02D66E40'.

Perform the following steps to find external RENT variables:

1. Find the offset of the static variable in the partial storage offset compiler listing.

   Example:

   ```
   sa0   66-0:66   Class = static,   Location = STATSTOR +96,   Length = 4
   ```

   The offset is 96 (X'60').
2. Add the offset to the base address of static variables.

   Example: X'2D66E40' + X'60' = X'2D66EA0'

When you are done, you have the address of the value of the static variable in the Language Environment dump.

Figure 36 shows how to locate NORENT C static variables by adding the Static Storage Area CSECT address to the variable offset.

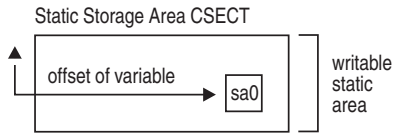


Figure 36. Location of NORENT static variable in storage

Steps for finding external NORENT variables

Before you begin: You need to find the address of the external variable CSECT. To find this information, see “Steps for finding the static storage area” on page 178. For this procedure’s example, the address of the external variable CSECT is X'02D66E40'.

The address of the external variable CSECT is the address of the value of the external variable in the Language Environment dump.

Steps for finding the C/370 parameter list

Perform the following steps to locate a parameter in the Language Environment dump:

1. Indentify the address of the start of the parameter list. A pointer to the parameter list is passed to the called function in register 1. This is the address of the start of the parameter list. Figure 37 on page 182 shows an example code for the parameter variable.

   Example:

```
func0() {
   :
 func1(a1,a2);
   :
}

func1(int ppx, int pp0) {
   :
}
```

Figure 37. Example code for parameter variable

Parameters *ppx* and *pp0* correspond to copies of *a1* and *a2* in the stack frame belonging to `func0`.

2. Use the address of the start of the parameter list to find the register and offset in the partial storage offset listing.

   Example:

   ```
   pp0     62-0:62    Class = parameter,   Location = 4(r1),    Length = 4
   ```

   The offset is 4 (X'4') from register 1.
3. Determine the value of `GPR1` in the Saved Registers section for the function that called the function you are interested in.
4. Add this base address to the offset of the parameter.

When you are done, the contents of the variable can then be read in the DSA frame section corresponding to the function the parameter was passed from.

Steps for finding the C++ parameter list

Before you begin: To locate C++ functions with `extern C` attributes, see "Steps for finding the C/370 parameter list" on page 181.

Perform the following steps to find the C++ parameter list:

1. Indentify the address of the start of the parameter list. A pointer to the parameter list is passed to the called function in register 1. This is the address of the start of the parameter list. Figure 38 shows an example code for the parameter variable.

   Example:

```
func0() {
   :
 func1(a1,a2);
   :
}

func1(int ppx, int pp0) {
   :
 }
```

Figure 38. Example code for parameter variable

Parameters *ppx* and *pp0* correspond to copies of *a1* and *a2* in the stack frame belonging to `func1`.

2. Locate the value of the base register in the Saved Registers section of the function you are interested in.
3. Find the offset of the static variable in the partial storage offset compiler listing.

   Example:

```
ppx    62-0:62    Class = parameter,    Location = 188(r13),    Length = 4
pp0    62-0:62    Class = parameter,    Location = 192(r13),    Length = 4
```

Figure 39. Partial storage offset listing

4. Add the value of the base register to the offset.
5. Locate the parameter.

Restriction: When OPTIMIZE is on, the parameter value might never be stored, since the first few parameters might be passed in registers and there might be no need to save them.

Steps for finding members of aggregates

You can define aggregates in any of the storage classes or pass them as parameters to a called function. The first step is to find the start of the aggregate. You can compute the start of the aggregate as described in previous sections, depending on the type of aggregate used.

The aggregate map provided for each declaration in a routine can further assist in finding the offset of a specific variable within an aggregate. Structure maps are generated using the AGGREGATE compiler option. Figure 40 shows an example of a static aggregate.

```
static struct {
    short int ss01;
    char      ss02[56];
    int       sz0[6];
    int       ss03;
} ss0;
```

Figure 40. Example code for structure variable

Figure 41 on page 184 shows an example aggregate map.

```
================================================================================
| Aggregate map for:  ss0                                                      |
================================================================================
|      Offset      |       Length      | Member Name                           |
|    Bytes(Bits)   |     Bytes(Bits)   |                                       |
====================================================================================
|       0          |         2         |  ss01                                 |
|       2          |        56         |  ss02[56]                             |
|      58          |         2         |  ***PADDING***                        |
|      60          |        24         |  sz0[6]                               |
|      84          |         4         |  ss03                                 |
================================================================================
```

Figure 41. Example of aggregate map

Assume the structure has been compiled as RENT. To find the value of variable *sz0[0]*:

1. Find the address of the writable static. For this example the address of writable static is X'02D66E40'.
2. Find the offset of @STATIC in the Writable Static Map. In this example, the offset is X'58'. Add this offset to the address of writable static. The result is X'2D66E98' (X'02D66E40' + X'58'). Figure 42 shows the Writable Static Map produced by the prelinker.

```
================================================================================
|                          Writable Static Map                                 |
================================================================================

  OFFSET    LENGTH  FILE ID  INPUT NAME

       0         1   00001   DFHC0011
       4         1   00001   DFHC0010
       8         2   00001   DFHDUMMY
       C         2   00001   DFHB0025
      10         2   00001   DFHB0024
      14         2   00001   DFHB0023
      18         2   00001   DFHB0022
      1C         2   00001   DFHB0021
      20         2   00001   DFHB0020
      24         2   00001   DFHEIB0
      28         4   00001   DFHEIPTR
      2C         4   00001   DFHCP011
      30         4   00001   DFHCP010
      34         4   00001   DFHBP025
      38         4   00001   DFHBP024
      3C         4   00001   DFHBP023
      40         4   00001   DFHBP022
      44         4   00001   DFHBP021
      48         4   00001   DFHBP020
      4C         4   00001   DFHEICB
      50         4   00001   DFHEID0
      54         4   00001   DFHLDVER
      58       320   00001   @STATIC
```

Figure 42. Writable static map produced by prelinker

3. Find the offset of the static variable in the storage offset listing. The offset is 96 (X'60'). Following is an example of a partial storage offset listing.

   ```
   ss0     66-0:66    Class = static,    Location = GPR13(96),    Length = 4
   ```

   Add this offset to the result from step 2. The result is X'2D66EF8' (X'2D66E98' + X'60'). This is the address of the value of the static variable in the dump.
4. Find the offset of sz0 in the Aggregate Map, shown in Figure 41 on page 184. The offset is 60.

Add the offset from the Aggregate Map to the address of the ss0 struct. The result is X'60' (X'3C' + X'60'). This is the address of the values of sz0 in the dump.

Finding the timestamp

The timestamp is in the compile unit block. The address for the compile unit block is located at eight bytes past the function entry point. The compile unit block is the same for all functions in the same compilation. The fourth word of the compile unit block points to the timestamp. The timestamp is 16 bytes long and has the following format:

```
YYYYMMDDHHMMSSSS
```

Generating a Language Environment dump of a C/C++ routine

You can use either the CEE3DMP callable service or the `cdump()`, `csnap()`, and `ctrace()` C/C++ functions to generate a Language Environment dump of C/C++ routines. These C/C++ functions call CEE3DMP with specific options.

cdump()

If your routine is running under z/OS or CICS, you can generate useful diagnostic information by using the `cdump()` function. `cdump()` produces a main storage dump with the activation stack. This is equivalent to calling CEE3DMP with the option string: TRACEBACK BLOCKS VARIABLES FILES STORAGE STACKFRAME(ALL) CONDITION ENTRY.

When `cdump()` is invoked from a user routine, the C/C++ library issues an OS SNAP macro to obtain a dump of virtual storage. The first invocation of `cdump()` results in a SNAP identifier of 0. For each successive invocation, the ID is increased by one to a maximum of 256, after which the ID is reset to 0.

The output of the dump is directed to the CEESNAP data set. The DD definition for CEESNAP is as follows:

```
 //CEESNAP DD SYSOUT= *
```

If the data set is not defined, or is not usable for any reason, `cdump()` returns a failure code of 1. This occurs even if the call to CEE3DMP is successful.

If the SNAP is not successful, the CEE3DMP DUMP file displays the following message:

```
Snap was
unsuccessful
```

If the SNAP is successful, CEE3DMP displays this message:

```
 Snap was
successful; snap ID = nnn
```

Where *nnn* corresponds to the SNAP identifier described above. An unsuccessful SNAP does not result in an incrementation of the identifier.

Because `cdump()` returns a code of 0 only if the SNAP was successful or 1 if it was unsuccessful, you cannot distinguish whether a failure of `cdump()` occurred in the call to CEE3DMP or SNAP. A return code of 0 is issued only if both SNAP and CEE3DMP are successful.

Support for SNAP dumps using the `_cdump` function is provided only under z/OS and z/VM®. SNAP dumps are not supported under CICS; no SNAP is produced in this environment. A successful SNAP results in a large quantity of output. A routine calling `cdump()` under CICS receives a return code of 0 if the ensuing call to CEE3DMP is successful. In addition to a SNAP dump, a Language Environment formatted dump is also taken.

csnap()

The `csnap()` function produces a condensed storage dump. `csnap()` is equivalent to calling CEE3DMP with the option string: TRACEBACK FILES BLOCKS VARIABLES NOSTORAGE STACKFRAME(ALL) CONDITION ENTRY.

To use these functions, you must add `#include <ctest.h>` to your C/C++ code. The dump is directed to output *dumpname* , which is specified in a `//CEEDUMP DD` statement in MVS/JCL.

`cdump()`, `csnap()`, and `ctrace()` all return a 1 code in the SPC environment because they are not supported in SPC.

See the *z/OS XL C/C++ Run-Time Library Reference* for more details about the syntax of these functions.

ctrace()

The `ctrace()` function produces a traceback and includes the offset addresses from which the calls were made. `ctrace()` is equivalent to calling CEE3DMP with the option string: TRACEBACK NOFILES NOBLOCKS NOVARIABLES NOSTORAGE STACKFRAME(ALL) NOCONDITION NOENTRY.

Sample C routine that calls cdump()

Figure 43 on page 187 shows a sample C routine that uses the `cdump` function to generate a dump.

Figure 48 on page 191 shows the dump output.

```
#include <stdio.h>
#include <signal.h>
#include <stdlib.h>

void hsigfpe(int);
void hsigterm(int);
void atf1(void);

typedef int (*FuncPtr_T)(void);

int st1    =  99;
int st2    = 255;
int xcount =   0;

int main(void) {
  /*
   * 1) Open multiple files
   * 2) Register 2 signals
   * 3) Register 1 atexit function
   * 4) Fetch and execute a module
   */

  FuncPtr_T fetchPtr;
  FILE*     fp1;
  FILE*     fp2;
  int       rc;
  fp1 = fopen("myfile.data", "w");
  if (!fp1) {
    perror("Could not open myfile.data for write");
    exit(101);
  }

  fprintf(fp1, "record 1\n");
  fprintf(fp1, "record 2\n");
  fprintf(fp1, "record 3\n");

  fp2 = fopen("memory.data", "wb,type=memory");
  if (!fp2) {
    perror("Could not open memory.data for write");
    exit(102);
  }
  fprintf(fp2, "some data");
  fprintf(fp2, "some more data");
  fprintf(fp2, "even more data");

  signal(SIGFPE , hsigfpe);
  signal(SIGTERM, hsigterm);

  rc = atexit(atf1);
  if (rc) {
    fprintf(stderr, "Failed on registration of atexit function atf1\n");
    exit(103);
  }
```

Figure 43. Example C routine using cdump() to generate a dump (Part 1 of 2)

```
  fetchPtr = (FuncPtr_T) fetch("MODULE1");
  if (!fetchPtr) {
    fprintf(stderr, "Failed to fetch MODULE1\n");
    exit(104);
  }
  fetchPtr();
  return(0);
}

void hsigfpe(int sig) {
  ++st1;
  return;
}

void hsigterm(int sig) {
  ++st2;
  return;
}

void atf1() {
  ++xcount;
}
```

Figure 43. Example C routine using cdump() to generate a dump (Part 2 of 2)

Figure 44 shows a fetched C module:

```
#include <ctest.h>

#pragma linkage(func1, fetchable)
int func1(void) {
  cdump("This is a sample dump");
  return(0);
}
```

Figure 44. Fetched module for C routine

Sample C++ routine that generates a Language Environment dump

Figure 45 on page 189 shows a sample C++ routine that uses a protection exception to generate a dump.

```
#include <iostream.h>
#include <ctest.h>
#include "stack.h"

int main() {
  cout << "Program starting:\n";
  cerr << "Error report:\n";

  Stack<int> x;
  x.push(1);
  cout << "Top value on stack : " << x.pop() << '\n';
  cout << "Next value on stack: " << x.pop() << '\n';
  return(0);
}
```

Figure 45. Example C++ routine with protection exception generating a dump

Figure 46 shows the template file stack.c

```
#ifndef __STACK__
  #include "stack.h"
#endif

template <class T> T Stack<T>::pop() {
  T value = head->value;
  head = head->next;

  return(value);
}
template <class T> void Stack<T>::push(T value) {
  Node* newNode  = new Node;
  newNode->value = value;
  newNode->next  = head;
  head = newNode;
}
```

Figure 46. Template file STACK.C

Figure 47 on page 190 shows the header file **stack.h**.

```
#ifndef __STACK_
  #define __STACK__
  template <class T> class Stack {
    public:
      Stack() {
        char* badPtr = 0; badPtr -= (0x01010101);
        head = (Node*) badPtr; /* head initialized to 0xFEFEFEFF */
      }
      T pop();
      void push(T);
    private:
      struct Node {
        T value;
        struct Node* next;
      }* head;
  };
#endif
```

Figure 47. Header file STACK.H

Sample Language Environment dump with C/C++-specific information

This sample dump was produced by compiling the routine in Figure 43 on page 187 with the TEST(SYM) compiler option, then running it. Notice the sequence of calls in the traceback section - EDCZMINV is the C-C++ management module that invokes `main` and @@FECBMODULE1 fetches the user-defined function `func1`, which in turn calls the library routine `__cdump`.

If source code is compiled with the `GONUMBER` or `TEST` compile option, statement numbers are shown in the traceback. If source code is compiled with the `TEST(SYM)` compile option, variables and their associated type and value are dumped out. For more information about C/C++-specific information contained in a dump, see “Finding C/C++ information in a Language Environment dump” on page 196.

```
     CEE3DMP V1 R9.0: This is a sample dump                                    01/10/07 1:12:11 PM                Page:    1
ASID: 0041   Job ID: JOB12852   Job name: CSAMPLE    Step name: STEP1      UserID: HEALY

CEE3845I CEEDUMP Processing started.
CEE3DMP called by program unit  (entry point __cdump) at offset +0000017C.

Snap was unsuccessful

Registers on Entry to CEE3DMP:

  PM....... 0100
  GPR0..... 20E56AF4  GPR1..... 20FCB5A0  GPR2..... 00000001  GPR3..... 20E56752
  GPR4..... A0FCB5B8  GPR5..... 20FCB5C4  GPR6..... 00000014  GPR7..... 20902760
  GPR8..... 00000030  GPR9..... 20FC7038  GPR10.... A0900310  GPR11.... A0900310
  GPR12.... 209139B0  GPR13.... 20FCB508  GPR14.... A0E56896  GPR15.... A09F0898
  FPR0..... 26100000  00000000            FPR2..... 18000000  00000000
  FPR4..... 00000000  00000000            FPR6..... 00000000  00000000
:
  Information for enclave main

  Information for thread 8000000000000000

  Registers on Entry to CEE3DMP:
    PM....... 0100
    GPR0..... 20E56AF4  GPR1..... 20FCB5A0  GPR2..... 00000001  GPR3..... 20E56752
    GPR4..... A0FCB5B8  GPR5..... 20FCB5C4  GPR6..... 00000014  GPR7..... 20902760
    GPR8..... 00000030  GPR9..... 20FC7038  GPR10.... A0900310  GPR11.... A0900310
    GPR12.... 209139B0  GPR13.... 20FCB508  GPR14.... A0E56896  GPR15.... A09F0898
    FPR0..... 26100000  00000000            FPR2..... 18000000  00000000
    FPR4..... 00000000  00000000            FPR6..... 00000000  00000000
:
  Traceback:
    DSA   Entry       E  Offset  Statement   Load Mod             Program Unit                  Service  Status
    1     __cdump     +0000017C               CEEEV003                                           D1908:e  Call
    2     func1       +0000006E  5            MODULE1              MODULE1                                 Call
    3     @@FECBMODULE1
                      -002BD99E                                                                          Call
    4     @@GETFN     +000000C2               CEEEV003                                                   Call
    5     main        +00000392  64           CSAMPLE              CSAMPLE                               Call
    6     EDCZMINV    +000000C2               CEEEV003                                                   Call
    7     CEEBBEXT    +000001B6               CEEPLPKA             CEEBBEXT                      D1908    Call

    DSA   DSA Addr   E  Addr    PU Addr    PU Offset  Comp Date  Compile Attributes
    1     20FCB508   20E56718   20E56718   +0000017C  20061215   LIBRARY   EBCDIC  HFP
    2     20FCB468   20900310   20900310   +0000006E  19970314   C/C++
    3     20FCB378   20FEBF90   20FEBF90   -002BD99E             LIBRARY
    4     20FCB2C0   20C0E3C0   20C0E468   +0000001A  12/15/06   LIBRARY
    5     20FCB208   20901078   20901078   +00000392  19970314   C/C++
    6     20FCB0F0   20E699EE   20E699EE   +000000C2  20061215   LIBRARY
    7     20FCB030   20992208   20992208   +000001B6  20061215   CEL

    Fully Qualified Names
    DSA   Entry       Program Unit                                    Load Module
    2     func1       POSIX.CRTL.C(MODULE1)                           MODULE1
    5     main        POSIX.CRTL.C(CSAMPLE)                           CSAMPLE

      Parameters, Registers, and Variables for Active Routines:
:
    main (DSA address 20FCB208):
      UPSTACK DSA
      Saved Registers:
        GPR0..... 20FEBE30  GPR1..... A0D2FE64  GPR2..... A0E69AB0  GPR3..... A09010C6
        GPR4..... A09922EC  GPR5..... 20FC7098  GPR6..... 20FEBE30  GPR7..... 20902760
        GPR8..... 00000030  GPR9..... 80000000  GPR10.... A0E699E2  GPR11.... A0992208
        GPR12.... 209139B0  GPR13.... 20FCB208  GPR14.... A090140C  GPR15.... 20C0E3C0
:
      Local Variables:
        fetchPtr        signed int (*) (void)
                                        0x20FEBE30
        fp2             struct __ffile *   0x20FF5AFC
        fp1             struct __ffile *   0x20FF4024
        rc              signed int                  0
:
```

Figure 48. Example dump from sample C routine (Part 1 of 6)

```
  Control Blocks for Active Routines:
⋮
    DSA for func1: 20FCB468
      +000000  FLAGS.... 1000      member... 0000      BKC...... 20FCB378  FWC...... D4D6C4E4  R14...... A0900380
      +000010  R15...... 20E56718  R0....... 20FCB508  R1....... 20FCB500  R2....... A0D2E5F2  R3....... A090035E
      +000024  R4....... A09922EC  R5....... 20FEBF70  R6....... 20FEBE30  R7....... 20902760  R8....... 00000030
      +000038  R9....... 20FC7038  R10...... A0900310  R11...... A0900310  R12...... 209139B0  reserved. 00000000
      +00004C  NAB...... 20FCB508  PNAB..... A099DD88  reserved. 20FCB378  20900B08
      +000064  reserved. 20900990  reserved. 00000000  MODE..... 20FCB390  reserved. 00000000
      +000078  reserved. 20991D52  reserved. A0915770
⋮
  [1]Storage for Active Routines:
⋮
    DSA frame: 20FCB468
      +000000 20FCB468  10000000 20FCB378 D4D6C4E4 A0900380  20E56718 20FCB508 20FCB500 A0D2E5F2  |........MODU.....V...........KV2|
      +000020 20FCB488  A090035E A09922EC 20FEBF70 20FEBE30  20902760 00000030 20FC7038 A0900310  |...;.r.............-............|
      +000040 20FCB4A8  A0900310 209139B0 00000000 20FCB508  A099DD88 20FCB378 20FCB534 20900B08  |.....j...........r.h............|
      +000060 20FCB4C8  20FCB378 20900990 00000000 20FCB390  00000000 00000000 20991D52 A0915770  |.........................r...j..|
      +000080 20FCB4E8  A0991A28 209139B0 00000000 20FCB5A0  20C4D1F2 00000400 20FEBF70 00000009  |.r...j...........DJ2............|
⋮
  [2]Control Blocks Associated with the Thread:
    CAA: 209139B0
      +000000 209139B0  00000800 00000000 20FCB018 20FEB018  00000000 00000000 00000000 00000000  |................................|
      +000020 209139D0  00000000 00000000 20910A58 00000000  00000000 00000000 00000000 00000000  |.........j......................|
      +000040 209139F0  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
      +000060 20913A10  00000000 00000000 00000000 00000000  00000000 80014608 00000000 00000000  |................................|
      +000080 20913A30  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
⋮

    [2A]C-C++ CAA information :
    C-C++ Specific CTHD......... 2090E858
    C-C++ Specific CEDB......... 2090F8D8

    C-C++ Specific Thread block: 2090E858
      +000000 2090E858  C3E3C8C4 00000380 2090E858 00000000  20D15090 00000000 00000000 00000000  |CTHD......Y......J&.............|
      +000020 2090E878  00000000 00000000 00000000 000000C4  2090EDE0 00000000 00000000 00000000  |...............D................|
      +000040 2090E898  00000000 00000000 00000000 2090E728  2090E830 00000000 00000000 00000001  |..............X...Y.............|
      +000060 2090E8B8  00000001 00000000 00000000 00000000  00000000 00000000 20FEBF50 20FEBF4C  |.........................&...<|
      +000080 2090E8D8  20FEBF48 20FEBF44 20FEBF38 20FEBF3C  20FEBF58 00000000 00000000 00000000  |................................|
⋮
      +000320 2090EB78  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
      +000340 2090EB98 - +00037F 2090EBD7             same as above
    C-C++ Specific EDB block: 2090F8D8
      +000000 2090F8D8  C3C5C4C2 000007C0 2090F8D8 20902B40  00030000 20911210 20911560 20901078  |CEDB......8Q... .....j...j.-....|
      +000020 2090F8F8  00000080 20900FD8 00000000 00000000  00000000 209100A0 20D164F0 20D15A18  |.......Q.............j...J.0.J!.|
      +000040 2090F918  20FEBF90 2090F9B0 2090F9C4 20FC71B8  2090F6BC 2090F28C 2090F4A4 20D1B242  |......9...9D......6...2...4u.J..|
      +000060 2090F938  00004650 20910130 40400000 00000000  00100000 00000000 00000000 00000000  |...&.j..  ......................|
      +000080 2090F958  7FFFFFFF FFFFFFFF 71FFFFFF FFFFFFFF  3C100000 00000000 34100000 00000000  |"...............................|
⋮
      +000780 20910058  00000000 00000000 00000000 0001D100  00002E80 00000000 00000000 00000000  |..............J.................|
      +0007A0 20910078  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
```

Figure 48. Example dump from sample C routine (Part 2 of 6)

```
   [2B]errno value................. 0
   memory file block chain..... 20FF5D18
   open FCB chain.............. 20FF5B10
   GTAB table.................. 2090EBE0

   [3]signal information :
   SIGFPE   :
   function pointer... 20901D20    WSA address... A0FC7038     function name... hsigfpe

   SIGTERM  :
   function pointer... 20901E90    WSA address... A0FC7038     function name... hsigterm

 Enclave variables:
   *.*.C(CSAMPLE):>hsigterm
                   void ()            0x20901E90
   *.*.C(CSAMPLE):>hsigfpe
                   void ()            0x20901D20
   *.*.C(CSAMPLE):>xcount
                   signed int                  0
   *.*.C(CSAMPLE):>main
                   signed int (void)
                                      0x20901078
   *.*.C(CSAMPLE):>atf1
                   void (void)        0x20901FF8
   *.*.C(CSAMPLE):>st2
                   signed int                255
   *.*.C(CSAMPLE):>st1
                   signed int                 99
   *.*.C(MODULE1):>func1
                   signed int (void)
                                      0x20900310

 Enclave Control Blocks:
   EDB: 20912648
     +000000 20912648  C3C5C5C5 C4C24040 C0000001 20913870  20912D50 00000000 00000000 00000000  |CEEEDB  .....j...j.&............|
     +000020 20912668  20912B58 20912B88 A0915770 20912198  00000000 00000000 20912768 00000000  |.j...j.h.j...j.q.........j......|
     +000040 20912688  00000000 00000000 00006F58 00000000  00000000 A0A33B58 2090A880 20FEBF60  |..........?..........t....y....-|
     +000060 209126A8  0000F460 00000000 20911E58 00000000  20914550 00000000 20AF4660 209139B0  |..4-.....j.......j.&.......-.j..|
     +000080 209126C8  50000000 0000FAF6 00000000 00000000  00000001 00000000 00006FF0 0O8FF4E8  |&......6.................?0..4Y|
     +0000A0 209126E8  00000001 00000100 2090A988 209126F0  00000000 00000000 00000000 00000001  |..........zh.j.0.................|
   MEML: 20913870
     +000000 20913870  00000000 00000000 209945B0 00000000  00000000 00000000 209945B0 00000000  |.........r..............r.......|
     +000020 20913890  00000000 00000000 209945B0 00000000  2090F8D8 00000000 A0B07F78 00000000  |.........r........8Q......".....|
     +000040 209138B0  00000000 00000000 209945B0 00000000  00000000 00000000 209945B0 00000000  |.........r..............r.......|
     +000060 209138D0 - +00011F 2091398F             same as above

   [4]WSA address.................20FC7038

   [5]atexit information :
   function pointer... A0901FF8    WSA address... 20FC7038     function name... atf1

   [6]fetch information :
   fetch pointer     : 20FEBF90
   function pointer... A0900310    WSA address... 20FEBF18

 Enclave Storage:
   Initial (User) Heap                                        : 20FEB018
     +000000 20FEB018  C8C1D5C3 20912B28 20912B28 00000000  A0FEB018 20FEC070 00008000 00006FA8  |HANC.j...j.....................?y|
     +000020 20FEB038  20FEB018 00000120 20FEB160 20FEB348  20FEB385 20FEB3C2 20FEB3FF 20FEB43C  |...........-.......e...B........|
     +000040 20FEB058  20FEB479 20FEB4B6 20FEB4F3 20FEB900  20FEB93D 00000000 00000000 00000000  |...........3....................|
:
     +001080 20FEC098  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
     +0010A0 20FEC0B8 - +007FFF 20FF3017             same as above
   LE/370 Anywhere Heap                                       : 20FC7000
     +000000 20FC7000  C8C1D5C3 21007000 20912B58 20912B58  A0FC7000 20FCAE60 00004000 000001A0  |HANC.....j...j.........-.. .....|
     +000020 20FC7020  20FC7000 00000190 00000000 00000000  00000000 00000000 00000000 2090F4A4  |.............................4u|
     +000040 20FC7040  2090F28C 2090F6BC 00000000 00000000  00000000 00000000 00000000 00000000  |..2...6.........................|
:
     +003F40 20FCAF40  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
     +003F60 20FCAF60 - +003FFF 20FCAFFF             same as above
   LE/370 Anywhere Heap                                       : 21007000
     +000000 21007000  C8C1D5C3 20912B58 20FC7000 20912B58  21007000 00000000 00004A50 00000000  |HANC.j.......j.............&....|
     +000020 21007020  21007000 00004A30 01000080 F2404040  404086A4 9583F140 40404040 4040D7D6  |............2     func1       PO|
     +000040 21007040  E2C9E74B C3D9E3D3 4BC34DD4 D6C4E4D3  C5F15D40 40404040 40404040 40404040  |SIX.CRTL.C(MODULE1)             |
:
     +000240 21007240  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
     +000260 21007260 - +004A5F 2100BA5F             same as above
```

Figure 48. Example dump from sample C routine (Part 3 of 6)

```
   Additional Heap, heapid = 20FCAE2C                    : 2100C000
  +000000 2100C000  C8C1D5C3 20FCAE2C 20FCAE2C 20FCAE2C  2100C000 2100C3D0 000003E8 00000018  |HANC.................C....Y....|
  +000020 2100C020  2100C000 00000050 00000000 209003AC  20900310 2100C098 20FEBF90 46F11000  |.......&.............q.....1..|
  +000040 2100C040  00000003 20900580 00020000 2100C078  00000000 20900310 20900310 00000000  |.............................|
⋮
  +0003C0 2100C3C0  00000000 209014F8 20901C78 00000000  00000000 00000000 00000000 00000000  |.......8....................|
  +0003E0 2100C3E0  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |.............................|

 [7]File Status and Attributes:
File Control Block: 20FF5B10
  +000000 20FF5B10  20FF5F0D 00000000 000003DB 20FF5BE0  20FF5C00 10000000 20FF5CCC 00000011  |..^...........$...*.......*.....|
  +000020 20FF5B30  00000044 00000000 00000000 20FF4038  00000000 20FF5B10 00000000 00000000  |.............. .......$.........|
  +000040 20FF5B50  00000000 FFFFFFFF 00080055 20FF5C44  20FF5C44 20CCCDA0 20CCCB90 20CCC7B0  |.............*...*...........G.|
  +000060 20FF5B70  20CCC558 20C41548 00000000 00000400  00000400 00000000 00000000 00000400  |..E..D.........................|
  +000080 20FF5B90  20FF5EE8 20FF5EE8 00000000 00000000  00000000 00000000 00000000 00000000  |..;Y..;Y.......................|
  +0000A0 20FF5BB0  00000000 00000000 00000000 00000000  20C3C4C8 00000000 00000000 00000000  |.................CDH............|
  +0000C0 20FF5BD0  43020008 40001100 00000000 2090DE68  58FF0008 07FF0000 20C3C830 00000000  |.... ...................CH.....|
  +0000E0 20FF5BF0  00000000 00000000 00000000 00000000  58FF0008 07FF0000 20CCEF00 00000000  |.............................|
  +000100 20FF5C10  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |.............................|
  +000120 20FF5C30  00000000 00000000 00000000 00000000  00000000 D4C5D4D6 20FF5D18 20FF5D8C  |....................MEMO..)...).|

fldata FOR FILE:   HEALY.MEMORY.DATA
__recfmF:1........ 1
__recfmV:1........ 0
__recfmU:1........ 0
__recfmS:1........ 0
__recfmBlk:1...... 0
__recfmASA:1...... 0
__recfmM:1........ 0
__recfmPO:1....... 0
__dsorgPDSmem:1... 0
__dsorgPDSdir:1... 0
__dsorgPS:1....... 0
__dsorgConcat:1... 0
__dsorgMem:1...... 1
__dsorgHiper:1.... 0
__dsorgTemp:1..... 0
__dsorgVSAM:1..... 0
__dsorgHFS:1...... 0
__openmode:2...... 1
__modeflag:4...... 2
__dsorgPDSE:1..... 0
__reserve2:4...... 0
__device.......... 8
__blksize......... 1024
__maxreclen....... 1024
__access_method... 0(0)
__noseek_to_seek.. 0(0)
__dsname.......... HEALY.MEMORY.DATA

FILE pointer........ 20FF5AFC

Buffer at current file position: 20FF5EE8
  +000000 20FF5EE8  A2969485 408481A3 81A29694 85409496  99854084 81A38185 A5859540 94969985  |some datasome more dataeven more|
  +000020 20FF5F08  408481A3 81000000 00000000 00000000  00000000 00000000 00000000 00000000  | data............................|
  +000040 20FF5F28  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |.............................|
  +000060 20FF5F48 - +0003FF 20FF62E7             same as above
Saved Buffer........ NULL

File Control Block: 20FF4038
  +000000 20FF4038  20FF4314 00000000 00000400 20FF4108  20FF4128 90000000 20FF41F4 00000011  |.........................4....|
  +000020 20FF4058  00000044 00000000 00000000 2090E100  20FF5B10 20FF4038 00000000 E2E8E2F0  |.................$... .....SYS0|
  +000040 20FF4078  F0F0F0F1 FFFFFFFF 0000003C 20FF416C  20FF416C 20CB4490 20CB7A58 20CB1240  |0001...........%...%......:....  |
  +000060 20FF4098  20CB3928 20CB0270 00000000 00000404  00001800 20FF5AEA 00000000 00001801  |.....................!.........|
  +000080 20FF40B8  20FF42E8 20FF4314 20FF4314 00000000  00000000 00000000 00000000 00000000  |...Y...........................|
  +0000A0 20FF40D8  0000001B 00000000 00000000 00000000  20C3C4C8 00000000 00000000 00000000  |.................CDH............|
  +0000C0 20FF40F8  43120020 28440100 00000000 2090DE68  58FF0008 07FF0000 20C3C830 00000000  |.........................CH.....|
  +0000E0 20FF4118  00000000 00000000 00000000 00000000  58FF0008 07FF0000 20CB8278 00000000  |.........................b.....|
  +000100 20FF4138  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |.............................|
  +000120 20FF4158  00000000 00000000 00000000 00000000  00000000 D6E2E5C6 20C3C830 20CB8278  |....................OSVF.CH...b.|
```

Figure 48. Example dump from sample C routine (Part 4 of 6)

```
  fldata FOR FILE:   'HEALY.MYFILE.DATA'
    __recfmF:1........ 0
    __recfmV:1........ 1
    __recfmU:1........ 0
    __recfmS:1........ 0
    __recfmBlk:1...... 1
    __recfmASA:1...... 0
    __recfmM:1........ 0
    __recfmPO:1....... 0
    __dsorgPDSmem:1... 0
    __dsorgPDSdir:1... 0
    __dsorgPS:1....... 1
    __dsorgConcat:1... 0
    __dsorgMem:1...... 0
    __dsorgHiper:1.... 0
    __dsorgTemp:1..... 0
    __dsorgVSAM:1..... 0
    __dsorgHFS:1...... 0
    __openmode:2...... 0
    __modeflag:4...... 2
    __dsorgPDSE:1..... 0
    __reserve2:4...... 0
    __device.......... 0
    __blksize......... 6144
    __maxreclen....... 1024
    __access_method... 1(1)
    __noseek_to_seek.. 0(0)
    __dsname.......... HEALY.MYFILE.DATA

    FILE pointer........ 20FF4024
    ddname.............. SYS00001
Buffer at current file position: 20FF42E8
      +000000 20FF42E8  00280000 000C0000 99858396 998440F1  000C0000 99858396 998440F2 000C0000  |........record 1....record 2....|
      +000020 20FF4308  99858396 998440F3 00040000 00000000  00000000 00000000 00000000 00000000  |record 3........................|
      +000040 20FF4328  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
      +000060 20FF4348 - +0003FF 20FF46E7             same as above
    Saved Buffer........ NULL

    Write Data Control Block: 00015020
      +000000 00015020  20FF42A8 00000000 000B0003 00E02026  002FE5A2 00000001 00004000 00006D40  |...y.............Vs...... ..._ |
      +000020 00015040  86000000 500157D0 00CC2424 008CED84  12B745B8 00B7E220 0A000000 00001800  |f...&.........d......S.........|
      +000040 00015060  30013030 00006DB0 01C45470 00C45470  00000404 00C45A08 90ECD00C 18BF58A0  |......_..D...D.......D!.........|
    read/update DCB..... NULL

    Write Data Control Block Extension: 20FF42A8
      +000000 20FF42A8  C4C3C2C5 00380000 00015020 00000000  C0880000 00000000 00000000 00000000  |DCBE......&......h..............|
      +000020 20FF42C8  00000000 00000000 20B74AB2 20B74A54  00000000 00000100 80001810 20FF4000  |............................. .|
    read/update DCBE.... NULL

    Job File Control Block: 000157E8
      +000000 000157E8  C8C5C1D3 E84BD4E8 C6C9D3C5 4BC4C1E3  C1404040 40404040 40404040 40404040  |HEALY.MYFILE.DATA              |
      +000020 00015808  40404040 40404040 40404040 40404040  40404040 80000000 00000000 00000000  |                        ............|
      +000040 00015828  00000200 00000000 00000000 00000000  6B000A00 00000040 00000000 00000000  |................,...... ........|
      +000060 00015848  00000000 00000000 00000000 00000000  00000000 0001E2D3 F8C2F1F3 40404040  |......................SL8B13    |
      +000080 00015868  40404040 40404040 40404040 40404040  40404040 000003AF 00000000 00000000  |                        ............|
      +0000A0 00015888  00000000 00000000 00000000 00000100  80000038 00015000 000158A0 20FF42E8  |......................&........Y|
```

Figure 48. Example dump from sample C routine (Part 5 of 6)

```
       [8]__amrc_type structure: 20FCDAB8
      +000000 20FCDAB8  00000000 00000000 00000007 00000000  00000000 00000000 00000000 00000000  |................................|
      +000020 20FCDAD8  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
      +000040 20FCDAF8 - +0000FF 20FCDBB7             same as above
    amrc __code union fields
    __error................. 0(0)
    __abend.__syscode....... 0(0)
    __abend.__rc............ 0(0)
    __feedback.rc........... 0(0)
    __feedback.__ftncd...... 0(0)
    __feedback.__fdbk....... 0(0)
    __alloc.__svc99_info.... 0(0)
    __alloc.__svc99_error... 0(0)

    __RBA.............. 0(0)
    __last_op.......... 7(7)
    __msg.__str........ NULL
    __msg.__parmr0..... 0(0)
    __msg.__parmr1..... 0(0)
    __msg.__str2....... NULL
    __rplfdbwd.............. 0x00000000
    __amrc_noseek_to_seek... 0(0)
    __XRBA.................. 0(0000000000000000)
    __amrc2_type structure: 20FCD9B8
      +000000 20FCD9B8  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
    __error2............ 0(0)
    __fileptr........... NULL

Process Control Blocks:

  PCB: 20912198
    +000000 20912198  C3C5C5D7 C3C24040 03030288 00000000  00000000 00000000 209123D0 A0AF74D0  |CEEPCB  ...h.............j......|
    +000020 209121B8  A0AEDB50 A0AF4A08 A0AF4528 20908AE8  20911F68 00000000 00000000 20912648  |...&...........Y.j...........j..|
    +000040 209121D8  A0AF4858 7F800000 00000000 000141D4  00000000 80000000 00000000 00000000  |....".........M.................|

  MEML: 209123D0
    +000000 209123D0  00000000 00000000 209945B0 00000000  00000000 00000000 209945B0 00000000  |.........r..............r......|
    +000020 209123F0  00000000 00000000 209945B0 00000000  2090DE68 00000000 A0B07F78 20FC7000  |.........r..............."......|
    +000040 20912410  00000000 00000000 209945B0 00000000  00000000 00000000 209945B0 00000000  |.........r..............r......|
    +000060 20912430 - +00011F 209124EF             same as above

Additional Language Specific Information:

  [9]errno information :
  Thread Id .... 8000000000000000 Errno ...... 0 Errnojr .... 00000000
CEE3846I CEEDUMP Processing completed.
```

Figure 48. Example dump from sample C routine (Part 6 of 6)

Finding C/C++ information in a Language Environment dump

When a Language Environment traceback or dump is generated for a C/C++ routine, information is provided that is unique to C/C++ routines. C/C++-specific information includes:

- Control block information for active routines
- Condition information for active routines
- Enclave level data

Each of the unique C/C++ sections of the Language Environment dump are described.

[1] Storage for Active Routines

The Storage for Active Routines section of the dump shows the DSAs for the active C and C++ routines. To relate a DSA frame to a particular function name, use the address associated with the frame to find the corresponding DSA. In this example, the function `func1` DSA address is X'20FCB468'.

[2] Control Blocks Associated with the Active Thread

In the Control Blocks Associated with the Thread section of the dump, the following information appears:
- Fields from the CAA
- Fields specific from the CTHD and CEDB
- Signal information

[2A] C/C++ CAA Fields

The CAA contains several fields that the C/C++ programmer can use to find information about the run-time environment. For each C/C++ program, there is a C-C++ Specific Thread area and a C-C++ Specific Enclave area.

[2B] C-C++ Specific CAA

The C-C++ specific CAA fields that are of interest to users are described below.

errno value	A variable used to display error information. Its value can be set to a positive number that corresponds to an error message. The functions `perror()` and `strerror()` print the error message that corresponds to the value of `errno`.
Memory file control block	You can use the memory file control block (MFCB) to locate additional information about memory files. This control block resides at the C/C++ thread level. For more information about the MFCB, see 198.
Open FCB chain	A pointer to the start of a linked list of open file control blocks (FCBs). For more information about FCBs, see 198.

[3] Signal Information

When the POSIX(OFF) run-time option is specified, signal information is provided in the dump to aid you in debugging. For each signal that is disabled with `SIG_IGN`, an entry value of 00000001 is made in the first field of the Signal Information field for the specified signal name.

For each signal that has a handler registered, the signal name and the handler name are listed. If the handler is a fetched C function, the value `@@FECB` is entered as the function name and the address of the fetched pointer is in the first field.

If you compile a C routine as `NORENT`, the WSA address is not available (`N/A`). For more information about the `signal` function, see *z/OS XL C/C++ Programming Guide*.

[4] WSA Address

The `WSA Address` is the base address of the writable static area which is available for all C and C++ programs except C programs compiled with the `NORENT` compile option.

[5] atexit() Information

The `atexit()` information lists the functions registered with the `atexit()` function that would be run at normal termination. The functions are listed in chronological order of registration.

If you compile a C routine as NORENT, the WSA address is not available (N/A). For more information about the atexit() function, see *z/OS XL C/C++ Run-Time Library Reference*.

[6] fetch() Information

The fetch() information shows information about modules that you have dynamically loaded using fetch(). For each module that was fetched, the fetch() pointer and the function pointer are included.

```
ptr1 = fetch("MOD");
```

If you compile a C routine as NORENT, the WSA address is not available (N/A). For more information about the fetch() function, see *z/OS XL C/C++ Programming Guide*.

[7] File Control Block Information

This section of the dump includes the file control block (FCB) information for each C/C++ file. The FCB contains file status and attributes for files open during C/C++ active routines. You can use this information to find the data set or file name.

The FCB is a handle that points to the following file information, which is displayed when applicable, for the file:

- Access method control block (ACB) address
- Data control block (DCB) address
- Data control block extension (DCBE) address
- Job file control block (JFCB) address
- RPL address
- Current buffer address
- Saved buffer address
- ddname

Not all FCB fields are always filled in. For example, RPLs are used only for VSAM data sets. The ddname field contains blanks if it is not used.

The save block buffer represents auxiliary buffers that are used to save the contents of the main buffers. Such saving occurs only when a reposition is performed and there is new data; for example, an incomplete text record or an incomplete fixed-block standard (FBS) block in the buffers that cannot be flushed out of the system.

Because the main buffers represent the current position in the file, while the save buffers merely indicate a save has occurred, check the save buffers only if data appears to be missing from the external device and is not found in the main buffers. Also, do not infer that the presence of save buffers means that data present there belongs at the end of the file. (The buffers remain, even when the data is eventually written.)

For information about the job file control block, see *z/OS MVS Data Areas, Vol 3 (IVT-RCWK)*.

Memory File Control Block

This section of the dump holds the memory file control block information for each memory file the routine uses. A sample memory file control block is shown in

Figure 49.

```
Memory File Control Block: 046F5CD0
  +000000 046F5CD0  046F5D40 00000001 00000000 00000000  046F5BA8 00010000 046F5E48 00000013  |.?) .............?$y.....?;.....|
  +000020 046F5CF0  00000014 00000000 00000000 00000000  00000000 046F5BA8 00000000 00000000  |.....................?$y........|
  +000040 046F5D10  046F5CD0 00000000 00000000 00000000  00000000 00000000 00000000 046F5D40  |.?*.........................?) |
  +000060 046F5D30  00010000 00000000 00000000 00000000  00000000 00000000 046F5E68 00000001  |.........................?;.....|
memory file name..... TSOID.MEMORY.DATA
First memory data space: 046F5E68
  +000000 046F5E68  93899585 40F19389 958540F2 93899585  40F30000 00000000 00000000 00000000  |line 1line 2line 3..............|
```

Figure 49. Memory file control block

Memory file name The name assigned to this memory file.

First memory data space A dump of the first 1K maximum of actual user data associated with this memory file.

[8] Information for __amrc

__amrc is a structure defined in the **stdio.h** header file to assist in determining errors resulting from I/O operations. The contents of __amrc can be checked for system information, such as the return code for VSAM. Certain fields of the __amrc structure can provide useful information about what occurred previously in your routine.

For more information about __amrc, see “Debugging C/C++ programs” on page 167 and to *z/OS XL C/C++ Programming Guide*.

[9] Errno Information

The Errno information shows the thread id of the thread that generated the dump and the settings of the errno and errnojr variables for that thread.

Both the errno and the errnojr variables contain the return code of the last failing z/OS UNIX system service call. These variables provide z/OS UNIX application programs access to diagnostic information returned from an underlying z/OS UNIX callable service. For more information on these return and reason codes, see *z/OS UNIX System Services Messages and Codes*.

Additional Floating-Point registers

The Language Environment dump formats Additional Floating Point (AFP) registers and Floating Point Control (FPC) registers when the AFP suboption of the FLOAT XL C/C++ compiler option is specified and the registers are needed. These floating-point registers are displayed in three sections of the CEEDUMP; Registers on Entry to CEE3DMP; Parameters, Registers, and Variables; and Condition Information for Active Routines. Samples of each section are given. For information on the FLOAT XL C/C++ compiler option, see *z/OS XL C/C++ User's Guide* .

Registers on entry to CEE3DMP: This section of the Language Environment dump displays the twelve floating-point registers. A sample output is shown.

```
CEE3DMP V1 R3.0: Sample dump produced by calling CEE3DMP                        08/30/01 5:19:52 PM
CEE3DMP called by program unit ./celdll.c (entry point dump_n_perc) at statement 34 (offset +0000017A).

Registers on Entry to CEE3DMP:

  PM....... 0100
  GPR0..... 183F8BE8  GPR1..... 00023D38  GPR2..... 00023E98  GPR3..... 1840E792
  GPR4..... 00023D98  GPR5..... 183F8CD0  GPR6..... 00023D48  GPR7..... 0002297F
  GPR8..... 17F4553D  GPR9..... 183F6870  GPR10.... 17F4353F  GPR11.... 17FA0550
  GPR12.... 00015920  GPR13.... 00023CA0  GPR14.... 800180E2  GPR15.... 97F57FE8
  FPC...... 40084000
  FPR0..... 40260000  00000000            FPR1..... 41086A00  00000000
  FPR2..... 00000000  00000000            FPR3..... 3F8CAC08  3126E979
  FPR4..... 3FF33333  33333333            FPR5..... 40C19400  00000000
  FPR6..... 3F661E4F  765FD8AE            FPR7..... 3FF06666  66666666
  FPR8..... 3FF33333  33333333            FPR9..... 00000000  00000000
  FPR10.... 3FF33333  33333333            FPR11.... 00000000  00000000
  FPR12.... 40260000  00000000            FPR13.... 00000000  00000000
  FPR14.... 40220000  00000000            FPR15.... 00000000  00000000
   ⋮
```

Figure 50. Registers on entry to CEE3DMP

Parameters, registers, and variables for active routines: This section of the Language Environment dump displays the non-volatile floating-point registers that are saved in the stack frame. The registers are only displayed if the program owning the stack frame saved them. Dashes are displayed in the registers when the register values are not saved. A sample output is shown.

```
Parameters, Registers, and Variables for Active Routines:
 ⋮
  goo (DSA address 000213B0):
    Saved Registers:
      GPR0..... 183F6CC0  GPR1..... 00021278  GPR2..... 183F6870  GPR3..... 17F01DC2
      GPR4..... 000000F8  GPR5..... 183F6968  GPR6..... 17F02408  GPR7..... 000212EC
      GPR8..... 000212F0  GPR9..... 80000000  GPR10.... 98125022  GPR11.... 80007F98
      GPR12.... 00015920  GPR13.... 000213B0  GPR14.... 97F01E1E  GPR15.... 0000002F
      FPR8..... 3FF33333  33333333            FPR9..... --------  --------
      FPR10.... 3FF33333  33333333            FPR11.... --------  --------
      FPR12.... 40260000  00000000            FPR13.... --------  --------
      FPR14.... 40220000  00000000            FPR15.... --------  --------
  GPREG STORAGE:
    Storage around GPR0 (183F6CC0)
 ⋮
```

Figure 51. Parameters, registers, and variables for active routines

Condition information for active routines: This section of the Language Environment dump displays the floating-point registers when they are saved in the machine state. A sample output is shown.

```
  ⋮
Condition Information for Active Routines
  Condition Information for ./celsamp.c (DSA address 000213B0)
    CIB Address: 00021F90
    Current Condition:
      CEE3224S The system detected an IEEE division-by-zero exception.
    Location:
      Program Unit: ./celsamp.c
      Program Unit:Entry:        goo Statement: 78 Offset: +000000BA
    Machine State:
      ILC..... 0004    Interruption Code..... 0007
      PSW..... 078D0400 97F01E46
      GPR0..... 183F6CC0  GPR1..... 00021278  GPR2..... 183F6870  GPR3..... 17F01DC2
      GPR4..... 000000F8  GPR5..... 183F6968  GPR6..... 17F02408  GPR7..... 000212EC
      GPR8..... 000212F0  GPR9..... 80000000  GPR10.... 98125022  GPR11.... 80007F98
      GPR12.... 00015920  GPR13.... 000213B0  GPR14.... 97F01E1E  GPR15.... 0000002F
      FPC...... 40084000
      FPR0..... 40260000  00000000            FPR1..... 41086A00  00000000
      FPR2..... 00000000  00000000            FPR3..... 3F8CAC08  3126E979
      FPR4..... 3FF33333  33333333            FPR5..... 40C19400  00000000
      FPR6..... 3F661E4F  765FD8AE            FPR7..... 3FF06666  66666666
      FPR8..... 3FF33333  33333333            FPR9..... 00000000  00000000
      FPR10.... 3FF33333  33333333            FPR11.... 00000000  00000000
      FPR12.... 40260000  00000000            FPR13.... 00000000  00000000
      FPR14.... 40220000  00000000            FPR15.... 00000000  00000000
  Storage dump near condition, beginning at location: 17F01E32
    +000000 17F01E32  68201008 5810D0F0 68401010 B31B0024  B31D0002 B3050000 5820D0F4 584031C2  |.......0. .................4. .B|
  ⋮
```

Figure 52. Condition information for active routines

Sample Language Environment dump with XPLINK-specific information

The programs `tranmain` shown in Figure 53 on page 202 and `trandll` shown in Figure 54 on page 203 were used to produce a Language Environment dump. The dump shows XPLINK-compiled routines calling NOXPLINK-compiled routines, and NOXPLINK-compiled routines calling XPLINK-compiled routines. The program `tranmain` was compiled XPLINK and `trandll` was compiled NOXPLINK. Each was link-edited as a separate program object with the sidedeck from the other. The Language Environment dump produced by running these program is shown in Figure 55 on page 204. Explanations for some of the sections are in “Finding XPLINK information in a Language Environment dump” on page 206.

```
#pragma runopts(TRACE(ON,1M,NODUMP,LE=1),XPLINK(ON),TERMTHDACT(UADUMP))
#include <stdio.h>
#pragma export(tran2)

int tran1(int, int, int, long double, int);
int tran3(int, int, int, long double, int);

void main(void) {

int         parm1 = 0x11111111;
int         parm2 = 0x22222222;
int         parm3 = 0x33333333;
long double parm4 = 1234.56789;
int         parm5 = 0x55555555;
int         retval;

   printf("Main: Call Tran1\n");
   retval = tran1(parm1,parm2,parm3,parm4,parm5);
   printf("Main: Return value from Tran1 = %d\n",retval);

}
int tran2(int parm1,int parm2,int parm3,long double parm4,int parm5) {

int         retval;

   printf("Tran2: Call Tran3\n");
   retval = tran3(parm1,parm2,parm3,parm4,parm5);
   printf("Tran2: Return value from Tran3 = %d\n",retval);
   return retval;

}
```

Figure 53. Sample XPLINK-compiled program (tranmain) which calls a NOXPLINK-compiled program

```
#include <stdio.h>
#include <ctest.h>
#include <leawi.h>
#pragma export(tran1)
#pragma export(tran3)

int tran2(int, int, int, long double, int);

int tran1(int parm1,int parm2,int parm3,long double parm4,int parm5) {

int         retval;

   printf("Tran1: Call Tran2\n");
   retval = tran2(parm1,parm2,parm3,parm4,parm5);
   printf("Tran1: Return value from Tran2 = %d\n",retval);
   return retval;

}
int tran3(int parm1,int parm2,int parm3,long double parm4,int parm5) {

_INT4 code, timing;

   code = 1001;   /* Abend code to issue */
   timing = 1;
   printf("Tran3: About to ABEND\n");
   CEE3ABD(&code,&timing);

   return parm1 + parm2 + parm3;

}
```

Figure 54. Sample NOXPLINK-compiled program (trandll) which calls an XPLINK-compiled program

```
CEE3DMP V1 R9.0: Condition processing resulted in the unhandled condition.         01/10/07 3:58:00 PM                 Page:    1
ASID: 0041   Job ID: JOB26310   Job name: XNTRAN     Step name: STEP1      UserID: HEALY

CEE3845I CEEDUMP Processing started.

Information for enclave main

  Information for thread 8000000000000000

  [1]Traceback:
    DSA   Entry       E  Offset  Statement   Load Mod             Program Unit                   Service  Status
    1     CEEHDSP     +00004030               CEEPLPKA             CEEHDSP                        D1908    Call
    2     CEL4ABD0    +0000024C               CEEPLPKA             CEL4ABD0                       D1908    Exception
    3     CEEHABD     +00000074               CEEPLPKA             CEEHABD                        D1908    Call
    4     tran3       +000000D6  26           XNTDLL               trandll.c                               Call
    5     CEEVRONU    +00001026               CEEPLPKA             CEEVRONU                       D1908    Call
    6     tran2       +00000070  27           XNTRAN               tranmain.c                              Call
    7     CEEVROND    +000011FA               CEEPLPKA                                                     Call
    8     tran1       +000000F2  14           XNTDLL               trandll.c                               Call
    9     CEEVRONU    +00001026               CEEPLPKA             CEEVRONU                       D1908    Call
    10    main        +0000008C  18           XNTRAN               tranmain.c                              Call
    11    CEEVROND    +000011FA               CEEPLPKA                                                     Call
    12    EDCZHINV    +000000B4               CELHV003             EDCZHINV                       D1908    Call
    13    CEEBBEXT    +000001B6               CEEPLPKA             CEEBBEXT                       D1908    Call

    DSA   DSA Addr   E  Addr    PU Addr    PU Offset  Comp Date  Compile Attributes
    1     2110CB08   209C4238  209C4238   +00004030  20061215   CEL
    2     2110CA60   20AFCA08  20AFCA08   +0000024C  20061215   CEL
    3     2110C9C8   209BFCD0  209BFCD0   +00000074  20061215   CEL
    4     2110C910   212BB8C0  212BB8C0   +000000D6  20000505   C/C++
    5     2110C750   20ACCA58  20ACCA58   +00001026  20061215   CEL
    6     212B6530   209000E8  209000E8   +00000070  20000421   C/C++    XPLINK EBCDIC  HFP
    7     212B65B0   20ACAAA0  20ACAA48   +00001252  20061215   CEL      XPLINK EBCDIC  HFP
    8     2110C500   212BBA40  212BBA40   +000000F2  20000505   C/C++
    9     2110C340   20ACCA58  20ACCA58   +00001026  20061215   CEL
    10    212B6680   20900218  20900218   +0000008C  20000421   C/C++    XPLINK EBCDIC  HFP
    11    212B6720   20ACAAA0  20ACAA48   +00001252  20061215   CEL      XPLINK EBCDIC  HFP
    12    2110C0F0   20C386A8  20C386A8   +000000B4  20061214   LIBRARY
    13    2110C030   20992208  20992208   +000001B6  20061215   CEL

    Fully Qualified Names
    DSA   Entry       Program Unit                                      Load Module
    4     tran3       ./trandll.c                                       XNTDLL
    6     tran2       ./tranmain.c                                      XNTRAN
    8     tran1       ./trandll.c                                       XNTDLL
    10    main        ./tranmain.c                                      XNTRAN

  Condition Information for Active Routines
    Condition Information for CEL4ABD0 (DSA address 2110CA60)
      CIB Address: 2110D428
      Current Condition:
        CEE0198S The termination of a thread was signaled due to an unhandled condition.
      Original Condition:
        CEE3250C The system or user abend U1001 R=00000000 was issued.
      Location:
        Program Unit: CEL4ABD0 Entry: CEL4ABD0 Statement:  Offset: +0000024C
      Machine State:
        ILC..... 0002    Interruption Code..... 000D
        PSW..... 078D1400 A0AFCC54
        GPR0..... 84000000  GPR1..... 840003E9  GPR2..... 00000000  GPR3..... 2110C9B0
        GPR4..... 00000001  GPR5..... 20914E10  GPR6..... 00000002  GPR7..... 00000000
        GPR8..... A0900003  GPR9..... 212BB868  GPR10.... 209BFDAC  GPR11.... 20AFCA08
        GPR12.... 209139B0  GPR13.... 2110CA60  GPR14.... A09BFD46  GPR15.... 00000000
      ABEND code: 000003E9 Reason code: 00000000
    Storage dump near condition, beginning at location: 20AFCC44
      +000000 20AFCC44  88100008 41000084 89000018 16100A0D  58D0D004 98ECD00C 07FE0000 D7C1E3C3  |h.....di...........q.......PATC|
    GPREG STORAGE:
      Storage around GPR0 (04000000)
        -0020 03FFFFE0    Inaccessible storage.
        +0000 04000000    Inaccessible storage.
        +0020 04000020    Inaccessible storage.
  ⋮
```

Figure 55. Example dump of calling between XPLINK and non-XPLINK programs (Part 1 of 3)

```
[2]Parameters, Registers, and Variables for Active Routines:
 :
  tran3 (DSA address 2110C910):
    UPSTACK DSA
    Parameters:
      parm5            signed int          1431655765
      parm4            long double      1.23456788999999997135303197E+03
      parm3            signed int           858993459
      parm2            signed int           572662306
      parm1            signed int           286331153
    Saved Registers:
      GPR0..... 20914D70  GPR1..... 2110C9A8  GPR2..... 2110C9B4  GPR3..... 212BB8FA
      GPR4..... 2110C9B0  GPR5..... 20914E10  GPR6..... 00000000  GPR7..... 00000000
      GPR8..... A0900003  GPR9..... 212BB868  GPR10.... 212BB8C0  GPR11.... 20ACDF1C
      GPR12.... 209139B0  GPR13.... 2110C910  GPR14.... A12BB998  GPR15.... A09BFCD0
  GPREG STORAGE:
    Storage around GPR0 (20914D70)
      -0020 20914D50  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
      +0000 20914D70  180F58FF 001007FF 212BB3A0 20914D70  212BB3B0 00000000 00000000 00000000  |.............j(.................|
      +0020 20914D90  180F58FF 001007FF 212BB0B0 20914D70  212BB3B0 00000000 00000000 00000000  |.............j(.................|
 :
    Storage around GPR15(209BFCD0)
      -0020 209BFCB0  209BFA00 F2F0F0F6 F1F2F1F5 F1F1F5F2  F0F0F0F1 F0F9F0F0 0005C4F1 F9F0F800  |....20061215115200010900..D1908.|
      +0000 209BFCD0  47F0F014 00C3C5C5 00000098 000000E0  47F0F001 90ECD00C 18BF5800 B0D05810  |.00..CEE...q.....00.............|
      +0020 209BFCF0  D04C1E01 5500C00C 47D0B034 58F0C2BC  05EF181F 5000104C D7011000 100018FD  |.<...........0B.....&..<P.......|
    Local Variables:
      timing           signed long int             1
      code             signed long int          1001
  CEEVRONU (DSA address 2110C750):
    TRANSITION DSA
    Saved Registers:
      GPR0..... 20914D70  GPR1..... 212B6D70  GPR2..... 212BBE18  GPR3..... 0000001F
      GPR4..... 212B6530  GPR5..... 21109718  GPR6..... 00000000  GPR7..... 00000000
      GPR8..... A0900003  GPR9..... 212BB868  GPR10.... 212BB8C0  GPR11.... 20ACDF1C
      GPR12.... 209139B0  GPR13.... 2110C750  GPR14.... A0ACDA80  GPR15.... 212BB8C0
 :
  tran2 (DSA address 212B6530):
    DOWNSTACK DSA
    Parameters:
      parm5            signed int          1431655765
      parm4            long double      1.23456788999999997135303197E+03
      parm3            signed int           858993459
      parm2            signed int           572662306
      parm1            signed int           286331153
    Saved Registers:
      GPR0..... 55555555  GPR1..... 11111111  GPR2..... 22222222  GPR3..... 33333333
      GPR4..... 212B6530  GPR5..... 21109718  GPR6..... 20ACCAD8  GPR7..... A090015A
      GPR8..... A09000F2  GPR9..... 20914E80  GPR10.... 209000B8  GPR11.... A0ACAA48
      GPR12.... 209139B0  GPR13.... 2110C5C8  GPR14.... 209000B8  GPR15.... 0000000C
 :
    Local Variables:
      retval           signed int          -455613482
  CEEVROND (DSA address 212B65B0):
    TRANSITION DSA
    Saved Registers:
      GPR0..... ********  GPR1..... ********  GPR2..... ********  GPR3..... ********
      GPR4..... 212B65B0  GPR5..... 20914E80  GPR6..... 209000E8  GPR7..... A0ACBC9C
      GPR8..... 209000B8  GPR9..... 20ACBA47  GPR10.... ********  GPR11.... ********
      GPR12.... ********  GPR13.... ********  GPR14.... ********  GPR15.... ********
 :
  tran1 (DSA address 2110C500):
    UPSTACK DSA
    Saved Registers:
      GPR0..... 211080A8  GPR1..... 2110C598  GPR2..... 55555555  GPR3..... 212BBA7A
      GPR4..... 33333333  GPR5..... 20914E10  GPR6..... 22222222  GPR7..... 11111111
      GPR8..... A0900203  GPR9..... 212BB9E8  GPR10.... 212BBA40  GPR11.... 20ACDF1C
      GPR12.... 209139B0  GPR13.... 2110C500  GPR14.... A12BBB34  GPR15.... A0ACAA48
 :
```

Figure 55. Example dump of calling between XPLINK and non-XPLINK programs (Part 2 of 3)

```
[3]Control Blocks for Active Routines:
  :
  DSA for tran3: 2110C910
    +000000  FLAGS.... 1010      member... 803C      BKC...... 2110C750  FWC...... 2110C9C8  R14...... A12BB998
    +000010  R15...... A09BFCD0  R0....... 20914D70  R1....... 2110C9A8  R2....... 2110C9B4  R3....... 212BB8FA
    +000024  R4....... 2110C9B0  R5....... 20914E10  R6....... 00000000  R7....... 00000000  R8....... A0900003
    +000038  R9....... 212BB868  R10...... 212BB8C0  R11...... 20ACDF1C  R12...... 209139B0  reserved. 00000000
    +00004C  NAB...... 2110C9C8  PNAB..... 00000001  reserved. 20914E70  209011DC
    +000064  reserved. A0A9AED0  reserved. 209139B0  MODE..... 20A9CD06  reserved. 20912668
    +000078  reserved. A0A8299C  reserved. 00000000
  DSA for CEEVRONU: 2110C750
    +000000  FLAGS.... 0000      member... 0000      BKC...... FFFFFFFF  FWC...... 2110C910  R14...... A0ACDA80
    +000010  R15...... 212BB8C0  R0....... 20914D70  R1....... 212B6D70  R2....... 212BBE18  R3....... 0000001F
    +000024  R4....... 212B6530  R5....... 21109718  R6....... 00000000  R7....... 00000000  R8....... A0900003
    +000038  R9....... 212BB868  R10...... 212BB8C0  R11...... 20ACDF1C  R12...... 209139B0  reserved. 00000000
    +00004C  NAB...... 2110C910  PNAB..... 2110C910  reserved. 00000000  00000000
    +000064  reserved. 2110C7D0  reserved. 00000000  MODE..... 00000000  reserved. 00000000
    +000078  reserved. 00000000  reserved. 00000000
  DSA for CEEVRONU: 2110C7D0
    +000000  EYE...... DOWNTOUP  TRTYPE... 00000003  BOS...... 00000000  STACKFLR. 00000000  SSTOPD... 212B6680
    +000018  SSDSAU... 2110C750  TRANEP... 20ACCA58  TR_R0.... 55555555  TR_R1.... 11111111  TR_R2.... 22222222
    +00002C  TR_R3.... 33333333  TR_R4.... 212B6530  TR_R5.... 21109718  TR_R6.... 20ACCAD8  TR_R7.... A090015A
    +000040  TR_R8.... A09000F2  TR_R9.... 20914E80  TR_R10... 209000B8  TR_R11... A0ACAA48  TR_R12... 209139B0
    +000054  TR_R13... 2110C5C8  TR_R14... 209000B8  TR_R15... 0000000C  CRENT.... 00000000  ROND_DSA. 2110C5C8
    +000068  INTF_MAP. 018F1000
  DSA for tran2: 212B6D30
    +000000  R4....... 212B65B0  R5....... 20914E80  R6....... 209000E8  R7....... A0ACBC9C  R8....... 209000B8
    +000014  R9....... 20ACBA47  R10...... 209000B8  R11...... A0ACAA48  R12...... 209139B0  R13...... 2110C5C8
    +000028  R14...... 209000B8  R15...... 0000000C  reserved. 00000A68  reserved. 20F2E0C7  HPTRAN... 00000000
    +00003C  reserved. 55555555  reserved. 11111111
  DSA for CEEVROND: 212B6DB0
    +000000  R4....... E3D9C1D5  R5....... 00000000  R6....... 20ACAAA0  R7....... 00000000  R8....... 2110C8B0
    +000014  R9....... 00000000  R10...... 00000000  R11...... A0A82AE8  R12...... 00000000  R13...... 00000000
    +000028  R14...... 212B6E10  R15...... 00000000  reserved. 20914E1C  reserved. 2110C5C0  HPTRAN... 212B6E10
    +00003C  reserved. 000000D0  reserved. 11111111
  DSA for CEEVROND: 212B6E10
    +000000  EYE...... UPTODOWN  TRTYPE... 00000002  BOS...... 00000000  STACKFLR. 00000000  SSTOPD... 212B6680
    +000018  SSDSAU... 2110C340  TRANEP... 20ACAAA0  TR_R0.... 00000000  TR_R1.... 00000000  TR_R2.... 00000000
    +00002C  TR_R3.... 00000000  TR_R4.... 2110C500  TR_R5.... 00000000  TR_R6.... 00000000  TR_R7.... A12BBB34
    +000040  TR_R8.... 00000000  TR_R9.... 00000000  TR_R10... 00000000  TR_R11... 00000000  TR_R12... 00000000
    +000054  TR_R13... 00000000  TR_R14... 00000000  TR_R15... 00000000  CRENT.... A0ACAA48  ROND_DSA. 00000000
    +000068  INTF_MAP. 00000000
  DSA for tran1: 2110C500
    +000000  FLAGS.... 1000      member... 0000      BKC...... 2110C340  FWC...... 2110C8B0  R14...... A12BBB34
    +000010  R15...... A0ACAA48  R0....... 211080A8  R1....... 2110C598  R2....... 55555555  R3....... 212BBA7A
    +000024  R4....... 33333333  R5....... 20914E10  R6....... 22222222  R7....... 11111111  R8....... A0900203
    +000038  R9....... 212BB9E8  R10...... 212BBA40  R11...... 20ACDF1C  R12...... 209139B0  reserved. 00000000
    +00004C  NAB...... 2110C5C8  PNAB..... 00000000  reserved. 00000000  2110C4A8
    +000064  reserved. 2110C584  reserved. 20912658  MODE..... 2110C5A4  reserved. 21135000
    +000078  reserved. 00000001  reserved. 21108020
  :
CEE3846I CEEDUMP Processing completed.
```

Figure 55. Example dump of calling between XPLINK and non-XPLINK programs (Part 3 of 3)

Finding XPLINK information in a Language Environment dump

[1] Traceback

When an XPLINK-compiled routine calls a NOXPLINK-compiled routine, a glue routine gets control to convert the linkage conventions of the XPLINK caller to those of the NOXPLINK callee. In the sample dump, this routine is CEEVRONU and it appears between `main()` and tran1() and again between `tran2()` and `tran3()`.

When a NOXPLINK-compiled routine calls an XPLINK-compiled routine, a glue routine gets control to convert the linkage conventions of the NOXPLINK caller to those of the XPLINK callee. In the sample dump, this routine is CEEVROND and it appears between EDCZHINV and `main()` and again between `tran1()` and `tran2()`.

[2] Parameters, Registers, and Variables for Active Routines

In this section, each DSA is identified as one of the following:

UPSTACK DSA The DSA format is that for a NOXPLINK-compiled program that uses an upward growing stack.

DOWNSTACK DSA The DSA format is that for ax XPLINK-compiled program that uses an downward growing stack.

TRANSITION DSA The DSA format is that of its callee. A transition DSA can occur between an UPSTACK DSA and a DOWNSTACK DSA where it represents a transition from one linkage convention to another. A transition DSA can also occur between two DOWNSTACK DSAs where it represents a transition from one stack segment to another (a stack overflow).

[3] Control Blocks for Active Routines

In this section, DSAs are formatted. Those previously identified as UPSTACK DSAs will have one format and those identified as DOWNSTACK DSAs will have a different format. Those identified as TRANSITION DSAs will have two parts — the first will be either the downstack or upstack format, the second is unique to transition DSAs and contains information about the transition.

It is important to understand that the registers saved in an upstack DSA are those saved by a routine that the DSA-owning routine called. Typically register 15 is the entry point of the routine that was called, and register 14 is the return address into the DSA-owning routine. In contrast, the registers saved in an downstack DSA are those saved by the DSA-owning routine on entry. Register 7 is the return address back to the caller of the DSA-owning routine. Register 6 may be the entry point of the DSA-owning routine. (This is not true when the Branch Relative and Save instruction is used to implement the call.)

C/C++ contents of the Language Environment trace tables

Language Environment provides four C/C++ trace table entry types that contain character data:

- Trace entry 1 occurs when a base C library function is called.
- Trace entry 2 occurs when a base C library function returns.
- Trace entry 3 occurs when a POSIX C library function is called.
- Trace entry 4 occurs when a POSIX C library function returns.
- Trace entry 5 occurs when an XPLINK base C or POSIX C library function is called.
- Trace entry 6 occurs when an XPLINK base C or POSIX C library function returns.
- Trace entry 7 occurs when an XPLINK function calls a non-XPLINK function.
- Trace entry 8 occurs when a non-XPLINK function calls an XPLINK function.

The format for trace table entry 1 is:

```
NameOfCallingFunction
—>(xxx) NameOfCalledFunction
```

or, for called functions calloc, free, malloc, and realloc:

```
NameOfCallingFunction
—>(xxx) NameOfCalledFunction<(input_parameters)>
```

In addition, when the call is due to one of these C++ operators:

```
-new,
-new[],
-delete,
-delete[]
```

then the C++ operator will appear and the format becomes:

```
NameOfCallingFunction
—>(xxx) NameOfCalledFunction<(input_parameters)>

NameOfC++Operator
```

The format for trace table entry 2 is:

```
<—(xxx) R15=value ERRNO=value
```

The format for trace table entry 3 is:

```
NameOfCallingFunction
—>(xxx) NameOfCalledFunction
```

The format for trace table entry 4 is:

```
<—(xxx) R15=value ERRNO=value ERRNO2=value
```

The format for trace table entry 5 is:

```
NameOfCallingFunction
-->(xxxx) NameOfCalledFunction<(input_parameters)>
```

5 is just like trace table entry 1. The `input_parameters` and `NameOfC++Operator` only appear for the appropriate functions. The angle brackets (<>) indicate that this information does not always appear.

The format for trace table entry 6 is:

```
<--(xxxx) R1=xxxxxxxx R2=xxxxxxxx R3=xxxxxxxx ERRNO=xxxxxxxx ERRNO2=xxxxxxxx
```

In all entry types, (xxx) and (xxxx) are numbers associated with the called library function and are used to associate a specific entry record with its corresponding return record.

For entry types 5 and 6, the number will be the same as the number of the function as seen in the C run-time library definition side-deck, SCEELIB dataset member CELHS003, on the IMPORT statement for that function.

The format for trace table entry 7 is:

```
ModuleNameOfCallingFunction:NameOfCallingXplinkFunction
-->ModuleNameOfCalledFunction:NameOfCalledNonXplinkFunction
```

The format for trace table entry 8 is:

```
ModuleNameOfCallingFunction:NameOfCallingNonXplinkFunction
-->ModuleNameOfCalledFunction:NameOfCalledXplinkFunction
```

For entry types 7 and 8, 16 bytes is for the module name and 32 bytes is for the function name. If the name is longer than 16 or 32 bytes, an extra trace entry is taken. The name is truncated and only the first 32/64(16/32) bytes will appear in the trace table entry. Also, a module name might not always be located, such as when a DLL is freed. If that occurs, ″UNKNOWN″ appears for the module name in the trace table entry.

Figure 56 shows a non-XPLINK trace which has examples of C/C++ trace table entry types 1 thru 4.

```
⋮
Language Environment Trace Table:

 Most recent trace entry is at displacement: 02D500

    Displacement                      Trace Entry in Hexadecimal                                  Trace Entry in EBCDIC
    ------------ ------------------------------------------------------------------------  --------------------------------
      +000000    Time 20.52.46.666280    Date 2001.08.26    Thread ID... 8000000000000000
      +000010    Member ID.... 03    Flags..... 000000    Entry Type..... 00000001
      +000018    94818995 40404040 40404040 40404040  40404040 40404040 40404040 40404040 |main                            |
      +000038    60606E4D F1F3F95D 40A2A399 8397A84D  5D404040 40404040 40404040 40404040 |-->(139) strcpy()                |
      +000058    40404040 40404040 40404040 40404040  40404040 40404040 40404040 40404040 |                                 |
      +000078    40404040 40404040                                                        |                                 |

      +000080    Time 20.52.46.666286    Date 2001.08.26    Thread ID... 8000000000000000
      +000090    Member ID.... 03    Flags..... 000000    Entry Type..... 00000002
      +000098    4C60604D F1F3F95D 40D9F1F5 7EF2F4C2  F7F3F1C4 F840C5D9 D9D5D67E F0F0F0F0 |<--(139) R15=24B731D8 ERRNO=0000|
      +0000B8    F0F0F0F0 00000000 00000000 00000000  00000000 00000000 00000000 00000000 |0000............................|
      +0000D8    00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000 |................................|
      +0000F8    00000000 00000000                                                        |........                         |

      +000100    Time 20.52.46.666289    Date 2001.08.26    Thread ID... 8000000000000000
      +000110    Member ID.... 03    Flags..... 000000    Entry Type..... 00000001
      +000118    94818995 40404040 40404040 40404040  40404040 40404040 40404040 40404040 |main                            |
      +000138    60606E4D F1F3F95D 40A2A399 8397A84D  5D404040 40404040 40404040 40404040 |-->(139) strcpy()                |
      +000158    40404040 40404040 40404040 40404040  40404040 40404040 40404040 40404040 |                                 |
      +000178    40404040 40404040                                                        |                                 |

      +000180    Time 20.52.46.666293    Date 2001.08.26    Thread ID... 8000000000000000
      +000190    Member ID.... 03    Flags..... 000000    Entry Type..... 00000002
      +000198    4C60604D F1F3F95D 40D9F1F5 7EF2F4C2  F7F3F2F2 F840C5D9 D9D5D67E F0F0F0F0 |<--(139) R15=24B73228 ERRNO=0000|
      +0001B8    F0F0F0F0 00000000 00000000 00000000  00000000 00000000 00000000 00000000 |0000............................|
      +0001D8    00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000 |................................|
      +0001F8    00000000 00000000                                                        |........                         |

      +000200    Time 20.52.46.666303    Date 2001.08.26    Thread ID... 8000000000000000
      +000210    Member ID.... 03    Flags..... 000000    Entry Type..... 00000003
      +000218    C98785A3 97819994 A2404040 40404040  40404040 40404040 40404040 40404040 |Igetparms                        |
      +000238    60606E4D F0F5F25D 4089A281 A3A3A84D  5D404040 40404040 40404040 40404040 |-->(052) isatty()                |
      +000258    40404040 40404040 40404040 40404040  40404040 40404040 40000000 00000000 |                         .......|
      +000278    00000000 00000000                                                        |........                         |

      +000280    Time 20.52.46.673289    Date 2001.08.26    Thread ID... 8000000000000000
      +000290    Member ID.... 03    Flags..... 000000    Entry Type..... 00000004
      +000298    4C60604D F0F5F25D 40D9F1F5 7EF0F0F0  F0F0F0F0 F040C5D9 D9D5D67E F0F0F0F0 |<--(052) R15=00000000 ERRNO=0000|
      +0002B8    F0F0F7F1 40C5D9D9 D5D6F27E F0F5C6C3  F0F1F1C3 00000000 00000000 00000000 |0071 ERRNO2=05FC011C............|
      +0002D8    00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000 |................................|
      +0002F8    00000000 00000000                                                        |........                         |

      +000300    Time 20.52.46.673296    Date 2001.08.26    Thread ID... 8000000000000000
      +000310    Member ID.... 03    Flags..... 000000    Entry Type..... 00000003
      +000318    C98785A3 97819994 A2404040 40404040  40404040 40404040 40404040 40404040 |Igetparms                        |
      +000338    60606E4D F0F5F25D 4089A281 A3A3A84D  5D404040 40404040 40404040 40404040 |-->(052) isatty()                |
      +000358    40404040 40404040 40404040 40404040  40404040 40404040 40000000 00000000 |                         .......|
      +000378    00000000 00000000                                                        |........                         |

      +000380    Time 20.52.46.673334    Date 2001.08.26    Thread ID... 8000000000000000
      +000390    Member ID.... 03    Flags..... 000000    Entry Type..... 00000004
      +000398    4C60604D F0F5F25D 40D9F1F5 7EF0F0F0  F0F0F0F0 F040C5D9 D9D5D67E F0F0F0F0 |<--(052) R15=00000000 ERRNO=0000|
      +0003B8    F0F0F7F1 40C5D9D9 D5D6F27E F0F5C6C3  F0F1F1C3 00000000 00000000 00000000 |0071 ERRNO2=05FC011C............|
      +0003D8    00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000 |................................|
      +0003F8    00000000 00000000                                                        |........                         |

      +000400    Time 20.52.46.673338    Date 2001.08.26    Thread ID... 8000000000000000
      +000410    Member ID.... 03    Flags..... 000000    Entry Type..... 00000003
      +000418    C98785A3 97819994 A2404040 40404040  40404040 40404040 40404040 40404040 |Igetparms                        |
      +000438    60606E4D F0F5F25D 4089A281 A3A3A84D  5D404040 40404040 40404040 40404040 |-->(052) isatty()                |
      +000458    40404040 40404040 40404040 40404040  40404040 40404040 40000000 00000000 |                         .......|
      +000478    00000000 00000000                                                        |........                         |
```

Figure 56. Trace table with C/C++ trace table entry types 1 thru 4 (Part 1 of 2)

```
+000480    Time 20.52.46.673373    Date 2001.08.26    Thread ID... 8000000000000000
+000490    Member ID.... 03    Flags..... 000000    Entry Type..... 00000004
+000498    4C60604D F0F5F25D 40D9F1F5 7EF0F0F0  F0F0F0F0 F040C5D9 D9D5D67E F0F0F0F0  <--(052) R15=00000000 ERRNO=0000
+0004B8    F0F0F7F1 40C5D9D9 D5D6F27E F0F5C6C3  F0F1F1C3 00000000 00000000 00000000  0071 ERRNO2=05FC011C............
+0004D8    00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  ................................
+0004F8    00000000 00000000                                                        ........

+000500    Time 20.52.46.673379    Date 2001.08.26    Thread ID... 8000000000000000
+000510    Member ID.... 03    Flags..... 000000    Entry Type..... 00000001
+000518    C98785A3 97819994 A2404040 40404040  40404040 40404040 40404040 40404040  Igetparms
+000538    60606E4D F1F2F95D 408785A3 8595A54D  5D404040 40404040 40404040 40404040  -->(129) getenv()
+000558    40404040 40404040 40404040 40404040  40404040 40404040 40404040 40404040
+000578    40404040 40404040

+000580    Time 20.52.46.673392    Date 2001.08.26    Thread ID... 8000000000000000
+000590    Member ID.... 03    Flags..... 000000    Entry Type..... 00000002
+000598    4C60604D F1F2F95D 40D9F1F5 7EF0F0F0  F0F0F0F0 F040C5D9 D9D5D67E F0F0F0F0  <--(129) R15=00000000 ERRNO=0000
+0005B8    F0F0F7F1 00000000 00000000 00000000  00000000 00000000 00000000 00000000  0071............................
+0005D8    00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  ................................
+0005F8    00000000 00000000                                                        ........

+000600    Time 20.52.46.673401    Date 2001.08.26    Thread ID... 8000000000000000
+000610    Member ID.... 03    Flags..... 000000    Entry Type..... 00000001
+000618    C9A285A3 A4974040 40404040 40404040  40404040 40404040 40404040 40404040  Isetup
+000638    60606E4D F1F9F15D 408685A3 83884D5D  40404040 40404040 40404040 40404040  -->(191) fetch()
+000658    40404040 40404040 40404040 40404040  40404040 40404040 40404040 40404040
+000678    40404040 40404040

+000680    Time 20.52.47.553343    Date 2001.08.26    Thread ID... 8000000000000000
+000690    Member ID.... 03    Flags..... 000000    Entry Type..... 00000002
+000698    4C60604D F1F9F15D 40D9F1F5 7EF2F4C2  F7F6F0F6 F040C5D9 D9D5D67E F0F0F0F0  <--(191) R15=24B76060 ERRNO=0000
+0006B8    F0F0F7F1 00000000 00000000 00000000  00000000 00000000 00000000 00000000  0071............................
+0006D8    00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  ................................
+0006F8    00000000 00000000                                                        ........

+000700    Time 20.52.47.553355    Date 2001.08.26    Thread ID... 8000000000000000
+000710    Member ID.... 03    Flags..... 000000    Entry Type..... 00000001
+000718    C9A285A3 A4974040 40404040 40404040  40404040 40404040 40404040 40404040  Isetup
+000738    60606E4D F1F2F45D 40948193 9396834D  F2F0F6F8 5D404040 40404040 40404040  -->(124) malloc(2068)
+000758    40404040 40404040 40404040 40404040  40404040 40404040 40404040 40404040
+000778    40404040 40404040

+000780    Time 20.52.47.553366    Date 2001.08.26    Thread ID... 8000000000000000
+000790    Member ID.... 03    Flags..... 000000    Entry Type..... 00000002
+000798    4C60604D F1F2F45D 40D9F1F5 7EF2F4C2  F7F6F2F3 F040C5D9 D9D5D67E F0F0F0F0  <--(124) R15=24B76230 ERRNO=0000
+0007B8    F0F0F7F1 00000000 00000000 00000000  00000000 00000000 00000000 00000000  0071............................
+0007D8    00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  ................................
+0007F8    00000000 00000000                                                        ........
```

⋮

Figure 56. Trace table with C/C++ trace table entry types 1 thru 4 (Part 2 of 2)

Figure 57 on page 211 shows an XPLINK trace which has examples of the trace entries 5 and 6.

```
 ⋮
Language Environment Trace Table:

  Most recent trace entry is at displacement: 000D80

    Displacement                    Trace Entry in Hexadecimal                          Trace Entry in EBCDIC
    ------------ ------------------------------------------------------------------  --------------------------------
      +000000    Time 22.41.35.433944    Date 2001.08.30    Thread ID... 26C70D0000000000
      +000010    Member ID.... 03    Flags..... 000000    Entry Type..... 00000006
      +000018    4C60604D F0F0F5F9 5D40D9F1 7EF2F3C6  C6C3C1C2 F040D9F2 7EF2F3C3 F5F8F9C4  |<--(0059) R1=23FFCAB0 R2=23C589D|
      +000038    F040D9F3 7EF2F3C6 C6C4F0F0 F040C5D9  D9D5D67E F0F0F0F0 F0F0F7F4 40C5D9D9  |0 R3=23FFD000 ERRNO=00000074 ERR|
      +000058    D5D6F27E F0F0F0F0 F0F0F0F0 00000000  00000000 00000000 00000000 00000000  |NO2=00000000....................|
      +000078    00000000 00000000                                                       |........                        |

      +000080    Time 22.41.35.433948    Date 2001.08.30    Thread ID... 26C70D0000000000
      +000090    Member ID.... 03    Flags..... 000000    Entry Type..... 00000005
      +000098    C9D9E3D3 D985A296 A4998385 7A7AA1C9  D9E3D3D9 85A296A4 9983854D 5D404040  |IRTLResource::.IRTLResource()   |
      +0000B8    60606E4D F0F2F0F4 5D4097A3 88998581  846D94A4 A385A76D 8485A2A3 9996A84D  |-->(0204) pthread_mutex_destroy(|
      +0000D8    5D404040 40404040 40404040 40404040  40404040 40404040 40404040 40404040  |)                               |
      +0000F8    40404040 40404040                                                       |                                |

      +000100    Time 22.41.35.433952    Date 2001.08.30    Thread ID... 26C70D0000000000
      +000110    Member ID.... 03    Flags..... 000000    Entry Type..... 00000006
      +000118    4C60604D F0F2F0F4 5D40D9F1 7EF2F3C6  C6C3C1F3 C340D9F2 7EF2F3C3 F5F8F9C4  |<--(0204) R1=23FFCA3C R2=23C589D|
      +000138    F040D9F3 7EF0F0F0 F0F0F0F0 F040C5D9  D9D5D67E F0F0F0F0 F0F0F7F4 40C5D9D9  |0 R3=00000000 ERRNO=00000074 ERR|
      +000158    D5D6F27E F0F0F0F0 F0F0F0F0 00000000  00000000 00000000 00000000 00000000  |NO2=00000000....................|
      +000178    00000000 00000000                                                       |........                        |

      +000180    Time 22.41.35.433957    Date 2001.08.30    Thread ID... 26C70D0000000000
      +000190    Member ID.... 03    Flags..... 000000    Entry Type..... 00000005
      +000198    C9D9E3D3 D985A296 A4998385 7A7AA1C9  D9E3D3D9 85A296A4 9983854D 5D404040  |IRTLResource::.IRTLResource()   |
      +0001B8    60606E4D F0F0F5F9 5D408699 85854DF0  A7F2F4F0 F0F4C3F2 F05D4040 40404040  |-->(0059) free(0x24004C20)       |
      +0001D8    40404040 40404040 40404040 40404040  40404040 40404040 40404040 40404040  |                                 |
      +0001F8    84859385 A3854040                                                       |delete                          |

      +000200    Time 22.41.35.433959    Date 2001.08.30    Thread ID... 26C70D0000000000
      +000210    Member ID.... 03    Flags..... 000000    Entry Type..... 00000006
      +000218    4C60604D F0F0F5F9 5D40D9F1 7EF2F3C6  C6C3C1C2 F040D9F2 7EF2F3C3 F5F8F9C4  |<--(0059) R1=23FFCAB0 R2=23C589D|
      +000238    F040D9F3 7EF2F3C6 C6C4F0F0 F040C5D9  D9D5D67E F0F0F0F0 F0F0F7F4 40C5D9D9  |0 R3=23FFD000 ERRNO=00000074 ERR|
      +000258    D5D6F27E F0F0F0F0 F0F0F0F0 00000000  00000000 00000000 00000000 00000000  |NO2=00000000....................|
      +000278    00000000 00000000                                                       |........                        |

      +000280    Time 22.41.35.433963    Date 2001.08.30    Thread ID... 26C70D0000000000
      +000290    Member ID.... 03    Flags..... 000000    Entry Type..... 00000005
      +000298    C9D9E3D3 D985A296 A4998385 7A7AA1C9  D9E3D3D9 85A296A4 9983854D 5D404040  |IRTLResource::.IRTLResource()   |
      +0002B8    60606E4D F0F2F0F4 5D4097A3 88998581  846D94A4 A385A76D 8485A2A3 9996A84D  |-->(0204) pthread_mutex_destroy(|
      +0002D8    5D404040 40404040 40404040 40404040  40404040 40404040 40404040 40404040  |)                               |
      +0002F8    40404040 40404040                                                       |                                |

      +000300    Time 22.41.35.433967    Date 2001.08.30    Thread ID... 26C70D0000000000
      +000310    Member ID.... 03    Flags..... 000000    Entry Type..... 00000006
      +000318    4C60604D F0F2F0F4 5D40D9F1 7EF2F3C6  C6C3C1F3 C340D9F2 7EF2F3C3 F5F8F9C4  |<--(0204) R1=23FFCA3C R2=23C589D|
      +000338    F040D9F3 7EF0F0F0 F0F0F0F0 F040C5D9  D9D5D67E F0F0F0F0 F0F0F7F4 40C5D9D9  |0 R3=00000000 ERRNO=00000074 ERR|
      +000358    D5D6F27E F0F0F0F0 F0F0F0F0 00000000  00000000 00000000 00000000 00000000  |NO2=00000000....................|
      +000378    00000000 00000000                                                       |........                        |

      +000380    Time 22.41.35.433972    Date 2001.08.30    Thread ID... 26C70D0000000000
      +000390    Member ID.... 03    Flags..... 000000    Entry Type..... 00000005
      +000398    C9D9E3D3 D985A296 A4998385 7A7AA1C9  D9E3D3D9 85A296A4 9983854D 5D404040  |IRTLResource::.IRTLResource()   |
      +0003B8    60606E4D F0F0F5F9 5D408699 85854DF0  A7F2F4F0 F0F4C3F3 F85D4040 40404040  |-->(0059) free(0x24004C38)       |
      +0003D8    40404040 40404040 40404040 40404040  40404040 40404040 40404040 40404040  |                                 |
      +0003F8    84859385 A3854040                                                       |delete                          |

      +000400    Time 22.41.35.433974    Date 2001.08.30    Thread ID... 26C70D0000000000
      +000410    Member ID.... 03    Flags..... 000000    Entry Type..... 00000006
      +000418    4C60604D F0F0F5F9 5D40D9F1 7EF2F3C6  C6C3C1C2 F040D9F2 7EF2F3C3 F5F8F9C4  |<--(0059) R1=23FFCAB0 R2=23C589D|
      +000438    F040D9F3 7EF2F3C6 C6C4F0F0 F040C5D9  D9D5D67E F0F0F0F0 F0F0F7F4 40C5D9D9  |0 R3=23FFD000 ERRNO=00000074 ERR|
      +000458    D5D6F27E F0F0F0F0 F0F0F0F0 00000000  00000000 00000000 00000000 00000000  |NO2=00000000....................|
      +000478    00000000 00000000                                                       |........                        |
 ⋮
```

Figure 57. Trace table with XPLINK trace table entries 5 and 6.

The following is an example of the format of the trace table entry type 7 and 8 :

```
Calculator      :calculatethesumoftwointegers    -->
exceptionhandler:exceptionhandlersub1
```

The following is an example of a dump of the trace table when you specify the LE=20 suboption:

```
 ⋮

Language Environment Trace Table:

  Most recent trace entry is at displacement: 000800

      Displacement                        Trace Entry in Hexadecimal                                  Trace Entry in EBCDIC
      ------------ ------------------------------------------------------------------------  --------------------------------
        +000000    Time 22.10.56.799195    Date 2005.05.01    Thread ID... 21DEC83000000000
        +000010    Member ID.... 03    Flags..... 000000    Entry Type..... 00000008
        +000018    C3C5D3C8 E5F0F0F3 40404040 40404040  7AC5C4C3 E9C8C9D5 E5404040 40404040  |CELHV003        :EDCZHINV       |
        +000038    40404040 40404040 40404040 40404040  4060606E 81F8F5F9 83F4F1A7 40404040  |                 -->a859c41x     |
        +000058    40404040 7A948189 95404040 40404040  40404040 40404040 40404040 40404040  |    :main                        |
        +000078    40404040 404040F1                                                         |       1                         |

        +000080    Time 22.10.56.804695    Date 2005.05.01    Thread ID... 21DEC83000000000
        +000090    Member ID.... 03    Flags..... 000000    Entry Type..... 00000007
        +000098    C3C5C5D7 D3D7D2C1 40404040 40404040  7AC3C5C5 D7C8E3D3 C3404040 40404040  |CEEPLPKA        :CEEPHTLC       |
        +0000B8    40404040 40404040 40404040 40404040  4060606E C3C5C5D7 D3D7D2C1 40404040  |                 -->CEEPLPKA     |
        +0000D8    40404040 7AC3C5C5 D7E3D3D6 D9404040  40404040 40404040 40404040 40404040  |    :CEEPTLOR                    |
        +0000F8    40404040 404040F1                                                         |       1                         |

        +000100    Time 22.10.56.825094    Date 2005.05.01    Thread ID... 21DEC83000000000
        +000110    Member ID.... 03    Flags..... 000000    Entry Type..... 00000007
        +000118    81F8F5F9 83F4F1A7 40404040 40404040  7A948189 95404040 40404040 40404040  |a859c41x        :main           |
        +000138    40404040 40404040 40404040 40404040  4060606E 81F8F5F9 83F4F186 9593F3F4  |                 -->a859c41fnl34|
        +000158    40404040 7A86A495 83A38996 956D9581  94856D93 859587A3 886D8598 A48193A2  |    :function_name_length_equals|
        +000178    6DA3966D F04040F1                                                         |_to_0  1                         |

        +000180    Time 22.10.56.825094    Date 2005.05.01    Thread ID... 21DEC83000000000
        +000190    Member ID.... 03    Flags..... 000000    Entry Type..... 00000007
        +000198    40404040 40404040 40404040 40404040  7A404040 40404040 40404040 40404040  |                :               |
        +0001B8    40404040 40404040 40404040 40404040  4060606E 40404040 40404040 40404040  |                 -->            |
        +0001D8    40404040 7AF3F440 40404040 40404040  40404040 40404040 40404040 40404040  |    :34                          |
        +0001F8    40404040 404040F2                                                         |       2                         |

        +000200    Time 22.10.56.826629    Date 2005.05.01    Thread ID... 21DEC83000000000
        +000210    Member ID.... 03    Flags..... 000000    Entry Type..... 00000008
        +000218    81F8F5F9 83F4F186 9593F3F4 40404040  7A86A495 83A38996 956D9581 94856D93  |a859c41fnl34    :function_name_l|
        +000238    859587A3 886D8598 A48193A2 6DA3966D  F060606E C3C5D3C8 E5F0F0F3 40404040  |ength_equals_to_0-->CELHV003    |
        +000258    40404040 7A979989 95A38640 40404040  40404040 40404040 40404040 40404040  |    :printf                      |
        +000278    40404040 404040F1                                                         |       1                         |

        +000280    Time 22.10.56.826629    Date 2005.05.01    Thread ID... 21DEC83000000000
        +000290    Member ID.... 03    Flags..... 000000    Entry Type..... 00000008
        +000298    40404040 40404040 40404040 40404040  7AF3F440 40404040 40404040 40404040  |                :34             |
        +0002B8    40404040 40404040 40404040 40404040  4060606E 40404040 40404040 40404040  |                 -->            |
        +0002D8    40404040 7A404040 40404040 40404040  40404040 40404040 40404040 40404040  |    :                            |
        +0002F8    40404040 404040F2                                                         |       2                         |

        +000300    Time 22.10.56.826670    Date 2005.05.01    Thread ID... 21DEC83000000000
        +000310    Member ID.... 03    Flags..... 000000    Entry Type..... 00000008
        +000318    81F8F5F9 83F4F186 9593F3F4 40404040  7A86A495 83A38996 956D9581 94856D93  |a859c41fnl34    :function_name_l|
        +000338    859587A3 886D8598 A48193A2 6DA3966D  F060606E C3C5D3C8 E5F0F0F3 40404040  |ength_equals_to_0-->CELHV003    |
        +000358    40404040 7A979989 95A38640 40404040  40404040 40404040 40404040 40404040  |    :printf                      |
        +000378    40404040 404040F1                                                         |       1                         |

        +000380    Time 22.10.56.826670    Date 2005.05.01    Thread ID... 21DEC83000000000
        +000390    Member ID.... 03    Flags..... 000000    Entry Type..... 00000008
        +000398    40404040 40404040 40404040 40404040  7AF3F440 40404040 40404040 40404040  |                :34             |
        +0003B8    40404040 40404040 40404040 40404040  4060606E 40404040 40404040 40404040  |                 -->            |
        +0003D8    40404040 7A404040 40404040 40404040  40404040 40404040 40404040 40404040  |    :                            |
        +0003F8    40404040 404040F2                                                         |       2                         |
```

Figure 58. Trace table with trace table entry types 7 and 8 (Part 1 of 2)

```
         +000400    Time 22.10.56.826697    Date 2005.05.01    Thread ID... 21DEC83000000000
         +000410    Member ID.... 03    Flags..... 000000    Entry Type..... 00000008
         +000418    81F8F5F9 83F4F186 9593F3F4 40404040  7A86A495 83A38996 956D9581 94856D93  |a859c41fnl34    :function_name_l|
         +000438    859587A3 886D8598 A48193A2 6DA3966D  F060606E C3C5D3C8 E5F0F0F3 40404040  |ength_equals_to_0-->CELHV003    |
         +000458    40404040 7A979989 95A38640 40404040  40404040 40404040 40404040 40404040  |    :printf                      |
         +000478    40404040 404040F1                                                       |       1                         |

         +000480    Time 22.10.56.826697    Date 2005.05.01    Thread ID... 21DEC83000000000
         +000490    Member ID.... 03    Flags..... 000000    Entry Type..... 00000008
         +000498    40404040 40404040 40404040 40404040  7AF3F440 40404040 40404040 40404040  |                :34              |
         +0004B8    40404040 40404040 40404040 40404040  4060606E 40404040 40404040 40404040  |                 -->             |
         +0004D8    40404040 7A404040 40404040 40404040  40404040 40404040 40404040 40404040  |    :                            |
         +0004F8    40404040 404040F2                                                       |       2                         |

         +000500    Time 22.10.56.836542    Date 2005.05.01    Thread ID... 21DEC83000000000
         +000510    Member ID.... 03    Flags..... 000000    Entry Type..... 00000008
         +000518    81F8F5F9 83F4F186 9593F3F4 40404040  7A86A495 83A38996 956D9581 94856D93  |a859c41fnl34    :function_name_l|
         +000538    859587A3 886D8598 A48193A2 6DA3966D  F060606E 81F8F5F9 83F4F186 9593F3F5  |ength_equals_to_0-->a859c41fnl35|
         +000558    40404040 7A86A495 83A38996 956D9581  94856D93 859587A3 886D8598 A48193F3  |    :function_name_length_equal3|
         +000578    F56DA285 834040F1                                                       |5_sec  1                         |

         +000580    Time 22.10.56.836543    Date 2005.05.01    Thread ID... 21DEC83000000000
         +000590    Member ID.... 03    Flags..... 000000    Entry Type..... 00000008
         +000598    40404040 40404040 40404040 40404040  7AF3F440 40404040 40404040 40404040  |                :34              |
         +0005B8    40404040 40404040 40404040 40404040  4060606E 40404040 40404040 40404040  |                 -->             |
         +0005D8    40404040 7A969584 40404040 40404040  40404040 40404040 40404040 40404040  |    :ond                         |
         +0005F8    40404040 404040F2                                                       |       2                         |

         +000600    Time 22.10.56.836579    Date 2005.05.01    Thread ID... 21DEC83000000000
         +000610    Member ID.... 03    Flags..... 000000    Entry Type..... 00000008
         +000618    81F8F5F9 83F4F186 9593F3F4 40404040  7A86A495 83A38996 956D9581 94856D93  |a859c41fnl34    :function_name_l|
         +000638    859587A3 886D8598 A48193A2 6DA3966D  F060606E C3C5D3C8 E5F0F0F3 40404040  |ength_equals_to_0-->CELHV003    |
         +000658    40404040 7A979989 95A38640 40404040  40404040 40404040 40404040 40404040  |    :printf                      |
         +000678    40404040 404040F1                                                       |       1                         |

         +000680    Time 22.10.56.836579    Date 2005.05.01    Thread ID... 21DEC83000000000
         +000690    Member ID.... 03    Flags..... 000000    Entry Type..... 00000008
         +000698    40404040 40404040 40404040 40404040  7AF3F440 40404040 40404040 40404040  |                :34              |
         +0006B8    40404040 40404040 40404040 40404040  4060606E 40404040 40404040 40404040  |                 -->             |
         +0006D8    40404040 7A404040 40404040 40404040  40404040 40404040 40404040 40404040  |    :                            |
         +0006F8    40404040 404040F2                                                       |       2                         |

         +000700    Time 22.10.56.836605    Date 2005.05.01    Thread ID... 21DEC83000000000
         +000710    Member ID.... 03    Flags..... 000000    Entry Type..... 00000008
         +000718    81F8F5F9 83F4F186 9593F3F4 40404040  7A86A495 83A38996 956D9581 94856D93  |a859c41fnl34    :function_name_
      +000738    859587A3 886D8598 A48193A2 6DA3966D  F060606E C3C5D3C8 E5F0F0F3 40404040  |ength_equals_to_0-->CELHV003    |
         +000758    40404040 7A979989 95A38640 40404040  40404040 40404040 40404040 40404040  |    :printf                      |
         +000778    40404040 404040F1                                                       |       1                         |

         +000780    Time 22.10.56.836605    Date 2005.05.01    Thread ID... 21DEC83000000000
         +000790    Member ID.... 03    Flags..... 000000    Entry Type..... 00000008

         +000798    40404040 40404040 40404040 40404040  7AF3F440 40404040 40404040 40404040  |                :34              |
         +0007B8    40404040 40404040 40404040 40404040  4060606E 40404040 40404040 40404040  |                 -->             |
         +0007D8    40404040 7A404040 40404040 40404040  40404040 40404040 40404040 40404040  |    :                            |
         +0007F8    40404040 404040F2                                                       |       2                         |

         +000800    Time 22.10.56.836671    Date 2005.05.01    Thread ID... 21DEC83000000000
         +000810    Member ID.... 01    Flags..... 000000    Entry Type..... 00001800
         +000818    0125D23C A04F07F0 2033E150 20C121B8  00000001 00000010 00000000 20C121B8  |..K..|.0...&.A..............A..|
         +000838    01000000 00000000 00000000 00000000  00000000 00000000 000000F2 00000000  |........................2....|
         +000858    00000000 202D92B8 03000000 00000000  BCF2310D 2130666C 40404040 40404040  |......k..........2.....%        |
         +000878    40404040 40404040                                                       |                                 |

Additional Language Specific Information:

  errno information :
  Thread Id .... 21DEC83000000000 Errno ..... 0 Errnojr .... 00000000

   ⋮
```

Figure 58. Trace table with trace table entry types 7 and 8 (Part 2 of 2)

For more information about the Language Environment trace table format, see “Understanding the trace table entry (TTE)” on page 154.

Debugging examples of C/C++ routines

This section contains examples that demonstrate the debugging process for C/C++ routines. Important areas of the output are highlighted. Data unnecessary to the debugging examples has been replaced by ellipses.

Divide-by-zero error

Figure 59 illustrates a C program that contains a divide-by-zero error. The code was compiled with RENT so static and external variables need to be calculated from the WSA field. The code was compiled with XREF, LIST and OFFSET to generate a listing, which is used to calculate addresses of functions and data. The code was processed by the binder with MAP to generate a binder map, which is used to calculate the addresses of static and external variables.

```
#include <stdio.h>
#include <stdlib.h>
#include <errno.h>
int statint = 73;
int fa;
void funcb(int *pp);

int main(void) {
  int aa, bb=1;
  aa = bb;
  funcb(&aa);
  return(99);
}

void funcb(int *pp) {
  int result;
  fa = *pp;
  result = fa/(statint-73);
  return;
}
```

Figure 59. C routine with a divide-by-zero error

To debug this routine, use the following steps:

1. Locate the Original Condition message in the Condition Information for Active Routines section of the dump. In this example, the message is CEE3209S. The system detected a fixed—point divide exception. This message indicates the error was caused by an attempt to divide by zero. For additional information about CEE3209S, see *z/OS Language Environment Run-Time Messages*.

   The traceback section of the dump indicates that the exception occurred at offset X'76' within function funcb. This information is used along with the compiler-generated Pseudo Assembly Listing to determine where the problem occurred.

   If the TEST compiler option is specified, variable information is in the dump. If the GONUMBER compiler option is specified, statement number information is in the dump. Figure 60 on page 215 shows the generated traceback from the dump.

```
CEE3DMP V1 R9.0: Condition processing resulted in the unhandled condition.         01/15/07 6:20:36 PM                Page:    1
ASID: 0049   Job ID: JOB23480   Job name: CDIVZERO   Step name: STEP1      UserID: HEALY

CEE3845I CEEDUMP Processing started.

Information for enclave main

  Information for thread 8000000000000000

  Traceback:
    DSA   Entry       E  Offset  Statement   Load Mod             Program Unit                   Service  Status
    1     CEEHDSP     +00004030               CEEPLPKA             CEEHDSP                        D1908    Call
    2     funcb       +00000076  18           CDIVZERO                                                     Exception
    3     main        +00000064  12           CDIVZERO                                                     Call
    4     EDCZMINV    +000000C2                CEEEV003                                                     Call
    5     CEEBBEXT    +000001B6                CEEPLPKA             CEEBBEXT                       D1908    Call

    DSA   DSA Addr   E  Addr    PU Addr    PU Offset  Comp Date  Compile Attributes
    1     20FCB358   209C4238  209C4238   +00004030  20061215   CEL
    2     20FCB2B0   20900960  20900960   +00000076  20070115   C/C++
    3     20FCB208   209008E0  209008E0   +00000064  20070115   C/C++
    4     20FCB0F0   20E699EE  20E699EE   +000000C2  20061215   LIBRARY
    5     20FCB030   20992208  20992208   +000001B6  20061215   CEL

  Condition Information for Active Routines
    Condition Information for  (DSA address 20FCB2B0)
      CIB Address: 20FCBC78
      Current Condition:
        CEE0198S The termination of a thread was signaled due to an unhandled condition.
      Original Condition:
        CEE3209S The system detected a fixed-point divide exception (System Completion Code=0C9).
      Location:
        Program Unit:  Entry: funcb Statement: 18 Offset: +00000076
      Machine State:
        ILC..... 0002    Interruption Code..... 0009
        PSW..... 078D2400 A09009D8
        GPR0..... 20900A08  GPR1..... 00000000  GPR2..... 20FCB2A8  GPR3..... 2090099A
        GPR4..... 00000000  GPR5..... 00000001  GPR6..... 20900B24  GPR7..... 20900098
        GPR8..... 00000030  GPR9..... 80000000  GPR10.... A0E699E2  GPR11.... A0992208
        GPR12.... 209139B0  GPR13.... 20FCB2B0  GPR14.... 20914F50  GPR15.... 00000008

    Storage dump near condition, beginning at location: 209009C6
      +000000 209009C6  5811E000 504FE000 A71AFFB7 8E400020  1D4158F0 306A4110 D0985000 D0985050  |....&|..x.... .....0.....q&..q&&|
    GPREG STORAGE:
      Storage around GPR0 (20900A08)
        -0020 209009E8  0DEF18F5 58D0D004 58E0D00C 9825D01C  051E0707 00000000 00000008 209000B8  |...5........q....................|
        +0000 20900A08  D985A2A4 93A3407E 406C8415 00000000  1CCEA106 00000228 00000178 00000000  |Result = %d.....................|
⋮
```

Figure 60. Sections of the dump from example C/C++ routine

2. Locate the instruction with the divide-by-zero error in the Pseudo Assembly Listing in Figure 61 on page 216.

   The offset (within `funcb`) of the exception from the traceback (X'76') reveals the divide instruction: `DR  r4,r1` at that location. Instructions X'66' through X'76' refer to the `result = fa/(statint-73);` line of the C/C++ routine.

```
OFFSET OBJECT CODE       LINE#  FILE#    P S E U D O   A S S E M B L Y   L I S T I N G

                         000015 |       *  int funcb(int *pp) {
000000                   000015 |        funcb    DS       0D
.
.
.
000046  50D0  E004       000015 |                 ST       r13,4(,r14)
00004A  18DE             000015 |                 LR       r13,r14
00004C                   End of Prolog

00004C  58E0  C1F4       000000 |                 L        r14,_CEECAA_(,r12,500)
                         000016 |       *    int result;
                         000017 |       *    fa = *pp;
000050  5820  1000       000017 |                 L        r2,pp(,r1,0)
000054  5810  3062       000018 |                 L        r1,=Q(statint)(,r3,98)
000058  58F0  3066       000017 |                 L        r15,=Q(fa)(,r3,102)
00005C  C000  0000  0026 000000 |                 LARL     r0,F'38'
000062  5840  2000       000017 |                 L        r4,(*)int(,r2,0)
                         000018 |       *    result = fa/(statint-73);
000066  5811  E000       000018 |                 L        r1,statint(r1,r14,0)
00006A  504F  E000       000017 |                 ST       r4,fa(r15,r14,0)
00006E  A71A  FFB7       000018 |                 AHI      r1,H'-73'
000072  8E40  0020       000018 |                 SRDA     r4,32
000076  1D41             000018 |                 DR       r4,r1
                         000019 |       *    printf("Result = %d\n",result);
000078  58F0  306A       000019 |                 L        r15,=V(printf)(,r3,106)
00007C  4110  D098       000019 |                 LA       r1,#MX_TEMP2(,r13,152)
000080  5000  D098       000019 |                 ST       r0,#MX_TEMP2(,r13,152)
000084  5050  D09C       000019 |                 ST       r5,#MX_TEMP2(,r13,156)
000088  0DEF             000019 |                 BASR     r14,r15
                         000020 |       *    return result;
00008A  18F5             000020 |                 LR       r15,r5
                         000021 |       *  }
00008C                   000021 |        @2L3     DS       0H

00008C                   Start of Epilog
00008C  58D0  D004       000021 |                 L        r13,4(,r13)
000090  58E0  D00C       000021 |                 L        r14,12(,r13)
000094  9825  D01C       000021 |                 LM       r2,r5,28(r13)
000098  051E             000021 |                 BALR     r1,r14
00009A  0707             000021 |                 NOPR     7

00009C                   Start of Literals
00009C  00000000                                         =Q(statint)
0000A0  00000000                                         =Q(fa)
0000A4  00000000                                         =V(printf)
0000A8                   End of Literals

                         ***   General purpose registers used: 1111110000001111
                         ***   Floating point  registers used: 1111111100000000
                         ***   Size of register spill area: 128(max) 0(used)
                         ***   Size of dynamic storage: 168
                         ***   Size of executable code: 156

                         Constant Area
000000  D985A2A4 93A3407E 406C8415 00          |Result = %d..   |

                         PPA1: Entry Point Constants
000000  1CCEA106                                        =F'483303686'      Flags
000004  00000228                                        =A(PPA2-main)
000008  00000178                                        =A(PPA3-main)
00000C  00000000                                        =F'0'              No EPD
000010  FE000000                                        =F'-33554432'      Register save mask
000014  00000000                                        =F'0'              Member flags
000018  90                                              =AL1(144)          Flags
000019  000000                                          =AL3(0)            Callee's DSA use/8
00001C  0040                                            =H'64'             Flags
00001E  0012                                            =H'18'             Offset/2 to CDL
000020  00000000                                        =F'0'              Reserved
000024  5000003C                                        =F'1342177340'     CDL function length/2
000028  FFFFFEC8                                        =F'-312'           CDL function EP offset
00002C  38260000                                        =F'942014464'      CDL prolog
000030  40090033                                        =F'1074331699'     CDL epilog
000034  00000000                                        =F'0'              CDL end
000038  0004  ****                                      AL2(4),C'main'
                         PPA1 End
⋮
```

Figure 61. Pseudo assembly listing

3. Verify the value of the divisor `statint`. The procedure specified below is to be used for determining the value of static variables only. If the divisor is an

automatic variable, there is a different procedure for finding the value of the variable. For more information about finding automatic variables in a dump, see “Steps for finding automatic variables” on page 177.

Because this routine was compiled with the RENT option, find the WSA address in the Enclave Control Blocks section of the dump. In this example, this address is X'20914F50'. Figure 62 shows the WSA address.

```
 Enclave Control Blocks:
.
.
.
   WSA address.................20914F50
.
.
.
```

Figure 62. C/C++ CAA information in dump

4. Routines compiled with the RENT option must also be processed by the binder. The binder produces the Writable Static Map. Find the offset of `statint` in the Writable Static Map in Figure 63. In this example, the offset is X'0'.

```
.
---------------
CLASS  C_WSA            LENGTH =       AC  ATTRIBUTES = MRG, DEFER , RMODE=ANY
                        OFFSET =        0 IN SEGMENT 002       ALIGN = DBLWORD
---------------

           CLASS
          OFFSET  NAME               TYPE    LENGTH   SECTION
               0  statint          PART             4  statint
               8  fa               PART             4  fa
              10  environ          PART             4  environ
              18  errno            PART             4  errno
.
.
.
```

Figure 63. Writable static map

5. Add the WSA address of X'20914F50' to the offset of `statint`. The result is X'20914F50'. This is the address of the variable `statint`, which is in the writable static area.

   The writable static area is shown in the Enclave Storage section of the dump.

   For a load module, the writable static area is storage allocated by the C/C++ run-time for the C/C++ user, so it is in the user heap. For a program object, the writable static area is storage allocated by the loader and is shown in the WSA for Program Object(s) section of the dump.

   For this example, the program was built as a program object. The writable static area is displayed in the Enclave Storage section of the dump, shown in Figure 64 on page 218.
6. To find the variable `statint` in the writable static area, locate the closest address listed that is before the address of `statint`. In this case, that address is X'20914F50'. Count across X'00' to location X'20914F50'. The value at that location is X'49' (that is, `statint` is 73), and hence the fixed point divide exception.

```
  Enclave Storage:
⋮
    WSA for Program Object(s)
    WSA: 20914F50
      +000000 20914F50  00000049 00000000 00000001 00000000  2090A880 00000000 00000000 00000000  |.................y.............|
      +000020 20914F70  20910260 2091026A 00000000 00000000  00000000 00000000 00000000 00000000  |.j.-.j..........................|
      +000040 20914F90  00000001 00000000 00000001 00000000  00000000 00000000 00000000 00000000  |................................|
      +000060 20914FB0  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
      +000080 20914FD0  00000000 00000000 00000000 00000000  2090F6BC 00000000 2090F28C 00000000  |.................6.......2.....|
      +0000A0 20914FF0  2090F4A4 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |..4u............................|
⋮
```

Figure 64. Enclave storage section of dump

Calling a nonexistent non-XPLINK function

Figure 65 demonstrates the error of calling a nonexistent function. This routine was compiled with the compiler options LIST, OFFSET, and RENT and was run with the option TERMTHDACT(DUMP). The code was processed by the binder with MAP to generate a binder map, which is used to calculate the addresses of static and external variables.

This routine was not compiled with the TEST(ALL) compiler option. As a result, arguments and variables do not appear in the dump.

```
#include <stdio.h>
#include <stdlib.h>
#include <errno.h>
#include <signal.h>
void funca(int* aa);
int (*func_ptr)(void)=0;
int main(void) {
  int aa;
  funca(&aa);
  printf("result of funca = %d\n",aa);
  return;
}
void funca(int* aa) {
  *aa = func_ptr();
  return;
}
```

Figure 65. C/C++ example of calling a nonexistent subroutine

To debug this routine, use the following steps:

1. Locate the Original Condition message in the Condition Information for Active Routines section of the dump, shown in Figure 66 on page 219. In this example, the message is `CEE3201S The system detected an operation exception (System Completion Code=0C1).` This message suggests that the error was caused by an attempt to branch to an unknown address. For additional information about CEE3201S, see *z/OS Language Environment Run-Time Messages*.

   The Location section of the dump indicates that the exception occurred at offset X'-20900978' within function `funca` and that there may have been a bad branch from offset X'+0000005A' within function `funca` . The negative offset indicates that the offset cannot be used to locate the instruction that caused the error. Another indication of bad data is the value of X'80000002' in the instruction

address of the PSW. This address indicates that an instruction in the routine branched outside the bounds of the routine.

```
CEE3DMP V1 R9.0: Condition processing resulted in the unhandled condition.         01/15/07 5:38:23 PM                Page:    1
ASID: 0049   Job ID: JOB21060   Job name: EXIST      Step name: STEP1      UserID: HEALY

CEE3845I CEEDUMP Processing started.

Information for enclave main

  Information for thread 8000000000000000

  Traceback:
    DSA   Entry       E  Offset  Statement   Load Mod             Program Unit                   Service  Status
    1     CEEHDSP     +00004030              CEEPLPKA             CEEHDSP                        D1908    Call
    2     funca       -20900978              EXIST                                                        Exception
    3     main        +0000005C              EXIST                                                        Call
    4     EDCZMINV    +000000C2              CEEEV003                                                     Call
    5     CEEBBEXT    +000001B6              CEEPLPKA             CEEBBEXT                       D1908    Call

    DSA   DSA Addr   E  Addr    PU Addr    PU Offset  Comp Date  Compile Attributes
    1     20FCB350   209D2B08   209D2B08   +00004030  20061215   CEL
    2     20FCB2B0   20900978   20900978   -20900978  20070115   C/C++
    3     20FCB208   209008E0   209008E0   +0000005C  20070115   C/C++
    4     20FCB0F0   20E699EE   20E699EE   +000000C2  20061215   LIBRARY
    5     20FCB030   209A0AD8   209A0AD8   +000001B6  20061215   CEL

  Condition Information for Active Routines
    Condition Information for  (DSA address 20FCB2B0)
      CIB Address: 20FCBC70
      Current Condition:
        CEE0198S The termination of a thread was signaled due to an unhandled condition.
      Original Condition:
        CEE3201S The system detected an operation exception (System Completion Code=0C1).
      Location:
        Program Unit:  Entry: funca Statement:  Offset: -20900978
        Possible Bad Branch:  Statement:   Offset: +0000005A
      Machine State:
        ILC..... 0002    Interruption Code..... 0001
        PSW..... 078D1400 80000002
        GPR0..... 20FCB350  GPR1..... 20FCB2A0  GPR2..... 20FCB2A0  GPR3..... 209009B2
        GPR4..... A09A0BBC  GPR5..... 20912648  GPR6..... 20900AA4  GPR7..... 20900098
        GPR8..... 00000030  GPR9..... 80000000  GPR10.... A0E699E2  GPR11.... A09A0AD8
        GPR12.... 209139B0  GPR13.... 20FCB2B0  GPR14.... A09009D4  GPR15.... 00000000

    Storage dump near condition, beginning at location: 00000000
      +000000 00000000  Inaccessible storage.
    GPREG STORAGE:
      Storage around GPR0 (20FCB350)
     -0020 20FCB330  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
     +0000 20FCB350  0808CEE1 20FCB2B0 20FCE470 A09D6B3A  A09EFFD8 20FCB350 20FCB7A8 20912648  |.........U...,....Q...&...y.j..|
:
 Parameters, Registers, and Variables for Active Routines:
    CEEHDSP (DSA address 20FCB350):
      UPSTACK DSA
      Saved Registers:
        GPR0..... 20FCB350  GPR1..... 20FCB7A8  GPR2..... 20912648  GPR3..... 00000080
        GPR4..... 209D7734  GPR5..... A0915000  GPR6..... 2090C2A8  GPR7..... 20FCBC70
        GPR8..... A09D665A  GPR9..... 20FCD34E  GPR10.... 20FCC34F  GPR11.... 209D2B08
        GPR12.... 209139B0  GPR13.... 20FCB350  GPR14.... A09D6B3A  GPR15.... A09EFFD8
:
    funca (DSA address 20FCB2B0):
      UPSTACK DSA
      Saved Registers:
        GPR0..... 20FCB350  GPR1..... 20FCB2A0  GPR2..... 20FCB2A0  GPR3..... 209009B2
        GPR4..... A09A0BBC  GPR5..... 20912648  GPR6..... 20900AA4  GPR7..... 20900098
        GPR8..... 00000030  GPR9..... 80000000  GPR10.... A0E699E2  GPR11.... A09A0AD8
        GPR12.... 209139B0  GPR13.... 20FCB2B0  GPR14.... A09009D4  GPR15.... 00000000
:
```

Figure 66. Sections of the dump from example C routine

2. Find the branch instructions at offset X'+0000005A' of `funca` in the listing in Figure 67 on page 220. The instruction is `BASR r14,r15`. This branch is part of

the source statement *aa = func_ptr().

```
OFFSET OBJECT CODE       LINE#  FILE#    P S E U D O   A S S E M B L Y   L I S T I N G

                         000016 |       *  void funca(int* aa) {
000000                   000016 |        funca    DS       0D
.
.
.
000046  50D0  E004       000016 |                 ST       r13,4(,r14)
00004A  18DE             000016 |                 LR       r13,r14
00004C                   End of Prolog

00004C  58E0  C1F4       000000 |                 L        r14,_CEECAA_(,r12,500)
                         000017 |       *    *aa = func_ptr();
000050  58F0  303A       000017 |                 L        r15,=Q(func_ptr)(,r3,58)
000054  1821             000016 |                 LR       r2,r1
000056  58FF  E000       000017 |                 L        r15,func_ptr(r15,r14,0)
00005A  0DEF             000017 |                 BASR     r14,r15
00005C  5810  2000       000017 |                 L        r1,aa(,r2,0)
000060  50F0  1000       000017 |                 ST       r15,(*)int(,r1,0)
                         000018 |       *    return;
                         000019 |       *  }
000064                   000019 |        @2L3     DS       0H

000064                   Start of Epilog
000064  58D0  D004       000019 |                 L        r13,4(,r13)
000068  58E0  D00C       000019 |                 L        r14,12(,r13)
00006C  9824  D01C       000019 |                 LM       r2,r4,28(r13)
000070  051E             000019 |                 BALR     r1,r14
000072  0707             000019 |                 NOPR     7
```

Figure 67. Pseudo assembly listing

3. Find the offset of `func_ptr` in the Writable Static Map, shown in Figure 68, as produced by the binder.

```
⋮
---------------
CLASS  C_WSA             LENGTH =       A4  ATTRIBUTES = MRG, DEFER , RMODE=ANY
                         OFFSET =        0 IN SEGMENT 002       ALIGN = DBLWORD
---------------

           CLASS
          OFFSET  NAME                TYPE    LENGTH   SECTION
               0  func_ptr         PART             4  func_ptr
               8  environ          PART             4  environ
              10  errno            PART             4  errno
              18  tzname           PART             8  tzname
⋮
```

Figure 68. Writable static map

4. Add the offset of `FUNC@PTR` (X'0') to the address of WSA (X'20914F58'). The result (X'20914F58') is the address of the function pointer `func_ptr` in the writable static storage area within the heap. This value is 0, indicating the variable is uninitialized.

   Figure 69 on page 221 shows the sections of the dump.

```
⋮
  Enclave Control Blocks:
⋮
    WSA address.................20914F58

  Enclave Storage:
⋮
    WSA for Program Object(s)
    WSA: 20914F58
      +000000 20914F58  00000000 00000000 2090A880 00000000  00000000 00000000 20910260 2091026A  |.........y.............j.-.j..|
      +000020 20914F78  00000000 00000000 00000000 00000000  00000000 00000000 00000001 00000000  |................................|
      +000040 20914F98  00000001 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
      +000060 20914FB8  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
      +000080 20914FD8  00000000 00000000 2090F6BC 00000000  2090F28C 00000000 2090F4A4 00000000  |.........6.......2.......4u....|
      +0000A0 20914FF8  00000000 00000000 A099FF10 A09C4A58  A09D0FD8 A09D7E98 A09D2B08 A09D9A78  |.........r.........Q..=q........|
⋮
```

Figure 69. Enclave control blocks and storage sections in dump

Calling a nonexistent XPLINK function

Figure 70 demonstrates the error of calling a nonexistent function. This routine was compiled with the compiler options XPLINK, LIST and RENT and was run with the option TERMTHDACT(DUMP).

This routine was not compiled with the TEST(ALL) compile option. As a result, arguments and variables do not appear in the dump.

```
#include <stdio.h>
#include <stdlib.h>
#include <errno.h>
#include <signal.h>
void funca(int* aa);
int (*func_ptr)(void)=0;
int main(void) {
  int aa;
  funca(&aa);
  printf("result of funca = %d\n",aa);
  return;
}
void funca(int* aa) {
  *aa = func_ptr();
  return;
}
```

Figure 70. C/C++ example of calling a nonexistent subroutine

To debug this routine, use the following steps:

1. Locate the Original Condition message in the Condition Information for Active Routines section of the dump, shown in Figure 71 on page 222. In this example, the message is `CEE3201S The system detected an operation exception (System Completion Code=0C1).` This message suggests that the error was caused by an attempt to branch to an unknown address. For additional information about CEE3201S, see *z/OS Language Environment Run-Time Messages*.

   The location section of the dump indicates that the exception occurred at offset X'-20900158' within function `funca` and that there may have been a bad branch from offset X'+0000001C'. The negative offset indicates that the offset cannot be used to locate the instruction that caused the error. Another indication of bad data is the value of X'80000004' in the instruction address of the PSW. This address indicates that an instruction in the routine branched outside the bounds

of the routine.

```
CEE3DMP V1 R9.0: Condition processing resulted in the unhandled condition.         01/15/07 1:41:48 PM                 Page:    1
ASID: 0051   Job ID: JOB06606   Job name: XEXIST     Step name: STEP1      UserID: HEALY

CEE3845I CEEDUMP Processing started.

Information for enclave main

  Information for thread 8000000000000000

  Traceback:
    DSA   Entry       E  Offset  Statement   Load Mod             Program Unit                   Service  Status
    1     CEEHDSP     +00004030              CEEPLPKA             CEEHDSP                        D1908    Call
    2     CEEHRNUH    +00000092              CEEPLPKA             CEEHRNUH                       D1908    Call
    3     funca       -20900158              XEXIST                                                       Exception
    4     main        +00000012              XEXIST                                                       Call
    5     CEEVROND    +000011FA              CEEPLPKA                                                     Call
    6     EDCZHINV    +000000B4              CELHV003             EDCZHINV                       D1908    Call
    7     CEEBBEXT    +000001B6              CEEPLPKA             CEEBBEXT                       D1908    Call

    DSA   DSA Addr   E  Addr    PU Addr    PU Offset  Comp Date  Compile Attributes
    1     2110C500   209D2B08   209D2B08   +00004030  20061215   CEL
    2     2110C340   209E0B80   209E0B80   +00000092  20061215   CEL
    3     211B5620   20900158   20900158   -20900158  20000404   C/C++    XPLINK EBCDIC  HFP
    4     211B56A0   209000D0   209000D0   +00000012  20000404   C/C++    XPLINK EBCDIC  HFP
    5     211B5720   20ACA1E0   20ACA188   +00001252  20061215   CEL      XPLINK EBCDIC  HFP
    6     2110C0F0   20C36CE8   20C36CE8   +000000B4  20061214   LIBRARY
    7     2110C030   209A0AD8   209A0AD8   +000001B6  20061215   CEL

  Condition Information for Active Routines
    Condition Information for  (DSA address 211B5620)
      CIB Address: 2110CE20
      Current Condition:
        CEE0198S The termination of a thread was signaled due to an unhandled condition.
      Original Condition:
        CEE3201S The system detected an operation exception (System Completion Code=0C1).
      Location:
        Program Unit:  Entry: funca Statement:  Offset: -20900158
        Possible Bad Branch:  Statement:   Offset: +0000001C
      Machine State:
        ILC..... 0002    Interruption Code..... 0001
        PSW..... 078D2400 80000002
        GPR0..... 2110C500  GPR1..... 211B5F00  GPR2..... 2110C294  GPR3..... 2110C298
        GPR4..... 211B5620  GPR5..... 00FDD100  GPR6..... 00000000  GPR7..... A0900176
        GPR8..... A09000DA  GPR9..... 20ACB187  GPR10.... 2110C1A0  GPR11.... A0ACA188
        GPR12.... 209139B0  GPR13.... 2110C1B8  GPR14.... 00000000  GPR15.... 00000000

    Storage dump near condition, beginning at location: 00000000
      +000000 00000000  Inaccessible storage.
    GPREG STORAGE:
     Storage around GPR0 (2110C500)
      -0020 2110C4E0  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
      +0000 2110C500  0808CEE1 2110C340 2110F620 A09D6B3A  A09EFFD8 2110C500 2110C958 20912648  |......C ..6...,....Q..E...I..j..|
      +0020 2110C520  00000080 209D7734 A0915000 2090C2A8  2110CE20 A09D665A 2110E4FE 2110D4FF  |.........j&...By.......!..U...M.|
⋮
```

Figure 71. Sections of the dump from example C routine (Part 1 of 2)

```
  Parameters, Registers, and Variables for Active Routines:
    CEEHDSP (DSA address 2110C500):
      UPSTACK DSA
      Saved Registers:
        GPR0..... 2110C500  GPR1..... 2110C958  GPR2..... 20912648  GPR3..... 00000080
        GPR4..... 209D7734  GPR5..... A0915000  GPR6..... 2090C2A8  GPR7..... 2110CE20
        GPR8..... A09D665A  GPR9..... 2110E4FE  GPR10.... 2110D4FF  GPR11.... 209D2B08
        GPR12.... 209139B0  GPR13.... 2110C500  GPR14.... A09D6B3A  GPR15.... A09EFFD8
⋮
    CEEHRNUH (DSA address 2110C340):
      TRANSITION DSA
      Saved Registers:
        GPR0..... 2110C500  GPR1..... 00000000  GPR2..... 2090B3B0  GPR3..... 2090B458
        GPR4..... 209E0B80  GPR5..... 211B5620  GPR6..... 2110C340  GPR7..... 209E625C
        GPR8..... 940C1000  GPR9..... 00000000  GPR10.... 2090B430  GPR11.... 209E0B80
        GPR12.... 209139B0  GPR13.... 2110C340  GPR14.... A09E0C14  GPR15.... 209D2B08
⋮
    funca (DSA address 211B5620):
      DOWNSTACK DSA
      Saved Registers:
        GPR0..... 2110C500  GPR1..... 211B5F00  GPR2..... 2110C294  GPR3..... 2110C298
        GPR4..... 211B5620  GPR5..... 00FDD100  GPR6..... 00000000  GPR7..... A0900176
        GPR8..... A09000DA  GPR9..... 20ACB187  GPR10.... 2110C1A0  GPR11.... A0ACA188
        GPR12.... 209139B0  GPR13.... 2110C1B8  GPR14.... 00000000  GPR15.... 00000000
⋮
```

Figure 71. Sections of the dump from example C routine (Part 2 of 2)

2. Find the branch instruction at offset X'+0000001C' of `funca` in the listing in Figure 72. This instruction is `BASR r7,r6`. This branch is part of the source statement `*aa = func_ptr()`.

```
                        00015 |       *  void funca(int* aa) {
  ⋮
000020                                   @2L0     DS    0D
000020  00C300C5                                 =F'12779717'       XPLink entrypoint marker
000024  00C500F1                                 =F'12910833'
000028  FFFFFFE0                                 =F'-32'
00002C  00000080                                 =F'128'
000000                          00015 |        funca    DS    0D
000000  9057  4784              00015 |                  STM   r5,r7,1924(r4)
000004  A74A  FF80              00015 |                  AHI   r4,H'-128'
000008                          End of Prolog

000008  5010  48C0              00015 |                  ST    r1,aa(,r4,2240)
                                00016 |       *    *aa = func_ptr();
00000C  5860  4804              00016 |                  L     r6,#Save_ADA_Ptr_2(,r4,2052)
000010  5860  6018              00016 |                  L     r6,=A(func_ptr)(,r6,24)
000014  5860  6000              00016 |                  L     r6,func_ptr(,r6,0)
000018  9856  6010              00016 |                  LM    r5,r6,&ADA_&EPA(r6,16)
00001C  0D76                    00016 |                  BASR  r7,r6
00001E  4700  0004              00016 |                  NOP   4
000022  1803                    00016 |                  LR    r0,r3
000024  5860  48C0              00016 |                  L     r6,aa(,r4,2240)
000028  5000  6000              00016 |                  ST    r0,(*)int(,r6,0)
                                00017 |       *    return;
                                00018 |       *  }
00002C                          00018 |        @2L3     DS    0H

00002C                          Start of Epilog
00002C  5870  480C              00018 |                  L     r7,2060(,r4)
000030  4140  4080              00018 |                  LA    r4,128(,r4)
000034  07F7                    00018 |                  BR    r7
  ⋮
```

Figure 72. Pseudo assembly listing

3. Find the offset of `func_ptr` in the Writable Static Map, shown in Figure 73 on page 224.

```
  ⋮
---------------
CLASS  C_WSA            LENGTH =       3C  ATTRIBUTES = MRG, DEFER , RMODE=ANY
                        OFFSET =        0 IN SEGMENT 002       ALIGN = DBLWORD
---------------

           CLASS
          OFFSET  NAME                TYPE    LENGTH   SECTION

               0  $PRIV000011       PART            10
              10  exist              PART            28  EXIST
              38  func_ptr           PART             4  func_ptr

  ⋮
```

Figure 73. Writable static map

4. Add the offset of `func_ptr` (X'38') to the address of WSA (X'20914FC0'). The result (X'20914FF8') is the address of the function pointer `func_ptr` in the writable static storage area within the heap. This value is 0, indicating the variable is uninitialized.

   Figure 74 shows the sections of the dump.

```
Enclave Control Blocks:
  ⋮
  DLL Information:
  WSA Addr  Module Addr  Thread ID        Use Count  Name
  20914FC0                                00000001   main

  WSA address.................20914FC0

Enclave Storage:
  ⋮
  WSA for Program Object(s)
  WSA: 20914FC0
    +000000 20914FC0  C36DE6E2 C1404040 40404040 40404040  9985A2A4 93A34096 864086A4 95838140  |C_WSA           result of funca |
    +000020 20914FE0  7E406C84 15000000 20914FF8 00000000  00000060 20F23280 00000000 00000000  |= %d.....j|8.......-.2.........|
  ⋮
```

Figure 74. Enclave control blocks and storage sections in dump

Handling dumps written to the z/OS UNIX file system

When a z/OS UNIX C/C++ application program is running in an address space created as a result of a call to `spawnp()`, `vfork()`, or one of the `exec` family of functions, the SYSMDUMP DD allocation information is not inherited. Even though the SYSMDUMP allocation is not inherited, a SYSMDUMP allocation must exist in the parent in order to obtain a HFS storage dump.

Alternatively, you can specify the DYNDUMP run-time option to generate a system dump. For more information, see *z/OS Language Environment Programming Reference*.

If the program terminates abnormally while running in this new address space, the kernel causes an unformatted storage dump to be written to an HFS file in the user's working directory. The file is placed in the current working directory or into /tmp if the current working directory is not defined. The file name has the following format:

```
/directory/coredump.pid
```

where directory is the current working directory or tmp, and pid is the hexadecimal process ID (PID) for the process that terminated. For details on how to generate the system dump, see “Steps for generating a system dump in a z/OS UNIX shell” on page 83.

To debug the dump, use the MVS Interactive Problem Control System (IPCS). If the dump was written to an HFS file, you must allocate a data set that is large enough and has the correct attributes for receiving a copy of the HFS file. For example, from the ISPF DATA SET UTILITY panel you can specify a volume serial and data set name to allocate. Doing so brings up the DATA SET INFORMATION panel for specifying characteristics of the data set to be allocated. The following filled-in panel shows the characteristics defined for the URCOMP.JRUSL.COREDUMP dump data set:

```
--------------------------  DATA SET INFORMATION  ----------------------
Command ===>

Data Set Name  . . . : URCOMP.JRUSL.COREDUMP

General Data                          Current Allocation
 Management class . . : STANDARD       Allocated cylinders : 30
 Storage class  . . . : OS390          Allocated extents . : 1
  Volume serial . . . : DPXDU1
  Device type . . . . : 3380
 Data class . . . . . :
  Organization  . . . : PS            Current Utilization
  Record format . . . : FB             Used cylinders. . . : 0
  Record length . . . : 4160           Used extents  . . . : 0
  Block size  . . . . : 4160
  1st extent cylinders: 30
  Secondary cylinders : 10
  Data set name type  :

  Creation date . . . : 2001/08/30
  Expiration date . . : ***None***

F1=Help     F2=Split     F3=End       F4=Return    F5=Rfind     F6=Rchange
F7=Up       F8=Down      F9=Swap     F10=Left     F11=Right    F12=Cancel
```

Figure 75. IPCS panel for entering data set information

Fill in the information for your data set as shown, and estimate the number of cylinders required for the dump file you are going to copy.

Use the TSO/E OGET or OCOPY command with the BINARY keyword to copy the file into the data set. For example, to copy the HFS storage dump file `coredump.00060007` into the data set URCOMP.JRUSL.COREDUMP just allocated, a user with the user ID URCOMP enters the following command:

```
OGET '/u/urcomp/coredump.00060007' 'urcomp.jrusl.coredump' BINARY
```

For more information on using the copy commands, see *z/OS UNIX System Services User's Guide*.

After you have copied the storage dump file to the data set, you can use IPCS to analyze the dump. See “Formatting and analyzing system dumps” on page 84 for information about formatting Language Environment control blocks.

Multithreading consideration

Certain control blocks are locked while a dump is in progress. For example, a `csnap()` of the file control block would prevent another thread from using or dumping the same information. An attempt to do so causes the second thread to wait until the first one completes before it can continue.

Understanding C/C++ heap information in storage reports

Storage reports that contain specific C/C++ heap information can be generated in two ways:

- By setting the Language Environment RPTSTG(ON) run-time option for Language Environment created heaps
- By issuing a stand-alone call to the C function `__uheapreport()` for user–created heaps.

Details on how to request and interpret the reports are provided in the following sections.

Language Environment storage report with HEAPPOOLS statistics

To request a Language Environment storage report set RPTSTG(ON). If the C/C++ application specified the HEAPPOOLS(ON) run-time option, then the storage report displays HEAPPOOLS statistics. For a sample storage report showing HEAPPOOLS statistics for a multithreaded C/C++ application, see Figure 3 on page 14.

The following describes the C/C++ specific heap pool information.

HEAPPOOLS storage statistics

The HEAPPOOLS run-time option controls usage of the heap pools storage algorithm at the enclave level. The heap pools algorithm allows for the definition of one to twelve heap pools, each consisting of a number of storage cells of a specified length.

Usage Note: The use of an alternative Vendor Heap Manager (VHM) overrides the use of the HEAPPOOLS run-time option.

HEAPPOOLS statistics:

- Pool *p* size: *ssss* Get requests: *gggg*
  - *p* — the number of the pool. When there are multiple pools for a cell size, the pools are numbered using the format *aa.bbb*.
    - *aa* — the number for the cell size.
    - *bbb* — the number for the pool within the cell size.
  - *ssss* — the cell size specified for the pool.
  - *gggg* — the number of storage requests that were satisfied from this pool.
- Successful Get Heap requests: *xxxx-yyyy n*
  - *xxxx* — the low side of the 8 byte range
  - *yyyy* — the high side of the 8 byte range
  - *n* — the number of requests in the 8 byte range.
- Requests greater than the largest cell size — the number of storage requests that are not satisfied by heap pools.

Note: Values displayed in the HEAPPOOLS Statistics report are not serialized when collected, therefore the values are not necessarily exact.

HEAPPOOLS summary: The HEAPPOOLS Summary displays a report of the HeapPool Statistics and provides suggested percentages for current cell sizes as well as suggested cell sizes.

- Specified Cell Size — the size of the cell specified in the HEAPPOOLS run-time option

- Element Size — the size of the cell plus any additional storage needed for control information or to maintain alignment
- Extent Percent — the cell pool percent specified by the HEAPPOOLS run-time option
- Cells Per Extent — the number of cells per extent. This number is calculated using the following formula:

  ```
  Initial Heap Size * (Extent Percent/100))/(Element Size)
  ```

  with a minimum of four cells.

  Note: Having a small number of cells per extent is not recommended since the pool could allocate many extents, which would cause the HeapPool algorithm to perform inefficiently.
- Extents Allocated — the number of times that each pool allocated an extent.

  In order to optimize storage usage, the extents allocated should be either one or two. If the number of extents allocated is too high, then increase the percentage for the pool.
- Maximum Cells Used — the maximum number of cells used for each pool.
- Cells In Use — the number of cells that were never freed.

  Note: A large number in this field could indicate a storage leak.
- Suggested Percentages for current Cell Sizes — percentages calculated to find the optimal size of the cell pool extent. The calculation is based on the following formula:

  ```
  (Maximum Cells Used * (Element Size) * 100) / Initial Heap Size
  With a minimum of 1% and a maximum of 90%
  ```

  Make sure that your cell pool extents are neither too large nor too small. If your percentages are too large then additional, unreferenced virtual storage will be allocated, thereby causing the program to exhaust the region size. If the percentages are too small then the HEAPPOOLS algorithm will run inefficiently.
- Suggested Cell Sizes — sizes that are calculated to optimally use storage (assuming that the application will __malloc/__free with the same frequency).

  Note: The suggested cell sizes are given with no percentages because the usage of each new cell pool size is not known. If there are less than 12 cell sizes calculated and the last calculated cell size is smaller than the largest cell size currently in effect, the largest cell size currently in effect will be used for the last suggested cell size.

For more information about stack and heap storage, see *z/OS Language Environment Programming Guide*.

C function __uheapreport() storage report

To generate a user-created heap storage report use the C function, *__uheapreport()*. Use the information in the report to assist with tuning your application's use of the user-created heap.

User-created HeapPools statistics

- Pool *p* size: *ssss*
  - *p* — the number of the pool
  - *ssss* — the cell size specified for the pool.
- Successful Get Heap requests: *xxxx-yyyy n*
  - *xxxx* — the low side of the range

  - *yyyy* — the high side of the range
  - *n* — the number of requests in the range.
- Requests greater than the largest cell size — the number of storage requests that are not satisfied by heap pools.

Note: Values displayed in the HeapPools Statistics report are not serialized when collected, therefore the values are not necessarily exact.

HeapPools summary

The HeapPools Summary displays a report of the HeapPool Statistics and provides suggested percentages for current cell sizes as well as suggested cell sizes.

- Cell Size — the size of the cell specified on the __ucreate() call
- Extent Percent — the cell pool percent specified on the __ucreate() call
- Cells Per Extent — the number of cells per extent. This number is calculated using the following formula:

  ```
  Initial Heap Size * (Extent Percent/100))/(8 + Cell Size)
  ```

  with a minimum of four cells.
- Extents Allocated — the number of times that each pool allocated an extent.
- Maximum Cells Used — the maximum number of cells used for each pool.
- Cells In Use — the number of cells that were never freed.

  Note: A large number in this field could indicate a storage leak.
- Suggested Percentages for current Cell Sizes — percentages calculated to find the optimal size of the cell pool extent. The calculation is based on the following formula:

  ```
  (Maximum Cells Used * (Cell Size + 8) * 100) / Initial Heap Size
  With a minimum of 1% and a maximum of 90%
  ```

  Make sure that your cell pool extents are neither too large nor too small. If your percentages are too large then additional, unreferenced virtual storage will be allocated, thereby causing the program to exhaust the region size. If the percentages are too small then the HeapPools algorithm will run inefficiently.
- Suggested Cell Sizes — sizes that are calculated to optimally use storage (assuming that the application will __umalloc/__ufree with the same frequency).

  Note: The suggested cell sizes are given with no percentages because the usage of each new cell pool size is not known. If there are less than 12 cell sizes calculated and the last calculated cell size is smaller than the largest cell size currently in effect, the largest cell size currently in effect will be used for the last suggested cell size.

For more information about stack and heap storage, see *z/OS Language Environment Programming Guide*.

For more information on the *__uheapreport()* function, see *z/OS XL C/C++ Run-Time Library Reference*. For tuning tips, see *z/OS Language Environment Programming Guide*.

A sample storage report generated by *__uheapreport()* is shown in Figure 76 on page 229.

```
Storage Report for Enclave  12/18/08 11:42:23 AM
Language Environment V01 R11.00

    HeapPools Statistics:
      Pool 1 size:    32
        Successful Get Heap requests:     1-   32          11250
      Pool 2 size:   128
        Successful Get Heap requests:    97-  128           3306
      Pool 3 size:   512
        Successful Get Heap requests:   481-  512            864
      Pool 4 size:  2048
        Successful Get Heap requests:  2017- 2048            216
      Pool 5 size:  8192
        Successful Get Heap requests:  8161- 8192             54
      Pool 6 size: 16384
        Successful Get Heap requests: 16353-16384             27
      Requests greater than the largest cell size:             0
    HeapPools Summary:
      Cell  Extent   Cells Per  Extents    Maximum     Cells In
      Size  Percent  Extent     Allocated  Cells Used  Use
      ------------------------------------------------------------
         32   15        3750           1        3750           0
        128   15        1102           1        1102           0
        512   15         288           1         288           0
       2048   15          72           1          72           0
       8192   15          18           1          18           0
      16384   15           9           1           9           0
      ------------------------------------------------------------
      Suggested Percentages for current Cell Sizes:
        32,15,128,15,512,15,2048,15,8192,15,16384,15
      Suggested Cell Sizes:
        32,,128,,512,,2048,,8192,,16384,
End of Storage Report
```

Figure 76. Storage report generated by __uheapreport()

MEMCHECK VHM memory leak analysis tool

The MEMCHECK VHM memory leak analysis tool is an alternative vendor heap manager used to diagnose memory problems. MEMCHECK VHM performs the following functions:

- check for heap storage leaks, double free, and overlays
- trace user heap storage allocation and deallocation requests

The results are displayed in two reports.

Restrictions

- MEMCHECK VHM works with C/C++ and Enterprise PL/I applications, but is not enabled for COBOL or Fortran.
- MEMCHECK VHM and HEAPPOOLS are mutually exclusive. HEAPPOOLS will be ignored when MEMCHEKC VHM is active.
- MEMCHECK VHM should not be used in PIPI, PICI, CICS, and SPC environments.

Invoking MEMCHECK VHM

As with any alternate vendor heap manager, you must specify the dllname with the environment variable _CEE_HEAP_MANAGER to indicate that MEMCHECK VHM will be used to manage the user heap. Since CEE_HEAP_MANAGER must be set

before any user code gains control, use the ENVAR run-time option to set the variable or set it inside the file specified by the environment variable, _CEE_ENVFILE or _CEE_ENVFILE_S. The format is

```
_CEE_HEAP_MANAGER=dllname
```

There are two DLLs associated with MEMCHECK VHM:

CEL4MCHK
31-bit base and xplink.

CELQMCHK
64-bit.

They use the following events:

_VHM_INIT
replaces C-RTL malloc(), calloc(), realloc(), and free() with the corresponding MEMCHECK VHM functions. This event is only at Language Environment Initialization and only called by Language Environment.

_VHM_TERM
terminates Vendor Heap Manager to free the memcheck storage functions. This event is called only by Language Environment at Language Environment Termination.

_VHM_REPORT
generates the Heap Leak Report and the optional Trace Report. This new event will be called by Language Environment at Language Environment Termination and will write the Heap Leak Report (and the optional Trace Report if the _CEE_MEMCHECK_TRACE environment variable is active) in the output file name specified in _CEE_MEMCHECK_OUTFILENAME. This event can also be called dynamically by the __vhm_event() API.

MEMCHECK VHM environment variables

The MEMCHECK VHM environment variables control the tool, the call levels of the Heap Leak Report and Trace Report, the Overlay Analysis, the pad length added in the user heap allocation for overlay analysis, and the output file name for the reports.

They should be activated through the ENVAR run-time option, the file specified by the _CEE_ENV_FILE environment variable, or using the export command from the USS shell before any user code gets control (prior to the HLL user exit, static constructors, or main getting control). Setting these environment variables once the user code has begun execution will not activate them and the default values will be used.

_CEE_MEMCHECK_DEPTH
Description: Controls the number of call-levels to be generated on the Heap Leak Report.

Valid settings: integer value : the minimum is 1 and the maximum is MAX_CALL_LEVELS (100). If an invalid value is specified, the default value will be used.

Default: 10.

_CEE_MEMCHECK_OVERLAY
Description: Activates the storage overlays analysis beyond the end of the malloc'd storage.

Valid settings: ON to activate the analysis, OFF to deactivate. If an invalid value is specified, the default value will be used.

Default: OFF

_CEE_MEMCHECK_OVERLAYLEN

Description: Sets the pad length added in the user heap allocation for overlay analysis. This environment variable will be used only if _CEE_MEMCHECK_OVERLAY is active.

Valid settings: integer value, multiple of 4 : the minimum is 4 and the maximum is MAX_OVERLAY_LENGTH (80). Non-multiples of 4 will be rounded up to the next multiple.

Default: 4

_CEE_MEMCHECK_TRACE

Description: Enables tracing of all heap storage allocation and deallocation and a Trace Report will be generated at Language Environment Termination.

Valid settings: ON to activate the analysis, OFF to deactivate. If an invalid value is specified, the default value will be used.

Default: OFF

_CEE_MEMTRACE_DEPTH

Description: Controls the number of call-levels to be generated in the Trace Report, on each call to a library function that deals with heap. This environment variable will be used only if _CEE_MEMCHECK_TRACE is active.

Valid settings: integer value: the minimum is 1 and the maximum is MAX_CALL_LEVELS (100). If an invalid value is specified, the default value will be used.

Default: 10

_CEE_MEMCHECK_OUTFILENAME

Description: Sets the name of the fully qualified path name of the file in which the Heap Leak Report and Trace Report should be directed. The report name could be any valid name used in C-RTL fopen() function, then it could also generates the reports in a Data Set.

Valid settings: string value. If an invalid value is specified, the default value will be used.

Default: standard error output

MEMCHECK VHM report sample scenario

In this example, the MEMCHECK VHM tool is used by specifying the environment variables from the USS shell. The user specifies a depth of 8 call levels in the Heap Leak Report and 8 call levels in the Trace Report for 31-bit.

1. `Export _CEE_MEMCHECK_DEPTH=8`

   specifies the depth to trace on storage requests (written to the Heap Leak Report)
2. `Export _CEE_MEMCHECK_TRACE=ON`

   activates the Trace Report option
3. `Export _CEE_MEMTRACE_DEPTH=8`

   specifies the depth to trace on storage requests (written to the Trace Report)
4. `Export _CEE_MEMCHECK_OVERLAY=ON`

   activates the Overlay analysis option

5. `Export _CEE_HEAP_MANAGER=CEL4MCHK`

   activates the tool with the 31-bit DLL (automatically generating the Heap Leak Report)

MEMCHECK VHM report examples

Both reports are written at Language Environment termination (_VHM_TERM event). They are written in the output file name specified in _CEE_MEMCHECK_OUTFILENAME and are consistent with the format of other Language Environment reports.

The Trace Report will be generated at Language Environment termination (_VHM_TERM event) if the _CEE_MEMCHECK_TRACE environment variable is active. The report generates the traceback information of all heap storage allocations and deallocations.

```
MEMCHECK
Language Environment V1 R7
TRACE REPORT for enclave main, termination report

DEALLOCATE of storage at 0x25a2ea30
      - sequence 12
      Called from: 25a43c78  +00000120  MemFree
      Called from: 05cd9918  +0000005c  CEEPGTFN
      Called from: 257f6888  +000002b0  _cterm
      Called from: 05d46788  +0000040c  (unknown)
DEALLOCATE of storage at 0x25a2e0c8
      - sequence 11
      Called from: 25a43c78  +00000120  MemFree
      Called from: 05cd9918  +0000005c  CEEPGTFN
      Called from: 257f6888  +000001bc  _cterm
      Called from: 05d46788  +0000040c  (unknown)
DEALLOCATE of storage at 0x25a2ecf8
      - sequence 10
      Called from: 25a43c78  +00000120  MemFree
      Called from: 05cd9918  +0000005c  CEEPGTFN
      Called from: 25601ae8  +000000b2  function3
      Called from: 25601bb8  +0000008c  function2
      Called from: 25601c68  +000000ca  function1
      Called from: 25601a60  +00000062  main
ALLOCATE of storage at 0x25a2ecf8 for 5 bytes
      - sequence 9
      Called from: 25a44330  +000000fc  MemAlloc
      Called from: 05cd9918  +0000005c  CEEPGTFN
      Called from: 25601ae8  +00000084  function3
      Called from: 25601bb8  +0000008c  function2
      Called from: 25601c68  +000000ca  function1
      Called from: 25601a60  +00000062  main
ALLOCATE of storage at 0x25a2ecd8 for 8 bytes
      - sequence 8
      Called from: 25a44330  +000000fc  MemAlloc
      Called from: 05cd9918  +0000005c  CEEPGTFN
      Called from: 25601bb8  +0000007e  function2
      Called from: 25601c68  +000000ca  function1
      Called from: 25601a60  +00000062  main
DEALLOCATE of storage at 0x25a2ecd8
      - sequence 7
      Called from: 25a43c78  +00000120  MemFree
      Called from: 05cd9918  +0000005c  CEEPGTFN
      Called from: 25601c68  +000000bc  function1
      Called from: 25601a60  +00000062  main
DEALLOCATE of storage at 0x25a2ecd8
      - sequence 6
      Called from: 25a43c78  +00000120  MemFree
      Called from: 05cd9918  +0000005c  CEEPGTFN
      Called from: 25601c68  +0000009e  function1
      Called from: 25601a60  +00000062  main
ALLOCATE of storage at 0x25a2ecd8 for 4 bytes
      - sequence 5
      Called from: 25a44330  +000000fc  MemAlloc
      Called from: 05cd9918  +0000005c  CEEPGTFN
      Called from: 25601c68  +0000007e  function1
      Called from: 25601a60  +00000062  main
ALLOCATE of storage at 0x25a2ec90 for 48 bytes
      - sequence 4
      Called from: 25a44330  +000000fc  MemAlloc
      Called from: 05cd9918  +0000005c  CEEPGTFN
      Called from: 25725c08  +000000a0  dllinit
      Called from: 05d49c88  +000007dc  (unknown)
```

Figure 77. Trace report generated by MEMCHECK VHM (Part 1 of 2)

```
ALLOCATE of storage at 0x25a2ea30 for 584 bytes
      - sequence 3
      Called from: 25a44330  +000000fc  MemAlloc
      Called from: 05cd9918  +0000005c  CEEPGTFN
      Called from: 258c6d70  +00000186  setlocale
      Called from: 25862540  +0000059e  tzset
      Called from: 257f8d30  +00002df2  _cinit
      Called from: 05d4abb0  +00000cb4  (unknown)
ALLOCATE of storage at 0x25a2e1f8 for 2074 bytes
      - sequence 2
      Called from: 25a44330  +000000fc  MemAlloc
      Called from: 05cd9918  +0000005c  CEEPGTFN
      Called from: 258c6958  +00000070  realloc_name_buffer
      Called from: 258c6d70  +00000132  setlocale
      Called from: 25862540  +0000059e  tzset
      Called from: 257f8d30  +00002df2  _cinit
      Called from: 05d4abb0  +00000cb4  (unknown)
ALLOCATE of storage at 0x25a2e0c8 for 280 bytes
      - sequence 1
      Called from: 25a44330  +000000fc  MemAlloc
      Called from: 05cd9918  +0000005c  CEEPGTFN
      Called from: 258c6d70  +000000f6  setlocale
      Called from: 25862540  +0000059e  tzset
      Called from: 257f8d30  +00002df2  _cinit
      Called from: 05d4abb0  +00000cb4  (unknown)
```

Figure 77. Trace report generated by MEMCHECK VHM (Part 2 of 2)

The Heap Leak Report will be generated with any remaining entries in the memory leak control block. The allocated entries will be reported as storage leaks, while the deallocated entries will be reported as duplicated deallocations and the overlay entries as overlay damage.

```
MEMCHECK
Language Environment V1 R7
HEAP LEAK REPORT for enclave main, termination report

     Total number of ALLOCATE calls = 7
     Total number of DEALLOCATE calls = 5


     Current number of bytes allocated = 288928
     Maximum number of bytes allocated = 289824


    Total number of unmatched ALLOCATE calls = 3
  Unmatched ALLOCATE of 8 bytes at address 0x25a2ecd8
      - sequence 8
      Called from: 25a44330  +000000d2  MemAlloc
      Called from: 05cd9918  +0000005c  CEEPGTFN
      Called from: 25601bb8  +0000007e  function2
      Called from: 25601c68  +000000ca  function1
      Called from: 25601a60  +00000062  main
  Unmatched ALLOCATE of 48 bytes at address 0x25a2ec90
      - sequence 4
      Called from: 25a44330  +000000d2  MemAlloc
      Called from: 05cd9918  +0000005c  CEEPGTFN
      Called from: 25725c08  +000000a0  dllinit
      Called from: 05d49c88  +000007dc  (unknown)
  Unmatched ALLOCATE of 2074 bytes at address 0x25a2e1f8
      - sequence 2
      Called from: 25a44330  +000000d2  MemAlloc
      Called from: 05cd9918  +0000005c  CEEPGTFN
      Called from: 258c6958  +00000070  realloc_name_buffer
      Called from: 258c6d70  +00000132  setlocale
      Called from: 25862540  +0000059e  tzset
      Called from: 257f8d30  +00002df2  _cinit
      Called from: 05d4abb0  +00000cb4  (unknown)

    Total number of unmatched DEALLOCATE calls = 1
  Unmatched DEALLOCATE at address 0x25a2ecd8
      - sequence 7
      Called from: 25a43c78  +000000f2  MemFree
      Called from: 05cd9918  +0000005c  CEEPGTFN
      Called from: 25601c68  +000000bc  function1
      Called from: 25601a60  +00000062  main

    Total number of OVERLAY calls = 1
  OVERLAY damage using more than 5 bytes requested at address 0x25a2ecf8
      Called from: 25a44330  +000000d2  MemAlloc
      Called from: 05cd9918  +0000005c  CEEPGTFN
      Called from: 25601ae8  +00000084  function3
      Called from: 25601bb8  +0000008c  function2
      Called from: 25601c68  +000000ca  function1
      Called from: 25601a60  +00000062  main
```

Figure 78. Heap Leak Report generated by MEMCHECK VHM

Note: The following names are used within MEMCHECK to denote special cases and may be displayed in any of the reports:

(unknown)
Name of the routine is not known.

(noname)
Routine does not have a name in the PPA section. (For example, module compiled with **compress** option).

(nospace)
Internal memory space reserved by MEMCHECK is full, so name was not saved for the traceback information. No action is needed from the user.

Chapter 5. Debugging COBOL programs

This chapter provides information for debugging applications that contain one or more COBOL programs. It includes information about:

- Determining the source of error
- Generating COBOL listings and the Language Environment dump
- Finding COBOL information in a dump
- Debugging example COBOL programs

Determining the source of error

The following sections describe how you can determine the source of error in your COBOL program. They explain how to simplify the process of debugging COBOL programs by using features such as the DISPLAY statement, declaratives, and file status keys. The following methods for determining errors are covered:

- Tracing program logic
- Finding and handling input/output errors
- Validating data
- Assessing switch problems
- Generating information about procedures

After you have located and fixed any problems in your program, you should delete all debugging aids and recompile it before running it in production. Doing so helps the program run more efficiently and use less storage.

Tracing program logic

You can add DISPLAY statements to help you trace through the logic of the program in a non-CICS environment. If, for example, you determine that the problem appears in an EVALUATE statement or in a set of nested IF statements, DISPLAY statements in each path tell you how the logic flows. You can also use DISPLAY statements to show you the value of interim results.

For example, to check logic flow, you might insert:

```
DISPLAY "ENTER CHECK PROCEDURE".
       .
       .  (checking procedure routine)
       .
DISPLAY "FINISHED CHECK PROCEDURE".
```

to determine whether you started and finished a particular procedure. After you are sure that the program works correctly, comment out the DISPLAY statement lines by putting asterisks in position 7 of the appropriate lines. For a detailed description of the DISPLAY statement, see *Enterprise COBOL for z/OS Language Reference*, SC23-8528 or *Enterprise COBOL for z/OS Language Reference*, SC27-1408.

Scope terminators can also help you trace the logic of your program because they clearly indicate the end of a statement. For a detailed description of scope terminators, see

- *Enterprise COBOL for z/OS Programming Guide*, SC23-8529
- *Enterprise COBOL for z/OS Programming Guide*, SC27-1412
- *COBOL for OS/390 & VM Programming Guide*

© Copyright IBM Corp. 1991, 2009

Finding input/output errors

VSAM file status keys can help you determine whether routine errors are due to the logic of your routine or are I/O errors occurring on the storage media.

To use file status keys as a debugging aid, include a test after each I/O statement to check for a value other than 0 in the file status key. If the value is other than 0, you can expect to receive an error message. You can use a nonzero value to indicate how the I/O procedures in the routine were coded. You can also include procedures to correct the error based on the file status key value.

The file status key values and their associated meanings are described in the following documents:

- *Enterprise COBOL for z/OS Language Reference*, SC23-8528
- *Enterprise COBOL for z/OS Language Reference*, SC27-1408
- *COBOL for OS/390 & VM Language Reference*

Handling input/output errors

If you have determined that the problem lies in one of the I/O procedures in your program, you can include the USE EXCEPTION/ERROR declarative to help debug the problem. If the file does not open, the appropriate USE EXCEPTION/ERROR declarative is activated. You can specify the appropriate declarative for the file or for the different open attributes—INPUT, OUTPUT, I/O, or EXTEND.

Code each USE AFTER STANDARD ERROR statement in a separate section immediately after the Declarative Section keyword of the Procedure Division. See the rules for coding such usage statements in the following documents:

- *Enterprise COBOL for z/OS Language Reference*, SC23-8528
- *Enterprise COBOL for z/OS Language Reference*, SC27-1408
- *COBOL for OS/390 & VM Language Reference*

Validating data (class test)

If you suspect that your program is trying to perform arithmetic on nonnumeric data or is somehow receiving the wrong type of data on an input record, you can use the class test to validate the type of data. For a detailed discussion of how to use the class test to check for incompatible data, see

- *Enterprise COBOL for z/OS Programming Guide*, SC23-8529
- *Enterprise COBOL for z/OS Programming Guide*, SC27-1412
- *COBOL for OS/390 & VM Programming Guide*

Assessing switch problems

Using INITIALIZE or SET statements to initialize a table or data item is useful when you suspect that a problem is caused by residual data left in those fields. If your problem occurs intermittently and not always with the same data, the problem could be that a switch is not initialized, but is generally set to the right value (0 or 1). By including a SET statement to ensure that the switch is initialized, you can determine whether or not the uninitialized switch is the cause of the problem. For a detailed discussion of how to use the INITIALIZE and SET statements, see

- *Enterprise COBOL for z/OS Programming Guide*, SC23-8529
- *Enterprise COBOL for z/OS Programming Guide*, SC27-1412
- *COBOL for OS/390 & VM Programming Guide*

Generating information about procedures

You can use the USE FOR DEBUGGING declarative to include COBOL statements in a COBOL program and specify when they should run. Use these statements to generate information about your program and how it is running.

For example, to check how many times a procedure is run, include a special procedure for debugging (in the USE FOR DEBUGGING declarative) that adds 1 to a counter each time control passes to that procedure. The adding-to-a-counter technique can be used as a check for:

- How many times a PERFORM ran. This shows you whether the control flow you are using is correct.
- How many times a loop routine actually runs. This tells you whether the loop is running and whether the number you have used for the loop is accurate.

Code each USE FOR DEBUGGING declarative in a separate section in the DECLARATIVES SECTION of the PROCEDURE DIVISION. See the rules for coding them in the following documents:

- *Enterprise COBOL for z/OS Language Reference*, SC23-8528
- *Enterprise COBOL for z/OS Language Reference*, SC27-1408
- *COBOL for OS/390 & VM Language Reference*

.

You can use debugging lines, debugging statements, or both in your program. Debugging lines are placed in your program, and are identified by a `D` in position 7. Debugging statements are coded in the DECLARATIVES SECTION of the PROCEDURE DIVISION.

- The USE FOR DEBUGGING declaratives must:
  - Be only in the DECLARATIVES SECTION
  - Follow a DECLARATIVES header USE FOR DEBUGGING

  With USE FOR DEBUGGING, the TEST compiler option must have the NONE hook-location suboption specified or the NOTEST compiler option must be specified. The TEST compiler option and the DEBUG run-time option are mutually exclusive, with DEBUG taking precedence.
- Debugging lines must have a `D` in position 7 to identify them.

To use debugging lines and statements in your program, you must include both:

- WITH DEBUGGING MODE in the SOURCE-COMPUTER paragraph in the ENVIRONMENT DIVISION
- The DEBUG run-time option

Figure 79 on page 240 shows how to use the DISPLAY statement and the USE FOR DEBUGGING declarative to debug a program.

```
Environment Division
Source Computer . . . With Debugging Mode.

:
Data Division.

:
  File Section.

  Working-Storage Section.

 *(among other entries you would need:)

  01  Trace-Msg    PIC X(30)
                   Value "  Trace for Procedure-Name : ".
  01  Total        PIC 99  Value Zeros.

 *(balance of Working-Storage Section)

Procedure Division.
Declaratives.
Debug-Declar Section.
    Use For Debugging On 501-Some-Routine.
Debug-Declar-Paragraph.
    Display Trace-Msg, Debug-Name, Total.
Debug-Declar-End.
    Exit.

End Declaratives.

Begin-Program Section.
:
    Perform 501-Some-Routine.

   *(within the module where you want to test, place:)

    Add 1 To Total

  * (whether you put a period at the end depends on
  * where you put this statement.)
```

Figure 79. Example of using the WITH DEBUGGING MODE clause

In the example in Figure 79, portions of a program are shown to illustrate the kind of statements needed to use the USE FOR DEBUGGING declarative. The DISPLAY statement specified in the DECLARATIVES SECTION issues the:

```
Trace For Procedure-Name : 501-Some-Routine nn
```

message every time the PERFORM 501-SOME-ROUTINE runs. The total shown, *nn*, is the value accumulated in the data item named TOTAL.

Another use for the DISPLAY statement technique shown above is to show the flow through your program. You do this by changing the USE FOR DEBUGGING declarative in the DECLARATIVES SECTION to:

```
USE FOR DEBUGGING ON ALL PROCEDURES.
```

and dropping the word TOTAL from the DISPLAY statement.

Using COBOL listings

When you are debugging, you can use one or more of the following listings:
- Sorted Cross-Reference listing
- Data Map listing
- Verb Cross-Reference listing
- Procedure Division Listings

This section gives an overview of each of these listings and specifies the compiler option you use to obtain each listing. For a detailed description of available listings, sample listings, and a complete description of COBOL compiler options, see the following documents:

- *Enterprise COBOL for z/OS Programming Guide*, SC23-8529
- *Enterprise COBOL for z/OS Programming Guide*, SC27-1412
- *COBOL for OS/390 & VM Programming Guide*

Table 16. Compiler-generated COBOL listings and their contents

Name	Contents	Compiler Option
Sorted Cross-Reference Listings	Provides sorted cross-reference listings of DATA DIVISION, PROCEDURE DIVISION, and program names. The listings provide the location of all references to this information.	XREF
Data Map listing	Provides information about the locations of all DATA DIVISION items and all implicitly declared variables. This option also supplies a nested program map, which indicates where the programs are defined and provides program attribute information.	MAP
Verb Cross-Reference listing	Produces an alphabetic listing of all the verbs in your program and indicates where each is referenced.	VBREF
Procedure Division listings	Tells the COBOL compiler to generate a listing of the PROCEDURE DIVISION along with the assembler coding produced by the compiler. The list output includes the assembler source code, a map of the task global table (TGT), information about the location and size of WORKING-STORAGE and control blocks, and information about the location of literals and code for dynamic storage usage.	LIST
Procedure Division listings	Instead of the full PROCEDURE DIVISION listing with assembler expansion information, you can use the OFFSET compiler option to get a condensed listing that provides information about the program verb usage, global tables, WORKING-STORAGE, and literals. The OFFSET option takes precedence over the LIST option. That is, OFFSET and LIST are mutually exclusive; if you specify both, only OFFSET takes effect.	OFFSET

Generating a Language Environment dump of a COBOL program

The two sample programs shown in Figure 80 on page 242 and Figure 81 on page 243 generate Language Environment dumps with COBOL-specific information.

COBOL program that calls another COBOL program

In this example, program COBDUMP1 calls COBDUMP2, which in turn calls the Language Environment dump service CEE3DMP.

```
CBL  TEST(STMT,SYM),RENT
     IDENTIFICATION DIVISION.
       PROGRAM-ID.   COBDUMP1.
       AUTHOR. USER NAME

     ENVIRONMENT DIVISION.

     DATA DIVISION.

     WORKING-STORAGE SECTION.
     01 SOME-WORKINGSTG.
        05 SUB-LEVEL PIC X(80).

     01   SALARY-RECORDA.
      02    NAMEA   PIC X(10).
      02    DEPTA   PIC 9(4).
      02    SALARYA PIC 9(6).

     PROCEDURE DIVISION.
     START-SEC.
         DISPLAY "STARTING TEST COBDUMP1".
         MOVE "THIS IS IN WORKING STORAGE" TO SUB-LEVEL.
         CALL "COBDUMP2" USING SALARY-RECORDA.
         DISPLAY "END OF TEST COBDUMP1"
         STOP RUN.
     END PROGRAM COBDUMP1.
```

Figure 80. COBOL program COBDUMP1 calling COBDUMP2

COBOL program that calls the Language Environment CEE3DMP callable service

In the example in Figure 81 on page 243, program COBDUMP2 calls the Language Environment dump service CEE3DMP.

```
CBL  TEST(STMT,SYM),RENT
     IDENTIFICATION DIVISION.
       PROGRAM-ID.   COBDUMP2.
       AUTHOR. USER NAME

     ENVIRONMENT DIVISION.
     INPUT-OUTPUT SECTION.
     FILE-CONTROL.
         SELECT OPTIONAL IOFSS1 ASSIGN AS-ESDS1DD
             ORGANIZATION SEQUENTIAL ACCESS SEQUENTIAL.

     DATA DIVISION.
     FILE SECTION.
     FD  IOFSS1 GLOBAL.
       1 IOFSS1R PIC X(40).

     WORKING-STORAGE SECTION.
       01  TEMP4.
           05  A-1 OCCURS 2 TIMES.
               10  A-2 OCCURS 2 TIMES.
                   15 A-3V PIC X(3).
                   15 A-6  PIC X(3).
     77   DMPTITLE   PIC X(80).
     77   OPTIONS    PIC X(255).
     77   FC         PIC X(12).

     LINKAGE SECTION.
     01   SALARY-RECORD.
      02    NAME   PIC X(10).
      02    DEPT   PIC 9(4).
      02    SALARY PIC 9(6).

     PROCEDURE DIVISION USING SALARY-RECORD.
     START-SEC.
         DISPLAY "STARTING TEST COBDUMP2"
         MOVE "COBOL DUMP" TO DMPTITLE.
         MOVE "XXX" TO A-6(1, 1).
         MOVE "YYY" TO A-6(1, 2).
         MOVE "ZZZ" TO A-6(2, 1).
         MOVE " BLOCKS STORAGE PAGE(55) FILES" TO OPTIONS.
         CALL "CEE3DMP" USING DMPTITLE, OPTIONS, FC.
         DISPLAY "END OF TEST COBDUMP2"
         GOBACK.
     END PROGRAM COBDUMP2.
```

Figure 81. COBOL program COBDUMP2 calling the Language Environment dump service CEE3DMP

Sample Language Environment dump with COBOL-specific information

The call in program COBDUMP2 to CEE3DMP generates a Language Environment dump, shown in Figure 82 on page 244. The dump includes a traceback section, which shows the names of both programs; a section on register usage at the time the dump was generated; and a variables section, which shows the storage and data items for each program. Character fields in the dump are indicated by single quotes. For an explanation of these sections of the dump, see “Finding COBOL information in a dump” on page 245.

```
CEE3DMP V1 R9.0: COBOL DUMP                                                    02/14/07 2:59:23 PM                  Page:    1
ASID: 0099   Job ID: J0005740   Job name: COBDUMP1   Step name: GO        UserID: BARBARA

CEE3845I CEEDUMP Processing started.
CEE3DMP called by program unit COBDUMP2 at statement 40 (offset +00000496).

Registers on Entry to CEE3DMP:

  PM....... 0000
  GPR0..... 11480BDC  GPR1..... 114842C0  GPR2..... 114A4340  GPR3..... 11202BBC
  GPR4..... 11202818  GPR5..... 11480100  GPR6..... 00000000  GPR7..... 00FDD100
  GPR8..... 114A41D8  GPR9..... 11480AA0  GPR10.... 11202908  GPR11.... 11202AD4
  GPR12.... 112129C0  GPR13.... 114841D0  GPR14.... 91202C78  GPR15.... 912EF898
  FPR0..... 00000000  00000000            FPR2..... 00000000  00000000
  FPR4..... 00000000  00000000            FPR6..... 00000000  00000000
    GPREG STORAGE:
      Storage around GPR0 (11480BDC)
        -0020 11480BBC  00000000 00000000 00000000 114A4158  114A41D8 00000000 114A4120 0001E038  |...................Q............|
        +0000 11480BDC  00000000 00000000 11202D2C 07FE07FE  00000000 00000000 00001FFF 07FE0000  |................................|
        +0020 11480BFC  00000000 00000000 00000000 11480C50  40000000 00000000 00000000 11480D68  |...............& ...............|
⋮
Information for enclave COBDUMP1

  Information for thread 8000000000000000

  Registers on Entry to CEE3DMP:
    PM....... 0000
    GPR0..... 11480BDC  GPR1..... 114842C0  GPR2..... 114A4340  GPR3..... 11202BBC
    GPR4..... 11202818  GPR5..... 11480100  GPR6..... 00000000  GPR7..... 00FDD100
    GPR8..... 114A41D8  GPR9..... 11480AA0  GPR10.... 11202908  GPR11.... 11202AD4
    GPR12.... 112129C0  GPR13.... 114841D0  GPR14.... 91202C78  GPR15.... 912EF898
    FPR0..... 00000000  00000000            FPR2..... 00000000  00000000
    FPR4..... 00000000  00000000            FPR6..... 00000000  00000000
    GPREG STORAGE:
      Storage around GPR0 (11480BDC)
        -0020 11480BBC  00000000 00000000 00000000 114A4158  114A41D8 00000000 114A4120 0001E038  |...................Q............|
        +0000 11480BDC  00000000 00000000 11202D2C 07FE07FE  00000000 00000000 00001FFF 07FE0000  |................................|
        +0020 11480BFC  00000000 00000000 00000000 11480C50  40000000 00000000 00000000 11480D68  |...............& ...............|
⋮

  Traceback:
    DSA   Entry       E  Offset  Statement   Load Mod             Program Unit                   Service  Status
    1     COBDUMP2    +00000496  40          GO                   COBDUMP2                                Call
    2     COBDUMP1    +000003A4  23          GO                   COBDUMP1                                Call

    DSA   DSA Addr   E  Addr    PU Addr    PU Offset  Comp Date  Compile Attributes
    1     114841D0   112027E0   112027E0   +00000496  20070214   COBOL
    2     11484030   11200398   11200398   +000003A4  20070214   COBOL

  Parameters, Registers, and Variables for Active Routines:
    COBDUMP2 (DSA address 114841D0):
      UPSTACK DSA
      Saved Registers:
        GPR0..... 11480BDC  GPR1..... 114842C0  GPR2..... 114A4340  GPR3..... 11202BBC
        GPR4..... 11202818  GPR5..... 11480100  GPR6..... 00000000  GPR7..... 00FDD100
        GPR8..... 114A41D8  GPR9..... 11480AA0  GPR10.... 11202908  GPR11.... 11202AD4
        GPR12.... 112129C0  GPR13.... 114841D0  GPR14.... 91202C78  GPR15.... 912EF898
    GPREG STORAGE:
      Storage around GPR0 (11480BDC)
        -0020 11480BBC  00000000 00000000 00000000 114A4158  114A41D8 00000000 114A4120 0001E038  |...................Q............|
        +0000 11480BDC  00000000 00000000 11202D2C 07FE07FE  00000000 00000000 00001FFF 07FE0000  |................................|
        +0020 11480BFC  00000000 00000000 00000000 11480C50  40000000 00000000 00000000 11480D68  |...............& ...............|
⋮

      Local Variables:
             13 IOFSS1                           FILE SPECIFIED AS: OPTIONAL, ORGANIZATION=VSAM SEQUENTIAL,
                                                ACCESS MODE=SEQUENTIAL, RECFM=FIXED.  CURRENT STATUS OF
                                                FILE IS: NOT OPEN, FILE STATUS CODE=00, VSAM FEEDBACK=000,
                                                VSAM RET CODE=000, VSAM FUNCTION CODE=000.
             14 01 IOFSS1R          X(40) DISP       '                                        '
             17 01 TEMP4            AN-GR
             18  02 A-1              AN-GR OCCURS 2
             19   03 A-2             AN-GR OCCURS 2
```

Figure 82. Sections of the Language Environment dump called from COBDUMP2 (Part 1 of 2)

```
            20    04 A-3V             XXX
                     SUB(1,1)         DISP            '   '
                    SUB(1,2) to SUB(2,2) elements same as above.
            21    04 A-6              XXX
                     SUB(1,1)         DISP            'XXX'
                     SUB(1,2)                         'YYY'
                     SUB(2,1)                         'ZZZ'
                     SUB(2,2)                         '   '
            22 77 DMPTITLE         X(80) DISP       'COBOL DUMP
                                                                '
            23 77 OPTIONS          X(255) DISP      ' BLOCKS STORAGE PAGE(55) FILES

                                                               '
            24 77 FC               X(12) DISP       '            '
            27 01 SALARY-RECORD    AN-GR
            28  02 NAME            X(10) DISP       '          '
            29  02 DEPT            9999 DISP
            30  02 SALARY          9(6) DISP
   COBDUMP1 (DSA address 11484030):
     UPSTACK DSA
     Saved Registers:
       GPR0..... 1148057C  GPR1..... 11484120  GPR2..... 114A4120  GPR3..... 112006C4
       GPR4..... 112003D0  GPR5..... 11211778  GPR6..... 00000000  GPR7..... 00000000
       GPR8..... 114A40D0  GPR9..... 11480448  GPR10.... 112004C0  GPR11.... 112005E8
       GPR12.... 112129C0  GPR13.... 11484030  GPR14.... 9120073E  GPR15.... 112027E0
   GPREG STORAGE:
     Storage around GPR0 (1148057C)
       -0020 1148055C  114A40D0 00000000 00000000 00000000  00000000 114A4050 114A40D0 00000000  |.. ..... &.. .....|
       +0000 1148057C  11480A48 00000000 11200824 07FE07FE  00000000 00000000 00001FFF 07FE0000  |.....|
       +0020 1148059C  00000000 00000000 00000000 40000000  00000000 00000000 00000000 00000001  |..... .....|
⋮
     Local Variables:
            10 01 SOME-WORKINGSTG  AN-GR
            11  02 SUB-LEVEL        X(80) DISP       'THIS IS IN WORKING STORAGE
                                                                '
            13 01 SALARY-RECORDA   AN-GR
            14  02 NAMEA           X(10) DISP       '          '
            15  02 DEPTA           9999 DISP
            16  02 SALARYA         9(6) DISP
⋮
```

Figure 82. Sections of the Language Environment dump called from COBDUMP2 (Part 2 of 2)

Finding COBOL information in a dump

Like the standard Language Environment dump format, dumps generated from COBOL programs contain:

- Control block information for active programs
- Storage for each active program
- Enclave-level data
- Process-level data

Control block information for active routines

The Control Blocks for Active Routines section of the dump, shown in Figure 83 on page 246, displays the following information for each active COBOL program:

- DSA
- Program name and date/time of compile
- COBOL compiler Version, Release, Modification, and User Level
- COBOL compile Options
- COBOL control blocks TGT and CLLE. The layout of the TGT can be found by looking at the compiler listing of the COBOL program. The CLLE is a COBOL control block that is allocated by the COBOL runtime for each program. The CLLE is dumped for IBM service personnel use.

```
⋮
  Control Blocks for Active Routines:
    DSA for COBDUMP2: 114841D0
      +000000  FLAGS.... 0010      member... 4001      BKC...... 11484030  FWC...... 11484370  R14...... 91202C78
      +000010  R15...... 912EF898  R0....... 11480BDC  R1....... 114842C0  R2....... 114A4340  R3....... 11202BBC
      +000024  R4....... 11202818  R5....... 11480100  R6....... 00000000  R7....... 00FDD100  R8....... 114A41D8
      +000038  R9....... 11480AA0  R10...... 11202908  R11...... 11202AD4  R12...... 112129C0  reserved. 00000000
      +00004C  NAB...... 11484370  PNAB..... 00000000  reserved. 00000000  11480AA0
      +000064  reserved. 11200398  reserved. 114803F0  MODE..... 00016108  reserved. 00000000
      +000078  reserved. 11205F98  reserved. 00000000

    Program COBDUMP2 was compiled 02/14/07 2:59:20 PM
    COBOL Version = 03 Release = 04 Modification = 01     User Level = '    '

    COBOL compile options

    Compile Options for COBDUMP2:
      ADV, ARITH(COMPAT), NOAWO, CODEPAGE(01140), DATA(31), NODATEPROC, DBCS,
      NODLL, NODYNAM, NOEXPORTALL, NOFASTSRT, INTDATE(ANSI), NUMPROC(NOPFD),
      NOOPTIMIZE, OUTDD(SYSOUT), PGMNAME(COMPAT), RENT, RMODE(ANY), NOSSRANGE,
      TEST(STMT,SYM,NOSEPARATE), NOTHREAD, TRUNC(STD), YEARWINDOW(1900), ZWB
    TGT for COBDUMP2: 11480AA0
      +000000 11480AA0  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
      +000020 11480AC0 - +00003F 11480ADF             same as above
      +000040 11480AE0  00000000 00000000 F3E3C7E3 00000000  06000000 42430260 11480100 000167FC  |........3TGT...........-........|
      +000060 11480B00  11480C20 00000001 00000174 00000000  00000000 114A4148 00000000 00000000  |................................|
      +000080 11480B20  112129C0 00000180 00000000 00000000  00000000 00000001 E2E8E2D6 E4E34040  |........................SYSOUT  |
      +0000A0 11480B40  C9C7E9E2 D9E3C3C4 00000000 00000000  00000000 00000000 00000000 00000000  |IGZSRTCD........................|
      +0000C0 11480B60  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
      +0000E0 11480B80  00000000 00000000 112028DC 00000000  11480C0C 11480A48 1120298B 11480BE0  |................................|
      +000100 11480BA0  112027E0 11202910 11480C08 11202904  11480C08 114A41D8 00000000 00000000  |........................Q........|
      +000120 11480BC0  00000000 00000000 114A4158 114A41D8  00000000 114A4120 0001E038 00000000  |..............Q.................|
      +000140 11480BE0  00000000 11202D2C 07FE07FE 00000000  00000000 00001FFF 07FE0000 00000000  |................................|
      +000160 11480C00  00000000 00000000 11480C50 40000000  00000000 00000000 11480D68 00000001  |...........& ...................|

    CLLE for COBDUMP2: 11480A48
      +000000 11480A48  C3D6C2C4 E4D4D7F2 00004100 00000000  84810000 112027E0 11480AA0 00000000  |COBDUMP2........da..............|
      +000020 11480A68  00000000 114808E4 114809F0 114803F0  00000001 00000000 00000000 00000000  |.......U...0...0................|
⋮
```

Figure 83. Control block information for active COBOL routines

Storage for each active routine

The Storage for Active Routines section of the dump, shown in Figure 84 on page 247, displays the following information for each COBOL program:

- Program name
- Contents of the base locators for files, WORKING-STORAGE, LINKAGE SECTION, LOCAL-STORAGE SECTION, variably-located areas, and EXTERNAL data.
- File record contents.
- WORKING-STORAGE, including the base locator for WORKING-STORAGE (BLW) and program class storage.

```
:
  Storage for Active Routines:
    COBDUMP2:
      Contents of base locators for files are:
           0-0001E038

      Contents of base locators for WORKING-STORAGE are:
           0-114A41D8

      Contents of base locators for the LINKAGE SECTION are:
           0-00000000        1-114A4120

      No indexes were used in this program.

      No variably-located areas were used in this program.

      No EXTERNAL data was used in this program.

      No OBJECT instance data were used in this program.

      No LOCAL-STORAGE was used in this program.

      No DSA indexes were used in this program.

      No FACTORY data was used in this program.

      No XML data was used in this program.

    File record contents for COBDUMP2
    ESDS1DD  (BLF-0): 0001E038
      +000000 0001E038  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
      +000020 0001E058 - +00003F 0001E077             same as above

    WORKING-STORAGE for COBDUMP2
    BLW-0: 114A41D8
      +000000 114A41D8  000000E7 E7E70000 00E8E8E8 000000E9  E9E90000 00000000 C3D6C2D6 D340C4E4  |...XXX...YYY...ZZZ......COBOL DU|
      +000020 114A41F8  D4D74040 40404040 40404040 40404040  40404040 40404040 40404040 40404040  |MP                              |
      +000040 114A4218  40404040 40404040 40404040 40404040  40404040 40404040 40404040 40404040  |                                |
      +000060 114A4238  40404040 40404040 40C2D3D6 C3D2E240  E2E3D6D9 C1C7C540 D7C1C7C5 4DF5F55D  |         BLOCKS STORAGE PAGE(55)|
      +000080 114A4258  40C6C9D3 C5E24040 40404040 40404040  40404040 40404040 40404040 40404040  | FILES                          |
      +0000A0 114A4278  40404040 40404040 40404040 40404040  40404040 40404040 40404040 40404040  |                                |
      +0000C0 114A4298 - +00015F 114A4337             same as above
      +000160 114A4338  40404040 40404000 00000000 00000000  00000000 00000000 00000000 00000000  |       ........................|

    LINKAGE SECTION for COBDUMP2
    BLL-1: 114A4120
      +000000 114A4120  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
      +000020 114A4140  114A4018 00000218 00000210 00000000  00000000 11480C40 00000000 00000000  |.. ................... ........|
      +000040 114A4160  00000000 00000000 00000000 00000000  C9C7E9E2 D9E3C3C4 00000000 00000000  |................IGZSRTCD........|
      +000060 114A4180  00000000 00000000 00000000 00000000  E2E8E2D6 E4E34040 00000000 00000000  |................SYSOUT  ........|
      +000080 114A41A0  0E000000 00000000 0F000000 00000000  00000000 00000000 40404040 40404040  |........................        |
      +0000A0 114A41C0  40404040 40404040 40404040 40404040  40404040 40400000 000000E7 E7E70000  |                                .....XXX..|
      +0000C0 114A41E0  00E8E8E8 000000E9 E9E90000 00000000  C3D6C2D6 D340C4E4 D4D74040 40404040  |.YYY...ZZZ......COBOL DUMP      |
      +0000E0 114A4200  40404040 40404040 40404040 40404040  40404040 40404040 40404040 40404040  |                                |
      +000100 114A4220 - +00011F 114A423F             same as above
      +000120 114A4240  40C2D3D6 C3D2E240 E2E3D6D9 C1C7C540  D7C1C7C5 4DF5F55D 40C6C9D3 C5E24040  | BLOCKS STORAGE PAGE(55) FILES  |
      +000140 114A4260  40404040 40404040 40404040 40404040  40404040 40404040 40404040 40404040  |                                |
      +000160 114A4280 - +0001FF 114A431F             same as above
      +000200 114A4320  40404040 40404040 40404040 40404040  40404040 40404040 40404040 40404000  |                               .|
      +000220 114A4340  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
      +000240 114A4360 - +000FFF 114A511F             same as above

    Program class storage: 114A4148
      +000000 114A4148  00000210 00000000 00000000 11480C40  00000000 00000000 00000000 00000000  |............... ................|
      +000020 114A4168  00000000 00000000 C9C7E9E2 D9E3C3C4  00000000 00000000 00000000 00000000  |........IGZSRTCD................|
      +000040 114A4188  00000000 00000000 E2E8E2D6 E4E34040  00000000 00000000 0E000000 00000000  |........SYSOUT  ................|
      +000060 114A41A8  0F000000 00000000 00000000 00000000  40404040 40404040 40404040 40404040  |................                |
      +000080 114A41C8  40404040 40404040 40404040 40400000  000000E7 E7E70000 00E8E8E8 000000E9  |                    .....XXX...YYY...Z|
      +0000A0 114A41E8  E9E90000 00000000 C3D6C2D6 D340C4E4  D4D74040 40404040 40404040 40404040  |ZZ......COBOL DUMP              |
      +0000C0 114A4208  40404040 40404040 40404040 40404040  40404040 40404040 40404040 40404040  |                                |
      +0000E0 114A4228  40404040 40404040 40404040 40404040  40404040 40404040 40C2D3D6 C3D2E240  |                           BLOCKS |
      +000100 114A4248  E2E3D6D9 C1C7C540 D7C1C7C5 4DF5F55D  40C6C9D3 C5E24040 40404040 40404040  |STORAGE PAGE(55) FILES          |
      +000120 114A4268  40404040 40404040 40404040 40404040  40404040 40404040 40404040 40404040  |                                |
      +000140 114A4288 - +0001DF 114A4327             same as above
      +0001E0 114A4328  40404040 40404040 40404040 40404040  40404040 40404000 00000000 00000000  |                       .........|
```

Figure 84. Storage for active COBOL programs (Part 1 of 2)

```
  +000200 114A4348  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
Program class storage: 11480C40
  +000000 11480C40  000001D2 00000000 114A4148 0001E028  C6C3C200 01020000 FFFFFFFF FFFFFFFF  |...K............FCB.............|
  +000020 11480C60  FFFFFFFF FFFFFFFF FFFFFFFF FFFFFFFF  FFFFFFFF 00000000 00000000 00000000  |................................|
  +000040 11480C80  00000000 00000000 00000000 800082C8  800082C8 800082C8 914754F8 800082C8  |..............bH..bH..bHj..8..bH|
  +000060 11480CA0  800082C8 800082C8 914754F8 00000000  00000000 00000000 00000000 00000000  |..bH..bHj..8....................|
  +000080 11480CC0  00000000 00000000 00000000 00000000  00000000 00000000 C3D6C2C4 E4D4D7F2  |........................COBDUMP2|
  +0000A0 11480CE0  C5E2C4E2 F1C4C440 00000000 00000000  00000000 11202A34 00000000 00000000  |ESDS1DD ........................|
  +0000C0 11480D00  00000000 00000000 00000000 00000000  00000000 00000000 00008800 00000000  |..........................h.....|
  +0000E0 11480D20  00000000 00000000 00000028 00000000  00000000 00000000 00000000 00000000  |................................|
  +000100 11480D40  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
  +000120 11480D60 - +0001BF 11480DFF             same as above
  +0001C0 11480E00  00000000 00000000 00000000 00000000  00000000 00000000 11480000 00000E20  |................................|
Program class storage: 0001E028
  +000000 0001E028  0000003F 00000000 11480C40 00000000  00000000 00000000 00000000 00000000  |...........  ...................|
  +000020 0001E048  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
⋮
```

Figure 84. Storage for active COBOL programs (Part 2 of 2)

Enclave-level data

The Enclave Control Blocks section of the dump, shown in Figure 85 on page 249, displays the following information:

- RUNCOM control block. The RUNCOM is a control block that is allocated by the COBOL runtime to anchor enclave level resources. The RUNCOM is dumped for IBM service personnel use.
- Storage for all run units
- COBOL control blocks FCB, FIB, and GMAREA. The FCB, FIB, and GMAREA are control blocks used for COBOL file processing. These control blocks are dumped for IBM service personnel use.

```
  Enclave Control Blocks:
⋮
    RUNCOM: 11480100
      +000000 11480100  C3F3D9E4 D5C3D6D4 000002D8 04C60000  11211658 00000002 00006F50 00000000 |C3RUNCOM...Q.F.....?&....|
      +000020 11480120  00000000 11200398 114803F0 00000000  11211778 00000000 00000000 00000000 |.......q...0.....................|
      +000040 11480140  00016A80 000161BC 00000000 000167FC  00000000 00000000 112129C0 00000000 |....../.....................|
      +000060 11480160  00000000 00000000 00000000 00000000  00000000 F0F0F0F0 F0F0F0F0 114809F0 |...................00000000...0|
⋮
  Enclave Storage:
    Initial (User) Heap                                        : 114A4018
      +000000 114A4018  C8C1D5C3 0001E000 11211B38 00000000  914A4018 114A4358 00008000 00007CC0 |HANC.....j. ..........@.|
      +000020 114A4038  114A4018 00000108 00000100 00000000  00000000 00000000 00000000 00000000 |.. .............................|
      +000040 114A4058  00000000 00000000 00000000 00000000  C9C7E9E2 D9E3C3C4 00000000 00000000 |.............IGZSRTCD........|
      +000060 114A4078  00000000 00000000 00000000 00000000  E2E8E2D6 E4E34040 00000000 00000000 |.............SYSOUT  ........|
      +000080 114A4098  0E000000 00000000 0F000000 00000000  00000000 00000000 40404040 40404040 |........................        |
      +0000A0 114A40B8  40404040 40404040 40404040 40404040  40404040 40400000 E3C8C9E2 40C9E240 |                        ..THIS IS |
      +0000C0 114A40D8  C9D540E6 D6D9D2C9 D5C740E2 E3D6D9C1  C7C54040 40404040 40404040 40404040 |IN WORKING STORAGE              |
      +0000E0 114A40F8  40404040 40404040 40404040 40404040  40404040 40404040 40404040 40404040 |                                |
      +000100 114A4118  40404040 40404040 00000000 00000000  00000000 00000000 00000000 00000000 |        ........................|
      +000120 114A4138  00000000 00000000 114A4018 00000218  00000210 00000000 00000000 11480C40 |......... ....................  |
      +000140 114A4158  00000000 00000000 00000000 00000000  00000000 00000000 C9C7E9E2 D9E3C3C4 |.......................IGZSRTCD|
      +000160 114A4178  00000000 00000000 00000000 00000000  00000000 00000000 E2E8E2D6 E4E34040 |........................SYSOUT  |
      +000180 114A4198  00000000 00000000 0E000000 00000000  0F000000 00000000 00000000 00000000 |................................|
      +0001A0 114A41B8  40404040 40404040 40404040 40404040  40404040 40404040 40404040 40400000 |                              ..|
      +0001C0 114A41D8  000000E7 E7E70000 00E8E8E8 000000E9  E9E90000 00000000 C3D6C2D6 D340C4E4 |...XXX...YYY...ZZZ......COBOL DU|
      +0001E0 114A41F8  D4D74040 40404040 40404040 40404040  40404040 40404040 40404040 40404040 |MP                              |
      +000200 114A4218  40404040 40404040 40404040 40404040  40404040 40404040 40404040 40404040 |                                |
      +000220 114A4238  40404040 40404040 40C2D3D6 C3D2E240  E2E3D6D9 C1C7C540 D7C1C7C5 4DF5F55D |         BLOCKS STORAGE PAGE(55)|
      +000240 114A4258  40C6C9D3 C5E24040 40404040 40404040  40404040 40404040 40404040 40404040 | FILES                          |
      +000260 114A4278  40404040 40404040 40404040 40404040  40404040 40404040 40404040 40404040 |                                |
      +000280 114A4298 - +00031F 114A4337             same as above
      +000320 114A4338  40404040 40404040 00000000 00000000  00000000 00000000 00000000 00000000 |       ........................|
      +000340 114A4358  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000 |................................|
      +000360 114A4378 - +007FFF 114AC017             same as above
⋮
    LE/370 Anywhere Heap                                       : 11480000
⋮
      +0003E0 114803E0  00000050 00000000 00000000 00000000  C3D6C2C4 E4D4D7F1 00004100 00000000 |...&............COBDUMP1........|
      +000400 11480400  94810000 91200398 11480448 00000000  00000000 114808E0 114809F0 00000000 |ma..j..q..................0....|
      +000420 11480420  00000001 00000000 00000000 00000000  11480000 000001A0 00000194 00000000 |............................m....|
      +000440 11480440  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000 |................................|
      +000460 11480460 - +00047F 1148047F             same as above
      +000480 11480480  00000000 00000000 00000000 00000000  F3E3C7E3 00000000 06000000 60430260 |................3TGT........-..-|
      +0004A0 114804A0  11480100 000167FC 114805C0 00000000  00000064 00000000 00000000 00000000 |................................|
⋮
      +000A40 11480A40  00000000 00000000 C3D6C2C4 E4D4D7F2  00004100 00000000 84810000 112027E0 |........COBDUMP2........da......|
      +000A60 11480A60  11480AA0 00000000 00000000 114808E4  114809F0 114803F0 00000001 00000000 |................U...0...0........|
      +000A80 11480A80  00000000 00000000 11480000 000001B0  000001A8 00000000 00000000 00000000 |....................y...........|
      +000AA0 11480AA0  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000 |................................|
      +000AC0 11480AC0 - +000ADF 11480ADF             same as above
      +000AE0 11480AE0  00000000 00000000 F3E3C7E3 00000000  06000000 42430260 11480100 000167FC |........3TGT..........-........|
      +000B00 11480B00  11480C20 00000001 00000174 00000000  00000000 00000000 00000000 00000000 |................................|
⋮
  File Control Blocks:
    FCB for file ESDS1DD  in program COBDUMP2: 11480C50
      +000000 11480C50  C6C3C200 01020000 FFFFFFFF FFFFFFFF  FFFFFFFF FFFFFFFF FFFFFFFF FFFFFFFF |FCB.............................|
      +000020 11480C70  FFFFFFFF 00000000 00000000 00000000  00000000 00000000 00000000 800082C8 |.............................bH|
      +000040 11480C90  800082C8 800082C8 914754F8 800082C8  800082C8 800082C8 914754F8 00000000 |..bH..bHj..8..bH..bH..bHj..8....|
      +000060 11480CB0  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000 |................................|
      +000080 11480CD0  00000000 00000000 C3D6C2C4 E4D4D7F2  C5E2C4E2 F1C4C440 00000000 00000000 |........COBDUMP2ESDS1DD ........|
      +0000A0 11480CF0  00000000 11202A34 00000000 00000000  00000000 00000000 00000000 00000000 |................................|
      +0000C0 11480D10  00000000 00000000 00008800 00000000  00000000 00000000 00000028 00000000 |.........h......................|
      +0000E0 11480D30  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000 |................................|
      +000100 11480D50 - +00011F 11480D6F             same as above
    FIB for file ESDS1DD  in program COBDUMP2: 11202A34
      +000000 11202A34  C6C9C200 0103C5E2 C4E2F1C4 C4400088  8080A000 00008000 00000000 00000028 |FIB...ESDS1DD .h................|
      +000020 11202A54  00010000 00000000 00000000 00000000  00000000 00000000 11202A2D 00000000 |.............................. |
      +000040 11202A74  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000 |................................|
      +000060 11202A94 - +00007F 11202AB3             same as above
      +000080 11202AB4  0000C9D6 C6E2E2F1 40404040 40404040  40404040 40404040 40404040 40404040 |..IOFSS1                        |
    GMAREA for file ESDS1DD  in program COBDUMP2: 00000000
      +000000 00000000  Inaccessible storage.
```

Figure 85. Enclave-level data for COBOL programs

Process-level data

The Process Control Block section of the dump, shown in Figure 86, displays COBOL process-level control blocks THDCOM, COBCOM, COBVEC, and ITBLK.

In a non-CICS environment, the ITBLK control block only appears when a VS COBOL II program is active. In a CICS environment, the ITBLK control block always appears.

COBOL control blocks THDCOM, COBCOM, COBVEC and ITBLK are dumped for IBM service personnel use.

```
Process Control Blocks:
⋮
  THDCOM: 00016A80
    +000000 00016A80  C3F3E3C8 C4C3D6D4 000001E8 81000000  00000100 00000000 00016108 000161BC  |C3THDCOM...Ya............./.../.|
    +000020 00016AA0  11480100 00000000 C3D6C2C4 E4D4D7F1  00000000 00000000 00000000 00000000  |.....COBDUMP1...............|
    +000040 00016AC0  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
    +000060 00016AE0 - +00007F 00016AFF             same as above
⋮
  COBCOM: 00016108
    +000000 00016108  C3F3C3D6 C2C3D6D4 00000978 00000000  00000000 00000000 00000000 00000000  |C3COBCOM.....................|
    +000020 00016128  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
    +000040 00016148  00000000 00000000 00000000 00000000  00000000 1140AE68 906000D6 000161BC  |.................... ...-.0../.|
    +000060 00016168  000167FC 00000100 00820000 00000000  00008000 08000000 00016A80 00000000  |.........b......................|
⋮
  COBVEC: 000161BC
    +000000 000161BC  0001643C 00016442 00016448 0001644E  00016454 0001645A 00016460 00016466  |..............+.......!...-....|
    +000020 000161DC  0001646C 00016472 00016478 0001647E  00016484 0001648A 00016490 00016496  |...%...........=...d...........o|
    +000040 000161FC  0001649C 000164A2 000164A8 000164AE  000164B4 000164BA 000164C0 000164C6  |.......s...y...................F|
    +000060 0001621C  000164CC 000164D2 000164D8 000164DE  000164E4 000164EA 000164F0 000164F6  |.......K...Q.......U.......0...6|
⋮
```

Figure 86. Process-level control blocks for COBOL programs

Debugging example COBOL programs

The following examples help demonstrate techniques for debugging COBOL programs. Important areas of the dump output are highlighted. Data unnecessary to debugging has been replaced by vertical ellipses.

Subscript range error

Figure 87 on page 251 illustrates the error of using a subscript value outside the range of an array. This program was compiled with LIST, TEST(STMT,SYM), and SSRANGE. The SSRANGE compiler option causes the compiler to generate code that checks (during run time) for data that has been stored or referenced outside of its defined area because of incorrect indexing and subscripting. The SSRANGE option takes effect during run time, unless you specify CHECK(OFF) as a run-time option.

The program was run with TERMTHDACT(TRACE) to generate the traceback information shown in Figure 88 on page 252.

```
CBL  LIST,SSRANGE,TEST(STMT,SYM)
     ID DIVISION.
     PROGRAM-ID. COBOLX.
     ENVIRONMENT DIVISION.
     DATA DIVISION.
     WORKING-STORAGE SECTION.
     77  J     PIC 9(4) USAGE COMP.
     01  TABLE-X.
      02  SLOT PIC 9(4) USAGE COMP OCCURS 8 TIMES.
     PROCEDURE DIVISION.
         MOVE 9 TO J.
         MOVE 1 TO SLOT (J).
         GOBACK.
```

Figure 87. COBOL example of moving a value outside an array range

To understand the traceback information and debug this program, use the following steps:

1. Locate the current error message in the Condition Information for Active Routines section of the Language Environment traceback, shown in Figure 88 on page 252. The message is `IGZ0006S The reference to table SLOT by verb number 01 on line 000011 addressed an area outside the region of the table.` The message indicates that line 11 was the current COBOL statement when the error occurred. For more information about this message, see *z/OS Language Environment Run-Time Messages*.
2. Statement 11 in the traceback section of the dump occurred in program COBOLX.

```
CEE3DMP V1 R9.0: Condition processing resulted in the unhandled condition.         02/14/07 2:59:00 PM                  Page:    1
ASID: 0099   Job ID: J0005735   Job name: COBOLX     Step name: GO         UserID: BARBARA

CEE3845I CEEDUMP Processing started.

Information for enclave COBOLX

  Information for thread 8000000000000000

  Traceback:
    DSA   Entry       E  Offset  Statement   Load Mod             Program Unit                   Service  Status
    1     CEEHDSP     +000049D6               CEEPLPKA             CEEHDSP                        D1908    Call
    2     CEEHSGLT    +0000005C               CEEPLPKA             CEEHSGLT                       D1908    Exception
    3     IGZCMSG     +000003C2               IGZCPAC              IGZCMSG                                 Call
    4     COBOLX      +000002BC  11           GO                   COBOLX                                  Call
    DSA   DSA Addr    E  Addr    PU Addr    PU Offset  Comp Date  Compile Attributes
    1     1147E880    112BD238   112BD238   +000049D6  20061215   CEL
    2     1147E6E8    112CF960   112CF960   +0000005C  20061215   CEL
    3     1147E1D0    11455AA0   11455AA0   +000003C2  20061213   LIBRARY
    4     1147E030    00008398   00008398   +000002BC  20070214   COBOL

  Condition Information for Active Routines
    Condition Information for CEEHSGLT (DSA address 1147E6E8)
      CIB Address: 1147F1A0
      Current Condition:
        IGZ0006S The reference to table SLOT by verb number 01 on line 000011 addressed an area outside the region of the table.
      Location:
        Program Unit: CEEHSGLT Entry: CEEHSGLT Statement:  Offset: +0000005C

    Storage dump near condition, beginning at location: 112CF9AC
      +000000 112CF9AC  F010D20B D0801000 58A0C2B8 58F0A01C  05EFD20B D098B108 41A0D098 50A0D08C  |0.K.......B..0....K..q.....q&...|

  Parameters, Registers, and Variables for Active Routines:
    CEEHDSP (DSA address 1147E880):
      UPSTACK DSA
      Saved Registers:
        GPR0..... 00008550  GPR1..... 1147ECD8  GPR2..... 1147F1A0  GPR3..... 1120BD60
        GPR4..... 112C1E64  GPR5..... 9120E770  GPR6..... 00000000  GPR7..... 112092A8
        GPR8..... 912C1988  GPR9..... 1148087E  GPR10.... 1147F87F  GPR11.... 912BD238
        GPR12.... 1120C9C0  GPR13.... 1147E880  GPR14.... 912C1C10  GPR15.... 912E9898
    GPREG STORAGE:
      Storage around GPR0 (00008550)
        -0020 00008530  08000004 00224000 00000006 C0000140  00040800 00040028 02400002 08000004  |..... ........ ........ ......|
        +0000 00008550  001F03C0 00060800 0004001C 40000000  0040C000 01400006 08000004 002202C0  |............ .... ... ..........|
        +0020 00008570  00060800 00040022 183F4100 11A05500  C00C05F0 47D0F00C 58F0C300 05EF181F  |...................0..0..0C.....|
⋮
    IGZCMSG  (DSA address 1147E1D0):
      UPSTACK DSA
      Saved Registers:
        GPR0..... 00008550  GPR1..... 1147E3A8  GPR2..... 1147E3A8  GPR3..... 00000000
        GPR4..... 9120E770  GPR5..... 9120E770  GPR6..... 1147E3EA  GPR7..... 00000005
        GPR8..... 00019A80  GPR9..... 0000A1A8  GPR10.... 1147A100  GPR11.... 91455AA0
        GPR12.... 1120C9C0  GPR13.... 1147E1D0  GPR14.... 91455E64  GPR15.... 912CF960
    GPREG STORAGE:
      Storage around GPR0 (00008550)
        -0020 00008530  08000004 00224000 00000006 C0000140  00040800 00040028 02400002 08000004  |..... ........ ........ ......|
        +0000 00008550  001F03C0 00060800 0004001C 40000000  0040C000 01400006 08000004 002202C0  |............ .... ... ..........|
        +0020 00008570  00060800 00040022 183F4100 11A05500  C00C05F0 47D0F00C 58F0C300 05EF181F  |...................0..0..0C.....|
⋮
    COBOLX (DSA address 1147E030):
      UPSTACK DSA
      Saved Registers:
        GPR0..... 1147E1D0  GPR1..... 00008536  GPR2..... 00000010  GPR3..... 000197FC
        GPR4..... 000083D0  GPR5..... 1120B778  GPR6..... 00000000  GPR7..... 00000000
        GPR8..... 0000A398  GPR9..... 0000A1A8  GPR10.... 000084A0  GPR11.... 000085E4
        GPR12.... 00008494  GPR13.... 1147E030  GPR14.... 80008656  GPR15.... 91455AA0
    GPREG STORAGE:
      Storage around GPR0 (1147E1D0)
        -0020 1147E1B0  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
        +0000 1147E1D0  00101001 1147E030 1147E6E8 91455E64  912CF960 00008550 1147E3A8 1147E3A8  |..........WYj.;.j.9-..e&..Ty..Ty|
        +0020 1147E1F0  00000000 9120E770 9120E770 1147E3EA  00000005 00019A80 0000A1A8 1147A100  |....j.X.j.X...T.............y....|
⋮
```

Figure 88. Sections of Language Environment dump for COBOLX (Part 1 of 2)

```
      Local Variables:
               6 77 J                9999 COMP        00009
               7 01 TABLE-X          AN-GR
               8  02 SLOT            9999  OCCURS 8
                     SUB(1)          COMP             00000
                   SUB(2) to SUB(8) elements same as above.
⋮
```

Figure 88. Sections of Language Environment dump for COBOLX (Part 2 of 2)

3. Find the statement on line 11 in the listing for program COBOLX, shown in Figure 89. This statement moves the 1 value to the array SLOT (J).

```
PP 5655-G53 IBM Enterprise COBOL for z/OS  3.4.1               COBOLX    Date 02/14/2007  Time 14:58:58   Page     3
  LineID  PL SL  ----+-*A-1-B--+----2----+----3----+----4----+----5----+----6----+----7-|--+----8 Map and Cross Reference
/* COBOLX
  000001                ID DIVISION.
  000002                PROGRAM-ID. COBOLX.
  000003                ENVIRONMENT DIVISION.
  000004                DATA DIVISION.
  000005                WORKING-STORAGE SECTION.
  000006                77  J     PIC 9(4) USAGE COMP.
  000007                01  TABLE-X.
  000008                 02  SLOT PIC 9(4) USAGE COMP OCCURS 8 TIMES.
  000009                PROCEDURE DIVISION.
  000010                    MOVE 9 TO J.                                                    6
  000011                    MOVE 1 TO SLOT (J).                                             8 6
  000012                    GOBACK.
*/ COBOLX
```

Figure 89. COBOL listing for COBOLX

4. Find the values of the local variables in the Parameters, Registers, and Variables for Active Routines section of the traceback, shown in Figure 88 on page 252. J, which is of type PIC 9(4) with usage COMP, has a 9 value. J is the index to the array SLOT.

   The array SLOT contains eight positions. When the program tries to move a value into the J or 9th element of the 8-element array named SLOT, the error of moving a value outside the area of the array occurs.

Calling a nonexistent subroutine

Figure 90 demonstrates the error of calling a nonexistent subroutine in a COBOL program. In this example, the program COBOLY was compiled with the compiler options LIST, MAP and XREF. The TEST option was also specified with the suboptions NONE and SYM. Figure 90 shows the program.

```
  CBL  LIST,MAP,XREF,TEST(NONE,SYM)
       ID DIVISION.
       PROGRAM-ID. COBOLY.
       ENVIRONMENT DIVISION.
       DATA DIVISION.
       WORKING-STORAGE SECTION.
       77  SUBNAME PIC X(8) USAGE DISPLAY VALUE 'UNKNOWN'.
       PROCEDURE DIVISION.
           CALL SUBNAME.
           GOBACK.
```

Figure 90. COBOL example of calling a nonexistent subroutine

To understand the traceback information and debug this program, use the following steps:

1. Locate the error message for the original condition under the Condition Information for Active Routines section of the dump, shown in Figure 91. The message is `CEE3501S The module UNKNOWN  was not found.` For more information about this message, see *z/OS Language Environment Run-Time Messages*.
2. Note the sequence of calls in the Traceback section of the dump. COBOLY called IGZCFCC; IGZCFCC (a COBOL library subroutine used for dynamic calls) called IGZCLDL; then IGZCLDL (a COBOL library subroutine used to load library routines) called CEESGLT, a Language Environment condition handling routine.

   This sequence indicates that the exception occurred in IGZCLDL when COBOLY was attempting to make a dynamic call. The call statement in COBOLY is located at offset +0000036E.

```
CEE3DMP V1 R9.0: Condition processing resulted in the unhandled condition.         02/14/07 2:59:09 PM                 Page:    1
ASID: 0099   Job ID: J0005737   Job name: COBOLY     Step name: GO         UserID: BARBARA

CEE3845I CEEDUMP Processing started.

Information for enclave COBOLY

  Information for thread 8000000000000000

  Traceback:
    DSA   Entry       E  Offset  Statement   Load Mod             Program Unit                  Service  Status
    1     CEEHDSP     +00004030               CEEPLPKA             CEEHDSP                       D1908    Call
    2     CEEHSGLT    +0000005C               CEEPLPKA             CEEHSGLT                      D1908    Exception
    3     IGZCLDL     +0000012A               IGZCPAC              IGZCLDL                                Call
    4     IGZCFCC     +000003EE               IGZCPAC              IGZCFCC                                Call
    5     COBOLY      +0000036E  8            GO                   COBOLY                                 Call

    DSA   DSA Addr   E  Addr    PU Addr    PU Offset  Comp Date  Compile Attributes
    1     1147E6F0   112BD238   112BD238   +00004030  20061215   CEL
    2     1147E558   112CF960   112CF960   +0000005C  20061215   CEL
    3     1147E3B0   11453680   11453680   +0000012A  20061213   LIBRARY
    4     1147E1D0   1140A5F8   1140A5F8   +000003EE  20061213   LIBRARY
    5     1147E030   000083F0   000083F0   +0000036E  20070214   COBOL

  Condition Information for Active Routines
    Condition Information for CEEHSGLT (DSA address 1147E558)
      CIB Address: 1147F010
      Current Condition:
        CEE0198S The termination of a thread was signaled due to an unhandled condition.
      Original Condition:
        CEE3501S The module UNKNOWN  was not found.
      Location:
        Program Unit: CEEHSGLT Entry: CEEHSGLT Statement:  Offset: +0000005C

    Storage dump near condition, beginning at location: 112CF9AC
      +000000 112CF9AC  F010D20B D0801000 58A0C2B8 58F0A01C  05EFD20B D098B108 41A0D098 50A0D08C  |0.K.......B..0....K..q.....q&...|
⋮
```

Figure 91. Sections of Language Environment dump for COBOLY

3. Use the offset of X'36E' from the COBOL listing, shown in Figure 92 on page 255, to locate the statement that caused the exception in the COBOLY program. At offset X'36E' is an instruction for statement 8. Statement 8 is a call with the identifier SUBNAME specified.

```
PP 5655-G53 IBM Enterprise COBOL for z/OS  3.4.1              COBOLY    Date 02/14/2007  Time 14:59:07   Page    11
   0002B0                 START    EQU   *                     COBOLY
   0002B0  183F                    LR    3,15
   0002B2  4100 11A0               LA    0,416(0,1)
   0002B6  5500 C00C               CL    0,12(0,12)
   0002BA  05F0                    BALR  15,0
   0002BC  47D0 F00C               BC    13,12(0,15)
   0002C0  58F0 C300               L     15,768(0,12)
   0002C4  05EF                    BALR  14,15
   0002C6  181F                    LR    1,15
   0002C8  50D0 1004               ST    13,4(0,1)
   0002CC  5000 104C               ST    0,76(0,1)
   0002D0  D203 1000 3058          MVC   0(4,1),88(3)
   0002D6  D703 1084 1084          XC    132(4,1),132(1)
   0002DC  5090 105C               ST    9,92(0,1)
   0002E0  18D1                    LR    13,1
   0002E2  58C0 90E8               L     12,232(0,9)             TGTFIXD+232
   0002E6  1812                    LR    1,2
   0002E8  50D0 D058               ST    13,88(0,13)
   0002EC  58A0 C004               L     10,4(0,12)              CBL=1
   0002F0  5880 912C               L     8,300(0,9)              BLW=0
   0002F4  D203 D088 A010          MVC   136(4,13),16(10)        DSAFIXD+136                     PGMLIT AT +8
   0002FA  4120 D100               LA    2,256(0,13)             CALLname+0
   0002FE  5020 D08C               ST    2,140(0,13)             DSAFIXD+140
   000302  BF2F 916C               ICM   2,15,364(9)             IPCB=1+16
   000306  58B0 C008               L     11,8(0,12)              PBL=1
   00030A  4780 B000               BC    8,0(0,11)               GN=7(00031C)
   00030E  5830 905C               L     3,92(0,9)               TGTFIXD+92
   000312  58F0 30F4               L     15,244(0,3)             V(IGZCMSG )
   000316  4110 A188               LA    1,392(0,10)             PGMLIT AT +384
   00031A  05EF                    BALR  14,15
   00031C                 GN=7     EQU   *
   00031C  5A20 C000               A     2,0(0,12)               SYSLIT AT +0
   000320  5020 916C               ST    2,364(0,9)              IPCB=1+16
   000324  9140 9057               TM    87(9),X'40'             TGTFIXD+87
   000328  4710 B024               BC    1,36(0,11)              GN=8(000340)
   00032C  9120 9054               TM    84(9),X'20'             TGTFIXD+84
   000330  47E0 B01C               BC    14,28(0,11)             GN=9(000338)
   000334  9620 D084               OI    132(13),X'20'           DSAFIXD+132
   000338                 GN=9     EQU   *
   000338  9640 9057               OI    87(9),X'40'             TGTFIXD+87
   00033C  47F0 B024               BC    15,36(0,11)             GN=10(000340)
   000340                 GN=8     EQU   *
   000340                 GN=10    EQU   *
   000340  9640 915C               OI    348(9),X'40'            IPCB=1
   000344  9601 D084               OI    132(13),X'01'           DSAFIXD+132
000008  *
000008  CALL
   000348                 GN=13    EQU   *
   000348  D207 D0F0 8000          MVC   240(8,13),0(8)          TS2=0                           SUBNAME
   00034E  DC07 D0F0 A01A          TR    240(8,13),26(10)        TS2=0                           PGMLIT AT +18
   000354  D203 D0F8 A162          MVC   248(4,13),354(10)       TS2=8                           PGMLIT AT +346
   00035A  4120 D0F0               LA    2,240(0,13)             TS2=0
   00035E  5020 D0FC               ST    2,252(0,13)             TS2=12
   000362  4110 D0F8               LA    1,248(0,13)             TS2=8
   000366  5820 905C               L     2,92(0,9)               TGTFIXD+92
   00036A  58F0 2100               L     15,256(0,2)             V(IGZCFCC )
   00036E  05EF                    BALR  14,15
   000370  5830 9128               L     3,296(0,9)              BL=1
PP 5655-G53 IBM Enterprise COBOL for z/OS  3.4.1              COBOLY    Date 02/14/2007  Time 14:59:07   Page    12
   000374  40F0 3008               STH   15,8(0,3)               RETURN-CODE
000009  GOBACK
   000378                 GN=14    EQU   *
   000378  58B0 C008               L     11,8(0,12)              PBL=1
   00037C  47F0 B07C               BC    15,124(0,11)            GN=2(000398)
   000380  0700                    BCR   0,0
   000382  9120 D084               TM    132(13),X'20'           DSAFIXD+132
   000386  47E0 B07C               BC    14,124(0,11)            GN=2(000398)
   00038A  5820 905C               L     2,92(0,9)               TGTFIXD+92
   00038E  58F0 20F4               L     15,244(0,2)             V(IGZCMSG )
   000392  4110 A176               LA    1,374(0,10)             PGMLIT AT +366
   000396  05EF                    BALR  14,15
   000398                 GN=2     EQU   *
   000398  5820 916C               L     2,364(0,9)              IPCB=1+16
   00039C  5B20 C000               S     2,0(0,12)               SYSLIT AT +0
   0003A0  5020 916C               ST    2,364(0,9)              IPCB=1+16
   0003A4  9140 9055               TM    85(9),X'40'             TGTFIXD+85
```

Figure 92. COBOL Listing for COBOLY (Part 1 of 2)

```
   0003A8  47E0 B09E              BC    14,158(0,11)           GN=11(0003BA)
   0003AC  4110 0008              LA    1,8(0,0)
   0003B0  5820 905C              L     2,92(0,9)              TGTFIXD+92
   0003B4  58F0 2020              L     15,32(0,2)             V(IGZCCTL )
   0003B8  05EF                   BALR  14,15
   0003BA                 GN=11   EQU   *
   0003BA  9128 9054              TM    84(9),X'28'            TGTFIXD+84
   0003BE  4770 B0BC              BC    7,188(0,11)            GN=12(0003D8)
   0003C2  5820 9128              L     2,296(0,9)             BL=1
   0003C6  48F0 2008              LH    15,8(0,2)              RETURN-CODE
   0003CA  58D0 D004              L     13,4(0,13)
   0003CE  58E0 D00C              L     14,12(0,13)
   0003D2  980C D014              LM    0,12,20(13)
   0003D6  07FE                   BCR   15,14
   0003D8                 GN=12   EQU   *
   0003D8  D20B D0F0 A156         MVC   240(12,13),342(10)     TS2=0                          PGMLIT AT +334
   0003DE  5830 9128              L     3,296(0,9)             BL=1
   0003E2  4820 3008              LH    2,8(0,3)               RETURN-CODE
   0003E6  5020 D0FC              ST    2,252(0,13)            TS2=12
   0003EA  4110 D0F0              LA    1,240(0,13)            TS2=0
   0003EE  5820 905C              L     2,92(0,9)              TGTFIXD+92
   0003F2  58F0 2224              L     15,548(0,2)            V(IGZETRM )
   0003F6  05EF                   BALR  14,15
.
.
.
```

Figure 92. COBOL Listing for COBOLY (Part 2 of 2)

4. Find the value of the local variables in the Parameters, Registers, and Variables for Active Routines section of the dump, shown in Figure 93. Notice that the value of SUBNAME with usage DISP, has a value of 'UNKNOWN'.

   Correct the problem by either changing the subroutine name to one that is defined, or by ensuring that the subroutine is available at compile time.

```
⋮
  Parameters, Registers, and Variables for Active Routines:
⋮
    COBOLY (DSA address 1147E030):
      UPSTACK DSA
      Saved Registers:
        GPR0..... 1147E1D0  GPR1..... 1147E128  GPR2..... 000197FC  GPR3..... 000083F0
        GPR4..... 00008428  GPR5..... 1120B778  GPR6..... 00000000  GPR7..... 00000000
        GPR8..... 0000A3A8  GPR9..... 0000A1B8  GPR10.... 000084F8  GPR11.... 0000870C
        GPR12.... 000084EC  GPR13.... 1147E030  GPR14.... 80008760  GPR15.... 9140A5F8
    GPREG STORAGE:
      Storage around GPR0 (1147E1D0)
        -0020 1147E1B0  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
        +0000 1147E1D0  00102001 1147E030 00000000 9140A9E8  91453680 1147E3B0 1147E368 000197FC  |............j zYj.....T...T...p.|
        +0020 1147E1F0  000083F0 1147E128 000197FC 00000000  1147E358 00019A80 0000A1B8 1147A100  |..c0......p.......T.............|
⋮
      Local Variables:
              6 77 SUBNAME          X(8) DISP        'UNKNOWN '
⋮
```

Figure 93. Parameters, registers, and variables for active routines section of dump for COBOLY

Divide-by-zero error

The following example demonstrates the error of calling an assembler routine that tries to divide by zero. Both programs were compiled with TEST(STMT,SYM) and run with the TERMTHDACT(TRACE) run-time option. Figure 94 on page 257 shows the main COBOL program (COBOLZ1), the COBOL subroutine (COBOLZ2), and the assembler routine.

```
[Main Program]

 CBL  TEST(STMT,SYM),DYN,XREF(FULL),MAP
      ID DIVISION.
      PROGRAM-ID. COBOLZ1.
      ENVIRONMENT DIVISION.
      DATA DIVISION.
      WORKING-STORAGE SECTION.
      77  D-VAL PIC 9(4) USAGE COMP VALUE 0.
      PROCEDURE DIVISION.
          CALL "COBOLZ2" USING D-VAL.
          GOBACK.


[Subroutine]

 CBL  TEST(STMT,SYM),DYN,XREF(FULL),MAP
      ID DIVISION.
      PROGRAM-ID. COBOLZ2.
      ENVIRONMENT DIVISION.
      DATA DIVISION.
      WORKING-STORAGE SECTION.
      77  DV-VAL PIC 9(4) USAGE COMP.
      LINKAGE SECTION.
      77  D-VAL PIC 9(4) USAGE COMP.
      PROCEDURE DIVISION USING D-VAL.
          MOVE D-VAL TO DV-VAL.
          CALL "ASSEMZ3" USING DV-VAL.
          GOBACK.


[Assembler Routine]

           PRINT NOGEN
ASSEMZ3  CEEENTRY MAIN=NO,PPA=MAINPPA
         LA    5,2348            Low order part of quotient
         SR    4,4               Hi order part of quitient
         L     6,0(1)            Get pointer to divisor
         LA    6,0(6)            Clear hi bit
         D     4,0(6)            Do division
         CEETERM  RC=0           Terminate with return code zero
*
MAINPPA  CEEPPA                  Constants describing the code block
         CEEDSA                  Mapping of the Dynamic Save Area
         CEECAA                  Mapping of the Common Anchor Area
         END   ASSEMZ3
```

Figure 94. Main COBOL program, COBOL subroutine, and assembler routine

To debug this application, use the following steps:

1. Locate the error message for the current condition in the Condition Information section of the dump, shown in Figure 95 on page 258. The message is `CEE3209S The system detected a fixed-point divide exception (System Completion Code=0C9).`

   For additional information about this message, see *z/OS Language Environment Run-Time Messages*.

2. Note the sequence of calls in the call chain. COBOLZ1 called IGZCFCC, which is a COBOL library subroutine used for dynamic calls; IGZCFCC called COBOLZ2; COBOLZ2 then called IGZCFCC; and IGZCFCC called ASSEMZ3. The exception occurred at this point, resulting in a call to CEEHDSP, a Language Environment condition handling routine.

   The call to ASSEMZ3 occurred at statement 11 of COBOLZ2. The exception occurred at offset +64 in ASSEMZ3.

```
CEE3DMP V1 R9.0: Condition processing resulted in the unhandled condition.         02/14/07 2:59:19 PM                  Page:    1
ASID: 0099   Job ID: J0005739   Job name: COBOLZ1N   Step name: GO         UserID: BARBARA

CEE3845I CEEDUMP Processing started.

Information for enclave COBOLZ1

  Information for thread 8000000000000000

  Traceback:
    DSA   Entry       E  Offset  Statement   Load Mod             Program Unit                  Service  Status
    1     CEEHDSP     +000049D6               CEEPLPKA             CEEHDSP                       D1908    Call
    2     ASSEMZ3     +00000064               ASSEMZ3              ASSEMZ3                                Exception
    3     IGZCFCC     +000002CA               IGZCPAC              IGZCFCC                                Call
    4     COBOLZ2     +000002A4  11           COBOLZ2              COBOLZ2                                Call
    5     IGZCFCC     +000002CA               IGZCPAC              IGZCFCC                                Call
    6     COBOLZ1     +0000028E  8            GO                   COBOLZ1                                Call

    DSA   DSA Addr   E  Addr    PU Addr    PU Offset  Comp Date  Compile Attributes
    1     1147E7D0   112BD238  112BD238   +000049D6  20061215   CEL
    2     1147E750   1120E448  1120E448   +00000064  20070214   ASM
    3     1147E570   1140A5F8  1140A5F8   +000002CA  20061213   LIBRARY
    4     1147E3C0   0001F320  0001F320   +000002A4  20070214   COBOL
    5     1147E1E0   1140A5F8  1140A5F8   +000002CA  20061213   LIBRARY
    6     1147E030   000083D0  000083D0   +0000028E  20070214   COBOL

  Condition Information for Active Routines
    Condition Information for ASSEMZ3 (DSA address 1147E750)
      CIB Address: 1147F0F0
      Current Condition:
        CEE3209S The system detected a fixed-point divide exception (System Completion Code=0C9).
      Location:
        Program Unit: ASSEMZ3 Entry: ASSEMZ3 Statement:  Offset: +00000064
      Machine State:
        ILC..... 0004    Interruption Code..... 0009
        PSW..... 078D0000 9120E4B0
        GPR0..... 1147E7D0  GPR1..... 1147E4B8  GPR2..... 1147AE54  GPR3..... 000212E8
        GPR4..... 00000000  GPR5..... 0000092C  GPR6..... 000213A8  GPR7..... 1147E4B8
        GPR8..... 00000002  GPR9..... 000211B0  GPR10.... 1147A100  GPR11.... 9120E448
        GPR12.... 1120C9C0  GPR13.... 1147E750  GPR14.... 9140A8C4  GPR15.... 9120E448

    Storage dump near condition, beginning at location: 1120E49C
      +000000 1120E49C  10184150 092C1B44 58610000 41660000  5D460000 58F0B0C8 5800B0C8 58DD0004  |...&...../......)....0.H...H....|
    GPREG STORAGE:
      Storage around GPR0 (1147E7D0)
        -0020 1147E7B0  1120C9C0 00000000 00000000 00000000  00008408 00000000 00000100 1147E958  |..I.............d...........Z.|
        +0000 1147E7D0  0808CEE1 1147E750 114818F0 912C1C10  912E9898 1147E7D0 1147EC28 1147F0F0  |......X&...0j...j.qq..X.......00|
        +0020 1147E7F0  1120BD60 112C1E64 9120E770 00000000  112092A8 912C1988 114807CE 1147F7CF  |...-....j.X.......kyj..h......7.|
⋮
  Parameters, Registers, and Variables for Active Routines:
⋮
    COBOLZ2 (DSA address 1147E3C0):
      UPSTACK DSA
      Saved Registers:
        GPR0..... 1147E570  GPR1..... 1147E4C0  GPR2..... 000197FC  GPR3..... 000212E8
        GPR4..... 1147E4B8  GPR5..... 000191BC  GPR6..... 1147AFD0  GPR7..... 00FDD100
        GPR8..... 000213A8  GPR9..... 000211B0  GPR10.... 0001F428  GPR11.... 0001F54C
        GPR12.... 0001F41C  GPR13.... 1147E3C0  GPR14.... 8001F5C6  GPR15.... 9140A5F8
    GPREG STORAGE:
      Storage around GPR0 (1147E570)
        -0020 1147E550  1147E30C 1147E44C 1120B658 00000000  1147E470 00000000 00000011 00000005  |..T...U<.........U.............|
        +0000 1147E570  00102401 1147E3C0 1147E750 9140A8C4  9120E448 1147E750 1147E4B8 1147AE54  |......T...X&j yDj.U...X&..U.....|
        +0020 1147E590  000212E8 1147E4C0 000212E8 1147B028  1147E4B8 00000002 000211B0 1147A100  |...Y..U....Y......U.............|
⋮
                                              o
      Local Variables:
              6 77 DV-VAL           9999 COMP        00000
              8 77 D-VAL            9999 COMP        00000
⋮
```

Figure 95. Sections of Language Environment dump for program COBOLZ1 (Part 1 of 2)

```
    COBOLZ1 (DSA address 1147E030):
      UPSTACK DSA
      Saved Registers:
        GPR0..... 1147E1E0  GPR1..... 1147E130  GPR2..... 000197FC  GPR3..... 0000A2E4
        GPR4..... 1147E128  GPR5..... 1120B778  GPR6..... 00000000  GPR7..... 00000000
        GPR8..... 0000A3A8  GPR9..... 0000A1B0  GPR10.... 000084D8  GPR11.... 000085F4
        GPR12.... 000084CC  GPR13.... 1147E030  GPR14.... 80008660  GPR15.... 9140A5F8
    GPREG STORAGE:
      Storage around GPR0 (1147E1E0)
        -0020 1147E1C0  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
        +0000 1147E1E0  00102401 1147E030 1147E3C0 9140A8C4  0001F320 1147E3C0 1147E128 000197FC  |.........T.j yD..3...T.......p.|
        +0020 1147E200  0000A2E4 1147E130 0000A2E4 1147AFD0  1147E128 00000002 0000A1B0 1147A100  |..sU......sU...................|
⋮
      Local Variables:
              6 77 D-VAL           9999 COMP        00000
⋮
```

Figure 95. Sections of Language Environment dump for program COBOLZ1 (Part 2 of 2)

3. Locate statement 11 in the COBOL listing for the COBOLZ2 program, shown in Figure 96. This is a call to the assembler routine ASSEMZ3.

```
PP 5655-G53 IBM Enterprise COBOL for z/OS  3.4.1              COBOLZ2   Date 02/14/2007  Time 14:59:15   Page     3
  LineID  PL SL  ----+-*A-1-B--+----2----+----3----+----4----+----5----+----6----+----7-|--+----8 Map and Cross Reference
/* COBOLZ2
  000001                ID DIVISION.
  000002                PROGRAM-ID. COBOLZ2.
  000003                ENVIRONMENT DIVISION.
  000004                DATA DIVISION.
  000005                WORKING-STORAGE SECTION.
  000006                77  DV-VAL PIC 9(4) USAGE COMP.                                    BLW=00000+000         2C
  000007                LINKAGE SECTION.
  000008                77  D-VAL PIC 9(4) USAGE COMP.                                     BLL=00001+000         2C
  000009                PROCEDURE DIVISION USING D-VAL.                                   8
  000010                    MOVE D-VAL TO DV-VAL.                                         8 6
  000011                    CALL "ASSEMZ3" USING DV-VAL.                                  EXT 6
  000012                    GOBACK.
*/ COBOLZ2
```

Figure 96. COBOL listing for COBOLZ2

4. Check offset +64 in the listing for the assembler routine ASSEMZ3, shown in Figure 97 on page 260.

   This shows an instruction to divide the contents of register 4 by the variable pointed to by register 6. You can see the two instructions preceding the divide instruction load register 6 from the first word pointed to by register 1 and prepare register 6 for the divide. Because of linkage conventions, you can infer that register 1 contains a pointer to a parameter list that passed to ASSEMZ3. Register 6 points to a 0 value because that was the value passed to ASSEMZ3 when it was called by a higher level routine.

   Note: To translate assembler instructions, see *z/Architecture Principles of Operation, SA22-7832.*

```
                                   High Level Assembler Option Summary                 (PTF UK21335)   Page    1
                                                                                      HLASM R5.0  2007/02/14 14.59
  No Overriding ASMAOPT Parameters
  Overriding Parameters-  NODECK,LIST
  No Process Statements
  Options for this Assembly
.
.
.
                                        External Symbol Dictionary                                     Page    2
Symbol   Type   Id     Address  Length   Owner Id Flags Alias-of                 HLASM R5.0  2007/02/14 14.59
ASSEMZ3   SD 00000001 00000000 000000CC            07
CEESTART  ER 00000002
                                                                                                       Page    3
  Active Usings: None
  Loc  Object Code    Addr1 Addr2  Stmt   Source Statement                       HLASM R5.0  2007/02/14 14.59
                                      1          PRINT NOGEN
000000 47F0 F014            00014     2 ASSEMZ3  CEEENTRY MAIN=NO,PPA=MAINPPA
000056 4150 092C            0092C    38          LA    5,2348            Low order part of quotient
00005A 1B44                          39          SR    4,4               Hi order part of quitient
00005C 5861 0000            00000    40          L     6,0(1)            Get pointer to divisor
000060 4166 0000            00000    41          LA    6,0(6)            Clear hi bit
000064 5D46 0000            00000    42          D     4,0(6)            Do division
000068 58F0 B0C8            000C8    43          CEETERM  RC=0           Terminate with return code zero
                                     50 *
000080 10                            51 MAINPPA  CEEPPA                  Constants describing the code block
                                    123+*,Time Stamp = 2007/02/14 14:59:00                              01-CEEPP
                                    124+*,Version 1 Release 1 Modification 0                            01-CEEPP
                                    135          CEEDSA                 Mapping of the Dynamic Save Area
                                    228          CEECAA                 Mapping of the Common Anchor Area
000000                              551          END   ASSEMZ3
0000C8 00000000                     552                =A(0)
```

Figure 97. Listing for ASSEMZ3

5. Check local variables for COBOLZ2 in the Local Variables section of the dump shown in Figure 98. From the dump and listings, you know that COBOLZ2 called ASSEMZ3 and passed a parameter in the variable DV-VAL. The two variables DV-VAL and D-VAL have 0 values.

```
⋮
      Local Variables:
            6 77 DV-VAL          9999 COMP       00000
            8 77 D-VAL           9999 COMP       00000
⋮
```

Figure 98. Variables section of Language Environment dump for COBOLZ2

6. In the COBOLZ2 subroutine, the variable D-VAL is moved to DV-VAL, the parameter passed to the assembler routine. D-VAL appears in the Linkage section of the COBOLZ2 listing, shown in Figure 99 on page 261, indicating that the value did pass from COBOLZ1 to COBOLZ2.

```
PP 5655-G53 IBM Enterprise COBOL for z/OS  3.4.1              COBOLZ2   Date 02/14/2007  Time 14:59:15   Page     3
  LineID  PL SL  ----+-*A-1-B--+----2----+----3----+----4----+----5----+----6----+----7-|--+----8 Map and Cross Reference
/* COBOLZ2
  000001                ID DIVISION.
  000002                PROGRAM-ID. COBOLZ2.
  000003                ENVIRONMENT DIVISION.
  000004                DATA DIVISION.
  000005                WORKING-STORAGE SECTION.
  000006                77  DV-VAL PIC 9(4) USAGE COMP.                                    BLW=00000+000         2C
  000007                LINKAGE SECTION.
  000008                77  D-VAL PIC 9(4) USAGE COMP.                                     BLL=00001+000         2C
  000009                PROCEDURE DIVISION USING D-VAL.                                   8
  000010                    MOVE D-VAL TO DV-VAL.                                         8 6
  000011                    CALL "ASSEMZ3" USING DV-VAL.                                  EXT 6
  000012                    GOBACK.
*/ COBOLZ2
```

Figure 99. Listing for COBOLZ2

7. In the Local Variables section of the dump for program COBOLZ1, shown in Figure 100, D-VAL has a 0 value. This indicates that the error causing a fixed-point divide exception in ASSEMZ3 was actually caused by the value of D-VAL in COBOLZ1.

```
⋮
        Local Variables:
              6 77 D-VAL            9999 COMP        00000
⋮
```

Figure 100. Variables section of Language Environment dump for COBOLZ1

Chapter 6. Debugging Fortran routines

This chapter provides information to help you debug applications that contain one or more Fortran routines. It includes the following topics:
- Determining the source of errors in Fortran routines
- Using Fortran compiler listings
- Generating a Language Environment dump of a Fortran routine
- Finding Fortran information in a dump
- Examples of debugging Fortran routines

This chapter provides information to help you debug applications that contain one or more Fortran routines. It includes the following topics:
- Determining the source of errors in Fortran routines
- Using Fortran compiler listings
- Generating a Language Environment dump of a Fortran routine
- Finding Fortran information in a dump
- Examples of debugging Fortran routines

Determining the source of errors in Fortran routines

Most errors in Fortran routines can be identified by the information provided in Fortran run-time messages, which begin with the prefix FOR.

The Fortran compiler cannot identify all possible errors. The following list identifies several errors not detected by the compiler that could potentially result in problems:
- Failing to assign values to variables and arrays before using them in your program.
- Specifying subscript values that are not within the bounds of an array. If you assign data outside the array bounds, you can inadvertently destroy data and instructions.
- Moving data into an item that is too small for it, resulting in truncation.
- Making invalid data references to EQUIVALENCE items of differing types (for example, integer or real).
- Transferring control into the range of a DO loop from outside the range of the loop. The compiler issues a warning message for all such branches if you specify OPT(2), OPT(3), or VECTOR.
- Using arithmetic variables and constants that are too small to give the precision you need in the result. For example, to obtain more than 6 decimal digits in floating-point results, you must use double precision.
- Concatenating character strings in such a way that overlap can occur.
- Trying to access services that are not available in the operating system or hardware.
- Failing to resolve name conflicts between Fortran and C library routines using the procedures described in *z/OS Language Environment Programming Guide*.

Identifying run-time errors

Fortran has several features that help you find run-time errors. Fortran run-time messages are discussed in *z/OS Language Environment Run-Time Messages*. Other debugging aids include the optional traceback map, program interruption messages, abnormal termination dumps, and operator messages.

© Copyright IBM Corp. 1991, 2009

- The optional traceback map helps you identify where errors occurred while running your application. The TERMTHDACT(TRACE) run-time option, which is set by default under Language Environment, generates a dump containing the traceback map.

  You can also get a traceback map at any point in your routine by invoking the ERRTRA subroutine.
- Program interruption messages are generated whenever the program is interrupted during execution. Program interruption messages are written to the Language Environment message file.

  The program interruption message indicates the exception that caused the termination; the completion code from the system indicates the specification or operation exception resulting in termination.
- Program interruptions causing an abnormal termination produce a dump, which displays the completion code and the contents of registers and system control fields.

  To display the contents of main storage as well, you must request an abnormal termination (ABEND) dump by including a SYSUDUMP DD statement in the appropriate job step. The following example shows how the statement can be specified for IBM-supplied cataloged procedures:

  ```
  //GO.SYSUDUMP DD SYSOUT=A
  ```
- You can request various dumps by invoking any of several dump service routines while your program runs. These dump service routines are discussed in "Generating a Language Environment dump of a Fortran routine" on page 265.
- Operator messages are displayed when your program issues a PAUSE or STOP *n* statement. These messages help you understand how far execution has progressed before reaching the PAUSE or STOP statement.

  The operator message can take the following forms:

n	String of 1–5 decimal digits you specified in the PAUSE or STOP statement. For the STOP statement, this number is placed in R15.
'message'	Character constant you specified in the PAUSE or STOP statement.
0	Printed when a PAUSE statement containing no characters is executed (not printed for a STOP statement).

  A PAUSE message causes the program to stop running pending an operator response. The format of the operator's response to the message depends on the system being used.
- Under Language Environment, error messages produced by Language Environment and Fortran are written to a common message file. Its ddname is specified in the MSGFILE run-time option. The default ddname is SYSOUT.

  Fortran information directed to the message file includes:
  - Error messages resulting from unhandled conditions
  - Printed output from any of the dump services (SDUMP, DUMP/PDUMP, CDUMP/CPDUMP)
  - Output produced by a WRITE statement with a unit identifier having the same value as the Fortran error message unit
  - Output produced by a WRITE statement with * given as the unit identifier (assuming the Fortran error message unit and standard print unit are the same unit)

– Output produced by the PRINT statement (assuming the Fortran error message unit and the standard print unit are the same unit)

For more information about handling message output using the Language Environment MSGFILE run-time option, see *z/OS Language Environment Programming Guide*.

Using Fortran compiler listings

Fortran listings provide you with:

- The date of compilation including information about the compiler
- A listing of your source program
- Diagnostic messages telling you of errors in the source program
- Informative messages telling you the status of the compilation

The following table contains a list of the contents of the various compiler-generated listings that you might find helpful when you use information in dumps to debug Fortran programs.

Table 17. Compiler-generated Fortran listings and their contents

Name	Contents	Compiler Option
Diagnostic message listing	Error messages detected during compilation.	FLAG
Source program	Source program statements.	SOURCE
Source program	Source program statements and error messages.	SRCFLG
Storage map and cross reference	Variable use, statement function, subprogram, or intrinsic function within a program.	MAP and XREF
Cross reference	Cross reference of names with attributes.	XREF
Source program map	Offsets of automatic and static internal variables (from their defining base).	MAP
Object code	Contents of the program control section in hexadecimal notation and translated into a pseudo-assembler format. To limit the size of the object code listing, specify the statement or range of statements to be listed; for example, LIST(20) or LIST(10,30).	LIST
Variable map, object code, static storage	Same as MAP and LIST options above, plus contents of static internal and static external control sections in hexadecimal notation with comments.	MAP and LIST
Symbolic dump	Internal statement numbers, sequence numbers, and symbol (variable) information.	SDUMP

Generating a Language Environment dump of a Fortran routine

To generate a dump containing Fortran information, call either DUMP/PDUMP, CDUMP/CPDUMP, or SDUMP.

DUMP/PDUMP and CDUMP/CPDUMP produce output that is unchanged from the output generated under Fortran. Under Language Environment, however, the output is directed to the message file.

When SDUMP is invoked, the output is also directed to the Language Environment message file. The dump format differs from other Fortran dumps, however, reflecting a common format shared by the various HLLs under Language Environment.

You cannot make a direct call to CEE3DMP from a Fortran program. It is possible to call CEE3DMP through an assembler routine called by your Fortran program. Fortran programs are currently restricted from directly invoking Language Environment callable services.

DUMP/PDUMP	Provides a dump of a specified area of storage.
CDUMP/CPDUMP	Provides a dump of a specified area of storage in character format.
SDUMP	Provides a dump of all variables in a program unit.

DUMP/PDUMP subroutines

The DUMP/PDUMP subroutine dynamically dumps a specified area of storage to the system output data set. When you use DUMP, the processing stops after the dump; when you use PDUMP, the processing continues after the dump.

Syntax

CALL {DUMP | PDUMP} (a_1, b_1,k_1, a_2,b_2, k_2,...**)**

a and *b*
Variables in the program unit. Each indicates an area of storage to be dumped. Either *a* or *b* can represent the upper or lower limit of the storage area.

k The dump format to be used. The values that can be specified for *k*, and the resulting dump formats, are:

Value	Format Requested
0	Hexadecimal
1	LOGICAL*1
2	LOGICAL*4
3	INTEGER*2
4	INTEGER*4
5	REAL*4
6	REAL*8
7	COMPLEX*8
8	COMPLEX*16
9	CHARACTER
10	REAL*16
11	COMPLEX*32
12	UNSIGNED*1
13	INTEGER*1
14	LOGICAL*2
15	INTEGER*8
16	LOGICAL*8

Usage considerations for DUMP/PDUMP

A load module or phase can occupy a different area of storage each time it is executed. To ensure that the appropriate areas of storage are dumped, the following conventions should be observed.

If an array and a variable are to be dumped at the same time, a separate set of arguments should be used for the array and for the variable. The specification of limits for the array should be from the first element in the array to the last element. For example, assume that A is a variable in common, B is a real number, and TABLE is an array of 20 elements. The following call to the storage dump routine could be used to dump TABLE and B in hexadecimal format, and stop the program after the dump is taken:

```
CALL DUMP(TABLE(1),TABLE(20),0,B,B,0)
```

If an area of storage in common is to be dumped at the same time as an area of storage not in common, the arguments for the area in common should be given separately. For example, the following call to the storage dump routine could be used to dump the variables A and B in REAL*8 format without stopping the program:

```
CALL PDUMP(A,A,6,B,B,6)
```

If variables not in common are to be dumped, each variable must be listed separately in the argument list. For example, if R, P, and Q are defined implicitly in the program, the statement

```
CALL PDUMP(R,R,5,P,P,5,Q,Q,5)
```

should be used to dump the three variables in REAL*4 format. If the statement

```
CALL PDUMP(R,Q,5)
```

is used, all main storage between R and Q is dumped, which might or might not include P, and could include other variables.

CDUMP/CPDUMP subroutines

The CDUMP/CPDUMP subroutine dynamically dumps a specified area of storage containing character data. When you use CDUMP, the processing stops after the dump; when you use CPDUMP, the processing continues after the dump.

Syntax

CALL {CDUMP | CPDUMP} (a_1, b_1, a_2, b_2,...**)**

a and *b*
: Variables in the program unit. Each indicates an area of storage to be dumped. Either *a* or *b* can represent the upper or lower limit of each storage area.

The dump is always produced in character format. A dump format type (unlike for DUMP/PDUMP) must not be specified.

Usage considerations for CDUMP/CPDUMP

A load module can occupy a different area of storage each time it is executed. To ensure that the appropriate areas of storage are dumped, the following conventions should be observed.

If an array and a variable are to be dumped at the same time, a separate set of arguments should be used for the array and for the variable. The specification of limits for the array should be from the first element in the array to the last element. For example, assume that B is a character variable and TABLE is a character array

of 20 elements. The following call to the storage dump routine could be used to dump TABLE and B in character format, and stop the program after the dump is taken:

```
CALL CDUMP(TABLE(1), TABLE(20), B, B)
```

SDUMP subroutine

The SDUMP subroutine provides a symbolic dump that is displayed in a format dictated by variable type as coded or defaulted in your source. Data is dumped to the error message unit. The symbolic dump is created by program request, on a program unit basis, using CALL SDUMP. Variables can be dumped automatically after abnormal termination using the compiler option SDUMP. For more information on the SDUMP compiler option, see *VS FORTRAN Version 2 Programming Guide for CMS and MVS.*

Items displayed are:

- All referenced, local, named, and saved variables in their Fortran-defined data representation
- All variables contained in a static common area (blank or named) in their Fortran-defined data representation
- All variables contained in a dynamic common area in their Fortran-defined data representation
- Nonzero or nonblank character array elements only
- Array elements with their correct indexes

The amount of output produced can be very large, especially if your program has large arrays, or large arrays in common blocks. For such programs, you might want to avoid calling SDUMP.

Syntax

CALL SDUMP [(*rtn*$_1$,*rtn*$_2$,...**)]**

***rtn*$_1$,*rtn*$_2$,...**

Names of other program units from which data will be dumped. These names must be listed in an EXTERNAL statement.

Usage considerations for SDUMP

- To obtain symbolic dump information and location of error information, compilation must be done either with the SDUMP option or with the TEST option.
- Calling SDUMP and specifying program units that have not been entered gives unpredictable results.
- Calling SDUMP with no parameters produces the symbolic dump for the current program unit.
- An EXTERNAL statement must be used to identify the names being passed to SDUMP as external routine names.
- At higher levels of optimization (1, 2, or 3), the symbolic dump could show incorrect values for some variables because of compiler optimization techniques.
- Values for uninitialized variables are unpredictable. Arguments in uncalled subprograms or in subprograms with argument lists shorter than the maximum can cause the SDUMP subroutine to fail.
- The display of data can also be invoked automatically. If the run-time option TERMTHDACT(DUMP) is in effect and your program abends in a program unit

compiled with the SDUMP option or with the TEST option, all data in that program unit is automatically dumped. All data in any program unit in the save area traceback chain compiled with the SDUMP option or with the TEST option is also dumped. Data occurring in a common block is dumped at each occurrence, because the data definition in each program unit could be different.

Examples of calling SDUMP from the main program and from a subprogram follow. Figure 101 on page 270 shows a sample program calling SDUMP and Figure 102 on page 271 shows the resulting output that is generated. In the main program, the statement

```
EXTERNAL PGM1,PGM2,PGM3
```

makes the address of subprograms PGM1, PGM2, and PGM3 available for a call to SDUMP as follows:

```
CALL SDUMP (PGM1,PGM2,PGM3)
```

This causes variables in PGM1, PGM2, and PGM3 to be printed.

In the subprogram PGM1, the statement

```
EXTERNAL PGM2,PGM3
```

makes PGM2 and PGM3 available. (PGM1 is missing because the call is in PGM1.) The statements

```
CALL SDUMP
CALL SDUMP (PGM2,PGM3)
```

dump variables PGM1, PGM2, and PGM3.

```
OPTIONS IN EFFECT: LIST NOMAP NOXREF NOGOSTMT NODECK SOURCE TERM OBJECT FIXED TRMFLG SRCFLG NODDIM NORENT SDUMP(ISN)
                   NOSXM NOVECTOR IL(DIM) NOTEST SC(*) NODC NOEC NOEMODE NOICA NODIRECTIVE NODBCS NOSAA NOPARALLEL NODYNAMIC NOSYM
                   NOREORDER NOPC
                   OPT(0) LANGLVL(77) NOFIPS FLAG(I) HALT(S) AUTODBL(NONE) PTRSIZE(8) LINECOUNT(60) CHARLEN(500) NAME(MAIN#)
 IF DO   ISN   *....*...1.........2.........3.........4.........5.........6.........7.*.......8
           1         PROGRAM FORTMAIN
           2         EXTERNAL PGM1,PGM2,PGM3
           3         INTEGER*4 ANY_INT
           4         INTEGER*4 INT_ARR(3)
           5         CHARACTER*20 CHAR_VAR
           6         ANY_INT = 555
           7         INT_ARR(1) = 1111
           8         INT_ARR(2) = 2222
           9         INT_ARR(3) = 2222
          10         CHAR_VAR = 'SAMPLE CONSTANT '
          11         CALL PGM1(ANY_INT,CHAR_VAR)
          12         CALL SDUMP(PGM1,PGM2,PGM3)
          13         STOP
          14         END
OPTIONS IN EFFECT: LIST NOMAP NOXREF NOGOSTMT NODECK SOURCE TERM OBJECT FIXED TRMFLG SRCFLG NODDIM NORENT SDUMP(ISN)
                   NOSXM NOVECTOR IL(DIM) NOTEST SC(*) NODC NOEC NOEMODE NOICA NODIRECTIVE NODBCS NOSAA NOPARALLEL NODYNAMIC NOSYM
                   NOREORDER NOPC
                   OPT(0) LANGLVL(77) NOFIPS FLAG(I) HALT(S) AUTODBL(NONE) PTRSIZE(8) LINECOUNT(60) CHARLEN(500) NAME(MAIN#)
 IF DO   ISN   *....*...1.........2.........3.........4.........5.........6.........7.*.......8
           1         SUBROUTINE PGM1(ARG1,ARG2)
           2         EXTERNAL PGM2,PGM3
           3         INTEGER*4 ARG1
           4         CHARACTER*20 ARG2
           5         ARG1 = 1
           6         ARG2 = 'ARGUMENT'
           7         CALL PGM2
           8         CALL SDUMP
           9         CALL SDUMP(PGM2,PGM3)
          10         RETURN
          11         END
OPTIONS IN EFFECT: LIST NOMAP NOXREF NOGOSTMT NODECK SOURCE TERM OBJECT FIXED TRMFLG SRCFLG NODDIM NORENT SDUMP(ISN)
                   NOSXM NOVECTOR IL(DIM) NOTEST SC(*) NODC NOEC NOEMODE NOICA NODIRECTIVE NODBCS NOSAA NOPARALLEL NODYNAMIC NOSYM
                   NOREORDER NOPC
                   OPT(0) LANGLVL(77) NOFIPS FLAG(I) HALT(S) AUTODBL(NONE) PTRSIZE(8) LINECOUNT(60) CHARLEN(500) NAME(MAIN#)
 IF DO   ISN   *....*...1.........2.........3.........4.........5.........6.........7.*.......8
           1         SUBROUTINE PGM2
           2         INTEGER*4 PGM2VAR
           3         PGM2VAR = 555
           4         CALL PGM3
           5         RETURN
           6         END
OPTIONS IN EFFECT: LIST NOMAP NOXREF NOGOSTMT NODECK SOURCE TERM OBJECT FIXED TRMFLG SRCFLG NODDIM NORENT SDUMP(ISN)
                   NOSXM NOVECTOR IL(DIM) NOTEST SC(*) NODC NOEC NOEMODE NOICA NODIRECTIVE NODBCS NOSAA NOPARALLEL NODYNAMIC NOSYM
                   NOREORDER NOPC
                   OPT(0) LANGLVL(77) NOFIPS FLAG(I) HALT(S) AUTODBL(NONE) PTRSIZE(8) LINECOUNT(60) CHARLEN(500) NAME(MAIN#)
 IF DO   ISN   *....*...1.........2.........3.........4.........5.........6.........7.*.......8
           1         SUBROUTINE PGM3
           2         CHARACTER*20 PGM3VAR
           3         PGM3VAR = 'PGM3 VAR'
           4         RETURN
           5         END
```

Figure 101. Example program that calls SDUMP

Figure 102 on page 271 shows the resulting output generated by the example in Figure 101.

```
Parameters, Registers, and Variables for Active Routines:
PGM1      (DSA address 06D004C8):
Parameters:
  ARG2             CHARACTER*20     ARGUMENT

  ARG1             INTEGER*4                  1
Local Variables:
Parameters, Registers, and Variables for Active Routines:
PGM2      (DSA address 000930FC):
Parameters:
Local Variables:
  PGM2VAR          INTEGER*4                555
Parameters, Registers, and Variables for Active Routines:
PGM3      (DSA address 000930FC):
Parameters:
Local Variables:
  PGM3VAR          CHARACTER*20     PGM3 VAR

Parameters, Registers, and Variables for Active Routines:
PGM1      (DSA address 000930FC):
Parameters:
  ARG2             CHARACTER*20     ARGUMENT

  ARG1             INTEGER*4                  1
Local Variables:
Parameters, Registers, and Variables for Active Routines:
PGM2      (DSA address 000930FC):
Parameters:
Local Variables:
  PGM2VAR          INTEGER*4                555
Parameters, Registers, and Variables for Active Routines:
PGM3      (DSA address 000930FC):
Parameters:
Local Variables:
  PGM3VAR          CHARACTER*20     PGM3 VAR
```

Figure 102. Language Environment dump generated using SDUMP

Finding Fortran information in a Language Environment dump

To locate Fortran-specific information in a Language Environment dump, you must understand how to use the traceback section and the section in the symbol table dump showing parameters and variables.

```
CEE3DMP V1 R3.0: Condition processing resulted in the unhandled condition.         08/30/01 10:32:56 AM                Page:    1

Information for enclave SAMPLE

  Information for thread 8000000000000000
[1]
  Traceback:
    DSA Addr  Program Unit  PU Addr   PU Offset  Entry         E Addr    E  Offset   Statement  Load Mod  Service  Status
    0002D018  CEEHDSP       05936760  +0000277C  CEEHDSP       05936760  +0000277C              CEEPLPKA           Call
    0002F018  AFHCSGLE      059DF718  +000001A8  AFHCSGLE      059DF718  +000001A8              AFHPRNAG           Exception
    05A44060  AFHOOPNR      05A11638  +00001EDE  AFHOOPNR      05A11638  +00001EDE              AFHPRNAG           Call
    05900A90  SAMPLE        059009A8  +0000021C  SAMPLE        059009A8  +0000021C       6_ISN  GO                 Call

[2]
  Condition Information for Active Routines
    Condition Information for AFHCSGLE (DSA address 0002F018)
      CIB Address: 0002D468
      Current Condition:
        FOR1916S The OPEN statement for unit 999 failed. The unit number was either less than 0 or greater than 99, the highest
unit number allowed at your installation.
      Location:
        Program Unit: AFHCSGLE Entry: AFHCSGLE Statement:  Offset: +000001A8
    Storage dump near condition, beginning at location: 059DF8B0
      +000000 059DF8B0  5060D198 5880C2B8 58F0801C 4110D190  05EFD502 D3019751 4770A1F0 4820D2FE  |&-Jq..B..0....J...N.L.p....0..K.|

  Parameters, Registers, and Variables for Active Routines:
    CEEHDSP (DSA address 0002D018):
      Saved Registers:
        GPR0..... 000003E7  GPR1..... 0002D3B4  GPR2..... 0002DFD7  GPR3..... 0002E027
        GPR4..... 0002DF94  GPR5..... 00000000  GPR6..... 00000004  GPR7..... 00000000
        GPR8..... 0002E017  GPR9..... 0593875E  GPR10.... 0593775F  GPR11.... 85936760
        GPR12.... 00014770  GPR13.... 0002D018  GPR14.... 800250DE  GPR15.... 85949C70

  GPREG STORAGE:
    Storage around GPR0 (000003E7)
      -000020 000003C7  Inaccessible storage.
      +000000 000003E7  Inaccessible storage.
      +000020 00000407  Inaccessible storage.
    Storage around GPR1 (0002D3B4)
      -000020 0002D394  00000006 00000000 0002E017 0593875E  0593775F 85936760 00014770 00000000  |.............lg;.l.¬el.-........|
      +000000 0002D3B4  0002DFD7 0002E027 0002DF94 0002DF94  0002DDF4 0002DEC4 0002E158 0002D018  |...P.......m...m...4...D........|
      +000020 0002D3D4  0002D468 00000000 00000000 00000007  859D67E0 00000000 00000000 05914848  |..M.............e............j..|

.
.
.
[3]
      Local Variables:
          ABC              CHARACTER*3      123
          J                INTEGER*4                444

[4]
  File Status and Attributes:
    The total number of units defined is 100.
    The default unit for the PUNCH statement is 7.
    The default unit for the Fortran error messages is 6.
    The default unit for formatted sequential output is 6.
    The default unit for formatted sequential input is 5.
```

Figure 103. Sections of the Language Environment dump

Understanding the Language Environment traceback table

Examine the traceback section of the dump, labeled with **[1]** in Figure 103, for condition information about your routine and information about the statement number and address where the exception occurred. The traceback section helps you locate where an error occurred in your program. The information in this section begins with the most recent program unit and ends with the first program unit.

Identifying condition information

The section labeled **[2]** in Figure 103 shows the condition information for the active routines, indicating the program message, program unit name, the statement number, and the offset within the program unit where the error occurred.

Identifying variable information

The local variable section of the dump, shown in the section labeled **[3]** in Figure 103 on page 272, contains information on all variables and arrays in each program unit in the save area chain, including the program causing the dump to be invoked. The output shows variable items (one line only) and array (more than one line) items.

Use the local variable section of the dump to identify the variable name, type, and value at the time the dump was called. Variable and array items can contain either character or noncharacter data, but not both.

Identifying file status information

The section labeled **[4]** in Figure 103 on page 272 shows the file status and attribute section of the dump. This section displays the total number of units defined, the default units for error messages, and the default unit numbers for formatted input or formatted output.

Examples of debugging Fortran routines

This section contains examples of Fortran routines and instructions for using information in the Language Environment dump to debug them.

Calling a nonexistent routine

Figure 104 illustrates an error caused by calling a nonexistent routine. The options in effect at compile time appear at the top of the listing.

```
OPTIONS IN EFFECT: LIST NOMAP NOXREF NOGOSTMT NODECK SOURCE TERM OBJECT FIXED TRMFLG SRCFLG NODDIM NORENT SDUMP(ISN)
                   NOSXM NOVECTOR IL(DIM) NOTEST SC(*) NODC NOEC NOEMODE NOICA NODIRECTIVE NODBCS NOSAA NOPARALLEL NODYNAMIC NOSYM
                   NOREORDER NOPC
                   OPT(0) LANGLVL(77) NOFIPS FLAG(I) HALT(S) AUTODBL(NONE) PTRSIZE(8) LINECOUNT(60) CHARLEN(500) NAME(MAIN#)
           1         PROGRAM CALLNON
           2         INTEGER*4 ARRAY_END
               C
           3         CALL SUBNAM
           4         STOP
           5         END
```

Figure 104. Example of calling a nonexistent routine

Figure 105 on page 274 shows sections of the dump generated by a call to SDUMP.

```
CEE3DMP V1 R3.0: Condition processing resulted in the unhandled condition.        08/30/01 10:33:01 AM                Page:    1

Information for enclave CALLNON

  Information for thread 8000000000000000

  Traceback:
    DSA Addr  Program Unit  PU Addr   PU Offset  Entry         E Addr    E  Offset   Statement  Load Mod  Service  Status
    0002D018  CEEHDSP       05936760  +0000277C  CEEHDSP       05936760  +0000277C              CEEPLPKA           Call
    05900C10  CALLNON       05900B28  -05900B26  CALLNON       05900B28  -05900B26       3_ISN  GO                 Exception

  Condition Information for Active Routines
    Condition Information for CALLNON   (DSA address 05900C10)
      CIB Address: 0002D468
      Current Condition:
        CEE3201S The system detected an operation exception.
      Location:
        Program Unit: CALLNON
        Entry:        CALLNON
        Statement:    3_ISN Offset: -05900B26
      Machine State:
        ILC..... 0002    Interruption Code..... 0001
        PSW..... 078D3D00 80000004
        GPR0..... FD000008  GPR1..... 00000000  GPR2..... 05900D04  GPR3..... 05900C10
        GPR4..... 007F6930  GPR5..... 007FD238  GPR6..... 007BFFF8  GPR7..... FD000000
        GPR8..... 007FD968  GPR9..... 807FD4F8  GPR10.... 00000000  GPR11.... 007FD238
        GPR12.... 00E21ED2  GPR13.... 05900C10  GPR14.... 85900CE8  GPR15.... 00000000
    Storage dump near condition, beginning at location: 00000000
      +000000 00000000  Inaccessible storage.

  Parameters, Registers, and Variables for Active Routines:
    CEEHDSP (DSA address 0002D018):
      Saved Registers:
        GPR0..... 00000000  GPR1..... 0002D3B4  GPR2..... 0002DFD7  GPR3..... 0002E027
        GPR4..... 0002DF94  GPR5..... 00000000  GPR6..... 00000004  GPR7..... 00000000
        GPR8..... 0002E017  GPR9..... 0593875E  GPR10.... 0593775F  GPR11.... 05936760
        GPR12.... 00014770  GPR13.... 0002D018  GPR14.... 800250DE  GPR15.... 85949C70

  GPREG STORAGE:
    Storage around GPR0 (00000000)
      +000000 00000000  Inaccessible storage.
      +000020 00000020  Inaccessible storage.
      +000040 00000040  Inaccessible storage.
    Storage around GPR1 (0002D3B4)
     -000020 0002D394  00000006 00000000 0002E017 0593875E  0593775F 05936760 00014770 00000000  |.............lg;.l.¬.l.-........|
     +000000 0002D3B4  0002DFD7 0002E027 0002DF94 0002DF94  0002DDF4 0002DEC4 0002E158 00000000  |...P.......m...m...4...D........|
     +000020 0002D3D4  0002D468 00000000 00000000 00000007  859D67E0 00000000 00000000 05914848  |..M.............e............j..|

⋮
CEE3DMP V1 R3.0: Condition processing resulted in the unhandled condition.        08/30/01 10:33:01 AM                Page:    4

  File Status and Attributes:
    The total number of units defined is 100.
    The default unit for the PUNCH statement is 7.
    The default unit for the Fortran error messages is 6.
    The default unit for formatted sequential output is 6.
    The default unit for formatted sequential input is 5.
```

Figure 105. Sections of the Language Environment dump resulting from a call to a nonexistent routine

To understand the traceback section, and debug this example routine, do the following:

1. Find the Current Condition information in the Condition Information for Active Routines section of the dump. The message is CEE3201S. The system detected an operation exception at statement 3. For more information about this message, see *z/OS Language Environment Run-Time Messages*. This section of the dump also provides such information as the name of the active routine and the current statement number at the time of the dump.
2. Locate statement 3 in the routine shown in Figure 104 on page 273. This statement calls subroutine SUBNAM. The message CEE3201S in the Condition Information section of the dump indicates that the operation exception was generated because of an unresolved external reference.
3. Check the linkage editor output for error messages.

Divide-by-zero error

Figure 106 demonstrates a divide-by-zero error. In this example, the main Fortran program passed 0 to subroutine DIVZEROSUB, and the error occurred when DIVZEROSUB attempted to use this data as a divisor.

```
OPTIONS IN EFFECT: LIST NOMAP NOXREF NOGOSTMT NODECK SOURCE TERM OBJECT FIXED TRMFLG SRCFLG NODDIM NORENT SDUMP(ISN)
                   NOSXM NOVECTOR IL(DIM) NOTEST SC(*) NODC NOEC NOEMODE NOICA NODIRECTIVE NODBCS NOSAA NOPARALLEL NODYNAMIC NOSYM
                   NOREORDER NOPC
                   OPT(0) LANGLVL(77) NOFIPS FLAG(I) HALT(S) AUTODBL(NONE) PTRSIZE(8) LINECOUNT(60) CHARLEN(500) NAME(MAIN#)
           1         PROGRAM DIVZERO
           2         INTEGER*4 ANY_NUMBER
           3         INTEGER*4 ANY_ARRAY(3)
           4         PRINT *,'EXAMPLE STARTING'
           5         ANY_NUMBER = 0
           6         DO I = 1,3
     1     7         ANY_ARRAY(I) = I
     1     8         END DO
           9         CALL DIVZEROSUB(ANY_NUMBER, ANY_ARRAY)
          10         PRINT *,'EXAMPLE ENDING'
          11         STOP
          12         END
OPTIONS IN EFFECT: LIST NOMAP NOXREF NOGOSTMT NODECK SOURCE TERM OBJECT FIXED TRMFLG SRCFLG NODDIM NORENT SDUMP(ISN)
                   NOSXM NOVECTOR IL(DIM) NOTEST SC(*) NODC NOEC NOEMODE NOICA NODIRECTIVE NODBCS NOSAA NOPARALLEL NODYNAMIC NOSYM
                   NOREORDER NOPC
                   OPT(0) LANGLVL(77) NOFIPS FLAG(I) HALT(S) AUTODBL(NONE) PTRSIZE(8) LINECOUNT(60) CHARLEN(500) NAME(MAIN#)
           1         SUBROUTINE DIVZEROSUB(DIVISOR, DIVIDEND)
           2         INTEGER*4 DIVISOR
           3         INTEGER*4 DIVIDEND(3)
           4         PRINT *,'IN SUBROUTINE DIVZEROSUB'
           5         DIVIDEND(1) = DIVIDEND(3) / DIVISOR
           6         PRINT *,'END OF SUBROUTINE DIVZEROSUB'
           7         RETURN
           8         END
```

Figure 106. Fortran routine with a divide-by-zero error

Figure 107 on page 276 shows the Language Environment dump for routine DIVZERO.

```
CEE3DMP V1 R3.0: Condition processing resulted in the unhandled condition.         08/30/01 10:33:01 AM                Page:    1

Information for enclave DIVZERO

  Information for thread 8000000000000000

  Traceback:
    DSA Addr  Program Unit  PU Addr   PU Offset  Entry         E Addr    E  Offset   Statement  Load Mod  Service  Status
    0002D018  CEEHDSP       05936760  +0000277C  CEEHDSP       05936760  +0000277C              CEEPLPKA           Call
    05900640  DIVZSUB       05900558  +00000258  DIVZSUB       05900558  +00000258       5_ISN  GO                 Exception
    0002F018  AFHLCLNR      0001B150  +00000000  AFHLCLNR      0001B150  +00000000              AFHPRNBG           Call
    059002E8  DIVZERO       05900200  +00000298  DIVZERO       05900200  +00000298       9_ISN  GO                 Call

  Condition Information for Active Routines
    Condition Information for DIVZSUB   (DSA address 05900640)
      CIB Address: 0002D468
      Current Condition:
        CEE3209S The system detected a fixed-point divide exception.
      Location:
        Program Unit: DIVZSUB
        Entry:        DIVZSUB
        Statement:    5_ISN Offset: +00000258
      Machine State:
        ILC..... 0004    Interruption Code..... 0009
        PSW..... 078D2A00 859007B4
        GPR0..... 00000000  GPR1..... 00000003  GPR2..... 059003FC  GPR3..... 05900400
        GPR4..... 007F6930  GPR5..... 05900468  GPR6..... 0000000C  GPR7..... 059003E0
        GPR8..... 85900400  GPR9..... 807FD4F8  GPR10.... 00000000  GPR11.... 007FD238
        GPR12.... 00E21ED2  GPR13.... 05900640  GPR14.... 8590079C  GPR15.... 05900BA0
    Storage dump near condition, beginning at location: 059007A0
      +000000 059007A0  5870D118 5800700C 5870D120 8E000020  5D007000 5870D118 50107004 58F0D128  |..J.......J.....).....J.&....0J.|

  Parameters, Registers, and Variables for Active Routines:
    CEEHDSP (DSA address 0002D018):
      Saved Registers:
        GPR0..... 00000000  GPR1..... 0002D3B4  GPR2..... 0002DFD7  GPR3..... 0002E027
        GPR4..... 0002DF94  GPR5..... 00000000  GPR6..... 00000004  GPR7..... 00000000
        GPR8..... 0002E017  GPR9..... 0593875E  GPR10.... 0593775F  GPR11.... 05936760
        GPR12.... 00014770  GPR13.... 0002D018  GPR14.... 800250DE  GPR15.... 85949C70

  GPREG STORAGE:
    Storage around GPR0 (00000000)
      +000000 00000000  Inaccessible storage.
      +000020 00000020  Inaccessible storage.
      +000040 00000040  Inaccessible storage.
    Storage around GPR1 (0002D3B4)
      -000020 0002D394  00000006 00000000 0002E017 0593875E  0593775F 05936760 00014770 00000000  |............lg;.l.¬.l.-........|
      +000000 0002D3B4  0002DFD7 0002E027 0002DF94 0002DF94  0002DDF4 0002DEC4 0002E158 00000000  |...P.......m...m...4...D........|
      +000020 0002D3D4  0002D468 00000000 00000000 00000007  859D67E0 00000000 00000000 05914848  |..M.............e............j..|

⋮
      Local Variables:
          I               INTEGER*4                 4

          ANY_ARRAY(3)    INTEGER*4
          ANY_ARRAY(1)                              1          2          3

          ANY_NUMBER      INTEGER*4                 0

  File Status and Attributes:
    The total number of units defined is 100.
    The default unit for the PUNCH statement is 7.
    The default unit for the Fortran error messages is 6.
    The default unit for formatted sequential output is 6.
    The default unit for formatted sequential input is 5.
```

Figure 107. Language Environment dump from divide-by-zero Fortran example

To debug this application, do the following:

1. Locate the error message for the current condition in the Condition Information section of the dump, shown in Figure 107. The message is CEE3209S. The system detected a fixed-point divide exception. See *z/OS Language Environment Run-Time Messages* for additional information about this message.
2. Note the sequence of the calls in the call chain:
   a. DIVZERO called AFHLCLNR, which is a Fortran library subroutine.
   b. AFHLCLNR called DIVZEROSUB.

Note: When a program-unit name is longer than 7 characters, the name as it appears in the dump consists of the first 4 and last 3 characters concatenated together.

c. DIVZEROSUB attempted a divide-by-zero operation at statement 5.

d. This resulted in a call to CEEHDSP, a Language Environment condition handling routine.

3. Locate statement 5 in the Fortran listing for the DIVZEROSUB subroutine in Figure 107 on page 276. This is an instruction to divide the contents of DIVIDEND(3) by DIVISOR.
4. Since DIVISOR is a parameter of subroutine DIVZEROSUB, go to the Parameters section of the dump shown in Figure 107 on page 276. The parameter DIVISOR shows a value of 0.
5. Since DIVISOR contains the value passed to DIVZEROSUB, check its value. ANY_NUMBER is the actual argument passed to DIVZEROSUB, and the dump and listing of DIVZERO indicate that ANY_NUMBER had value 0 when passed to DIVZEROSUB, leading to the divide-by-zero exception.

Chapter 7. Debugging PL/I for MVS & VM routines

This chapter contains information that can help you debug applications that contain one or more PL/I for MVS & VM routines. Following a discussion about potential errors in PL/I for MVS & VM routines, the first part of this chapter discusses how to use compiler-generated listings to obtain information about PL/I for MVS & VM routines, and how to use PLIDUMP to generate a Language Environment dump of a PL/I for MVS & VM routine. The last part of the chapter provides examples of PL/I for MVS & VM routines and explains how to debug them using information contained in the traceback information provided in the dump. The topics covered are listed below.

- Determining the source of errors in PL/I for MVS & VM routines
- Using PL/I for MVS & VM compiler listings
- Generating a Language Environment dump of a PL/I for MVS & VM routine
- Finding PL/I for MVS & VM information in a dump
- Debugging example of PL/I for MVS & VM routines

Determining the source of errors in PL/I for MVS & VM routines

Most errors in PL/I for MVS & VM routines can be identified by the information provided in PL/I run-time messages, which begin with the prefix IBM. For a list of these messages, see *z/OS Language Environment Run-Time Messages*.

A malfunction in running a PL/I for MVS & VM routine can be caused by:

- Logic errors in the source routine
- Invalid use of PL/I for MVS & VM
- Unforeseen errors
- Invalid input data
- Compiler or run-time routine malfunction
- System malfunction
- Unidentified routine malfunction
- Overlaid storage

Logic errors in the source routine

Errors of this type are often difficult to detect because they often appear as compiler or library malfunctions.

Some common errors in source routines are:

- Incorrect conversion from arithmetic data
- Incorrect arithmetic and string manipulation operations
- Unmatched data lists and format lists

Invalid use of PL/I for MVS & VM

A misunderstanding of the language or a failure to provide the correct environment for using PL/I for MVS & VM can result in an apparent malfunction of a PL/I for MVS & VM routine.

Any of the following, for example, might cause a malfunction:

- Using uninitialized variables
- Using controlled variables that have not been allocated
- Reading records into incorrect structures
- Misusing array subscripts
- Misusing pointer variables
- Incorrect conversion

© Copyright IBM Corp. 1991, 2009

- Incorrect arithmetic operations
- Incorrect string manipulation operations

Unforeseen errors

If an error is detected during run time and no ON-unit is provided in the routine to terminate the run or attempt recovery, the job terminates abnormally. However, the status of a routine at the point where the error occurred can be recorded by using an ERROR ON-unit that contains the statements:

```
ON ERROR
 BEGIN;
  ON ERROR SYSTEM;
  CALL PLIDUMP;         /*generates a dump*/
  PUT DATA;             /*displays variables*/
 END;
```

The statement ON ERROR SYSTEM ensures that further errors do not result in a permanent loop.

Invalid input data

A routine should contain checks to ensure that any incorrect input data is detected before it can cause the routine to malfunction.

Use the COPY option of the GET statement to check values obtained by stream-oriented input. The values are listed on the file named in the COPY option. If no file name is given, SYSPRINT is assumed.

Compiler or run-time routine malfunction

If you are certain that the malfunction is caused by a compiler or run-time routine error, you can either open a PMR or submit an APAR for the error. See *PL/I for MVS & VM Diagnosis Guide* for more information about handling compiler and run-time routine malfunctions. Meanwhile, you can try an alternative way to perform the operation that is causing the trouble. A bypass is often feasible, since the PL/I for MVS & VM language frequently provides an alternative method of performing operations.

System malfunction

System malfunctions include machine malfunctions and operating system errors. System messages identify these malfunctions and errors to the operator.

Unidentified routine malfunction

In most circumstances, an unidentified routine malfunction does not occur when using the compiler. If your routine terminates abnormally without an accompanying Language Environment run-time diagnostic message, the error causing the termination might also be inhibiting the production of a message. Check for the following:

- Your job control statements might be in error, particularly in defining data sets.
- Your routine might overwrite main storage areas containing executable instructions. This can happen if you have accidentally:
  - Assigned a value to a nonexistent array element. For example:

```
DCL ARRAY(10);

⋮
DO I = 1 TO 100;
ARRAY(I) = VALUE;
```

To detect this type of error in a compiled module, set the SUBSCRIPTRANGE condition so that each attempt to access an element outside the declared range of subscript values raises the SUBSCRIPTRANGE condition. If there is no ON-unit for this condition, a diagnostic message is printed and the ERROR condition is raised. This facility, though expensive in run time and storage space, is a valuable routine-testing aid.

– Used an incorrect locator value for a locator (pointer or offset) variable. This type of error can occur if a locator value is obtained by means of record-oriented transmission. Ensure that locator values created in one routine, transmitted to a data set, and subsequently retrieved for use in another routine, are valid for use in the second routine.
– Attempted to free a nonbased variable. This can happen when you free a based variable after its qualifying pointer value has been changed. For example:

```
DCL A STATIC,B BASED (P);
ALLOCATE B;
P = ADDR(A);
FREE B;
```

– Used the SUBSTR pseudovariable to assign a string to a location beyond the end of the target string. For example:

```
DCL X CHAR(3);
I=3
SUBSTR(X,2,I) = 'ABC';
```

To detect this type of error, enable the STRINGRANGE condition during compilation.

Storage overlay problems

If you suspect an error in your PL/I for MVS & VM application is a storage overlay problem, check for the following:

- The use of a subscript outside the declared bounds (check the SUBSCRIPTRANGE condition)
- An attempt to assign a string to a target with an insufficient maximum length (check the STRINGSIZE condition)
- The failure of the arguments to a SUBSTR reference to comply with the rules described for the SUBSTR built-in function (check the STRINGRANGE condition)
- The loss of significant last high-order (left-most) binary or decimal digits during assignment to an intermediate result or variable or during an input/output operation (check the SIZE condition)
- The reading of a variable-length file into a variable
- The misuse of a pointer variable
- The invocation of a Language Environment callable service with fewer arguments than are required

The first four situations are associated with the listed PL/I for MVS & VM conditions, all of which are disabled by default. If you suspect one of these problems exists in your routine, use the appropriate condition prefix on the suspected statement or on the BEGIN or PROCEDURE statement of the containing block.

The fifth situation occurs when you read a data record into a variable that is too small. This type of problem only happens with variable-length files. You can often isolate the problem by examining the data in the file information and buffer.

The sixth situation occurs when you misuse a pointer variable. This type of storage overlay is particularly difficult to isolate. There are a number of ways pointer variables can be misused:

- When a READ statement runs with the SET option, a value is placed in a pointer. If you then run a WRITE statement or another READ SET option with another pointer, you overlay your storage if you try to use the original pointer.
- When you try to use a pointer to allocate storage that has already been freed, you can also cause a storage overlay.
- When you attempt to use a pointer set with the ADDR built-in function as a base for data with different attributes, you can cause a storage overlay.

The seventh situation occurs when a Language Environment callable service is passed fewer arguments than its interface requires. The following example might cause a storage overlay because Language Environment assumes that the fourth item in the argument list is the address of a feedback code, when in reality it could be residue data pointing anywhere in storage.

Invalid calls:

```
DCL CEEDATE ENTRY OPTIONS(ASM);
CALL CEEDATE(x,y,z);      /* invalid */
```

Valid calls:

```
DCL CEEDATE ENTRY(*,*,*,* OPTIONAL) OPTIONS(ASM);
CALL CEEDATE(x,y,z,*);    /* valid   */
CALL CEEDATE(x,y,z,fc);   /* valid   */
```

Using PL/I for MVS & VM compiler listings

The following sections explain how to generate listings that contain information about your routine. PL/I for MVS & VM listings show machine instructions, constants, and external or internal addresses that the linkage editor resolves. This information can help you find other information, such as variable values, in a dump of a PL/I for MVS & VM routine.

The PL/I compiler listings included below are from the PL/I for MVS & VM product.

Generating PL/I for MVS & VM listings and maps

The following table shows compiler-generated listings that you might find helpful when you use information in dumps to debug PL/I for MVS & VM routines. For more information about supported compiler options that generate listings, reference the *PL/I for MVS & VM Programming Guide*.

Table 18. Compiler-generated PL/I for MVS & VM listings and their contents

Name	Contents	Compiler Option
Source program	Source program statements	SOURCE
Cross reference	Cross reference of names with attributes	XREF and ATTRIBUTES
Aggregate table	Names and layouts of structures and arrays	AGGREGATE
Variable map	Offsets of automatic and static internal variables (from their defining base)	MAP

Table 18. Compiler-generated PL/I for MVS & VM listings and their contents (continued)

Name	Contents	Compiler Option
Object code	Contents of the program control section in hexadecimal notation and translated into a pseudo-assembler format. To limit the size of the object code listing, specify a certain statement or range of statements to be listed; for example, LIST(20) or LIST(10,30).	LIST
Variable map, object code, static storage	Same as MAP and LIST options above, plus contents of static internal and static external control sections in hexadecimal notation with comments	MAP and LIST

Finding information in PL/I for MVS & VM listings

Figure 108 shows an example PL/I for MVS & VM routine that was compiled with LIST and MAP.

```
*PROCESS SOURCE, LIST, MAP;

                  SOURCE LISTING

   STMT

      1  |EXAMPLE: PROC OPTIONS(MAIN);
      2  |           DCL EXTR ENTRY EXTERNAL;
      3  |           DCL A FIXED BIN(31);
      4  |           DCL B(2,2)  FIXED BIN(31) STATIC EXTERNAL INIT((4)0);
      5  |           DCL C CHAR(20) STATIC INIT('SAMPLE CONSTANT');
      6  |           DCL D FIXED BIN(31) STATIC;
      7  |           DCL E FIXED BIN(31);
      8  |           FETCH EXTR;
      9  |           CALL EXTR(A,B,C,D,E);
     10  |           DISPLAY(C);
     11  |         END;
```

Figure 108. PL/I for MVS & VM routine compiled with LIST and MAP

Figure 109 on page 284 shows the output generated by the LIST and MAP options for this routine, including the static storage map, variable storage map, and the object code listing. The sections following this example describe the contents of each type of listing.

```
                        STATIC INTERNAL STORAGE MAP

000000  E00000E8              PROGRAM ADCON
000004  00000008              PROGRAM ADCON
000008  00000096              PROGRAM ADCON
00000C  00000096              PROGRAM ADCON
000010  00000096              PROGRAM ADCON
000014  00000000              A..IBMSJDSA
000018  00000000              A..IBMSPFRA
00001C  00000000              A..STATIC
000020  0000000000000044      LOCATOR..B
000028  0000008800140000      LOCATOR..C
000030  91E091E0              CONSTANT
000034  0A000000C5E7E3D9      FECB..EXTR
        40404040
000040  80000034              A..FECB..EXTR
000044  0000000C00000008      DESCRIPTOR
        0000000200000001
        0000000400000002
        00000001
000060  80000034              A..FECB..EXTR
000064  00000000              A..B
000068  00000000              A..A
00006C  00000020              A..LOCATOR
000070  00000028              A..LOCATOR
000074  000000A0              A..D
000078  80000000              A..E
00007C  00000000              A..ENTRY EXTR
000080  80000028              A..LOCATOR
000084
000088  E2C1D4D7D3C540C3      INITIAL VALUE..C
        D6D5E2E3C1D5E340
        40404040

                        STATIC EXTERNAL CSECTS

000000  0000000000000000      CSECT FOR EXTERNAL VARIABLE
        0000000000000000

⋮
                                VARIABLE STORAGE MAP

IDENTIFIER                      LEVEL         OFFSET       (HEX)   CLASS     BLOCK

E                                   1            184          B8   AUTO      EXAMPLE
D                                   1            160          A0   STATIC    EXAMPLE
C                                   1            136          88   STATIC    EXAMPLE
A                                   1            188          BC   AUTO      EXAMPLE

⋮
  OBJECT LISTING
                                                      000096  58 B0 C 004              L     11,4(0,12)
                                                      00009A  58 FB 0 000              L     15,PR..EXTR
* STATEMENT NUMBER  1                                 00009E  59 F0 C 064              C     15,100(0,12)
000000                          DC    C'EXAMPLE'      0000A2  47 70 2 01E              BNE   CL.5
000007                          DC    AL1(7)          0000A6  41 10 3 040              LA    1,64(0,3)
                                                      0000AA  58 F0 3 018              L     15,A..IBMSPFRA
* PROCEDURE                            EXAMPLE        0000AE  05 EF                     BALR  14,15
                                                      0000B0  58 FB 0 000              L     15,PR..EXTR
* REAL ENTRY                                          0000B4                   CL.5    EQU   *
000008  90 EC D 00C             STM   14,12,12(13)
00000C  47 F0 F 04C             B     *+72
000010  00000000                DC    A(STMT. NO. TABLE)  * STATEMENT NUMBER  9
000014  000000D8                DC    F'216'          0000B4  D2 13 D 0C0 3 068         MVC   192(20,13),104(3)
000018  00000000                DC    A(STATIC CSECT)     0000BA  41 70 D 0BC              LA    7,A
00001C  00000000                DC    A(SYMTAB VECTOR)    0000BE  50 70 D 0C0              ST    7,192(0,13)
000020  00000000                DC    A(COMPILATION INFO) 0000C2  41 70 D 0B8              LA    7,E
000024  A8000000                DC    X'A8000000'         0000C6  50 70 D 0D0              ST    7,208(0,13)
000028  00010100                DC    X'00010100'         0000CA  96 80 D 0D0              OI    208(13),X'80'
00002C  00000000                DC    X'00000000'         0000CE  58 FB 0 000              L     15,PR..EXTR
000030  00000000                DC    X'00000000'         0000D2  59 F0 C 064              C     15,100(0,12)
000034  00000000                DC    A(ENTRY LIST VECTOR)0000D6  47 70 2 052              BNE   CL.6
```

Figure 109. Compiler-generated listings from example PL/I for MVS & VM routine (Part 1 of 2)

```
000038  00000000                DC    X'00000000'         0000DA  41 10 3 060             LA    1,96(0,3)
00003C  01008000                DC    X'01008000'         0000DE  58 F0 3 018             L     15,A..IBMSPFRA
000040  00000000                DC    A(REGION TABLE)     0000E2  05 EF                   BALR  14,15
000044  00000002                DC    X'00000002'         0000E4  58 FB 0 000             L     15,PR..EXTR
000048  00000000                DC    A(PRIMARY ENTRY)    0000E8                  CL.6    EQU   *
00004C  00000000                DC    X'00000000'         0000E8  1B 55                  SR    5,5
000050  00000000                DC    X'00000000'         0000EA  41 10 D 0C0             LA    1,192(0,13)
000054  58 30 F 010             L     3,16(0,15)          0000EE  05 EF                   BALR  14,15
000058  58 10 D 04C             L     1,76(0,13)
00005C  58 00 F 00C             L     0,12(0,15)
000060  1E 01                   ALR   0,1                 * STATEMENT NUMBER  10
000062  55 00 C 00C             CL    0,12(0,12)          0000F0  41 10 3 080             LA    1,128(0,3)
000066  47 D0 F 068             BNH   *+10                0000F4  58 F0 3 014             L     15,A..IBMSJDSA
00006A  58 F0 C 074             L     15,116(0,12)        0000F8  05 EF                   BALR  14,15
00006E  05 EF                   BALR  14,15
000070  58 E0 D 048             L     14,72(0,13)
000074  18 F0                   LR    15,0                * STATEMENT NUMBER  11
000076  90 E0 1 048             STM   14,0,72(1)          0000FA  18 0D                   LR    0,13
00007A  50 D0 1 004             ST    13,4(0,1)           0000FC  58 D0 D 004             L     13,4(0,13)
00007E  92 80 1 000             MVI   0(1),X'80'          000100  58 E0 D 00C             L     14,12(0,13)
000082  92 25 1 001             MVI   1(1),X'25'          000104  98 2C D 01C             LM    2,12,28(13)
000086  92 02 1 076             MVI   118(1),X'02'        000108  05 1E                   BALR  1,14
00008A  41 D1 0 000             LA    13,0(1,0)
00008E  D2 03 D 054 3 030       MVC   84(4,13),48(3)      * END PROCEDURE
000094  05 20                   BALR  2,0                 00010A  07 07                   NOPR  7

* PROCEDURE BASE                                         * END PROGRAM
```

Figure 109. Compiler-generated listings from example PL/I for MVS & VM routine (Part 2 of 2)

Static internal storage map

To get a complete variable storage map and static storage map, but not a complete LIST, specify a single statement for LIST to minimize the size of the listing; for example, LIST(1).

Each line of the static storage map contains the following information:

1. Six-digit hexadecimal offset.
2. Hexadecimal text, in 8-byte sections where possible.
3. Comment, indicating the type of item to which the text refers. The comment appears on the first line of the text for an item.

Some typical comments you might find in a static storage listing:

Table 19. Typical comments in a PL/I for MVS & VM static storage listing

Comment	Explanation
A..*xxx*	Address constant for *xxx*
COMPILER LABEL CL.*n*	Compiler-generated label *n*
CONDITION CSECT	Control section for programmer-named condition
CONSTANT	Constant
CSECT FOR EXTERNAL VARIABLE	Control section for external variable
D..*xxx*	Descriptor for *xxx*
DED..*xxx*	Data element descriptor for *xxx*
DESCRIPTOR	Data descriptor
ENVB	Environment control block
FECB..*xxx*	Fetch control block for *xxx*
DCLCB	Declare control block
FED..*xxx*	Format element descriptor for *xxx*

Table 19. Typical comments in a PL/I for MVS & VM static storage listing (continued)

Comment	Explanation
KD..*xxx*	Key descriptor for *xxx*
LOCATOR..*xxx*	Locator for *xxx*
ONCB	ON statement control block
PICTURED DED..*xxx*	Pictured data element descriptor for *xxx*
PROGRAM ADCON	Program address constant
RD..*xxx*	Record descriptor for *xxx*
SYMBOL TABLE ELEMENT	Symbol table address
SYMBOL TABLE..*xxx*	Symbol table for *xxx*
SYMTAB DED..*xxx*	Symbol table DED for *xxx*
USER LABEL..*xxx*	Source program label for *xxx*
xxx	Variable with name *xxx*. If the variable is not initialized, no text appears against the comment. There is also no static offset if the variable is an array (the static offset can be calculated from the array descriptor, if required).

Variable storage map

For automatic and static internal variables, the variable storage map contains the following information:

- PL/I for MVS & VM identifier name
- Level
- Storage class
- Name of the PL/I for MVS & VM block in which it is declared
- Offset from the start of the storage area, in both decimal and hexadecimal form

If the LIST option is also specified, a map of the static internal and external control sections, called the static storage map, is also produced.

Object code listing

The object code listing consists of the machine instructions and a translation of these instructions into a form that resembles assembler and includes comments, such as source program statement numbers.

The machine instructions are formatted into blocks of code, headed by the statement or line number in the PL/I for MVS & VM source program listing. Generally, only executable statements appear in the listing. DECLARE statements are not normally included. The names of PL/I for MVS & VM variables, rather than the addresses that appear in the machine code, are listed. Special mnemonics are used to refer to some items, including test hooks, descriptors, and address constants.

Statements in the object code listing are ordered by block, as they are sequentially encountered in the source program. Statements in the external procedure are given first, followed by the statements in each inner block. As a result, the order of statements frequently differs from that of the source program.

Every object code listing begins with the name of the external procedure. The actual entry point of the external procedure immediately follows the heading comment `REAL ENTRY`. The subsequent machine code is the prolog for the block,

which performs block activation. The comment PROCEDURE BASE marks the end of the prolog. Following this is a translation of the first executable statement in the PL/I for MVS & VM source program.

Following are the comments used in the listing:

Table 20. Comments in a PL/I for MVS & VM object code listing

Comment	Function
BEGIN BLOCK *xxx*	Indicates the start of the begin block with label *xxx*
BEGIN BLOCK NUMBER *n*	Indicates the start of the begin block with number *n*
CALCULATION OF COMMONED EXPRESSION FOLLOWS	Indicates that an expression used more than once in the routine is calculated at this point
CODE MOVED FROM STATEMENT NUMBER *n*	Indicates object code moved by the optimization process to a different part of the routine and gives the number of the statement from which it originated
COMPILER GENERATED SUBROUTINE *xxx*	Indicates the start of compiler-generated subroutine *xxx*
CONTINUATION OF PREVIOUS REGION	Identifies the point at which addressing from the previous routine base recommences
END BLOCK	Indicates the end of a begin block
END INTERLANGUAGE PROCEDURE *xxx*	Identifies the end of an ILC procedure *xxx*
END OF COMMON CODE	Identifies the end of code used in running more than one statement
END OF COMPILER GENERATED SUBROUTINE	Indicates the end of the compiler-generated subroutine
END PROCEDURE	Identifies the end of a procedure
END PROGRAM	Indicates the end of the external procedure
INITIALIZATION CODE FOR *xxx*	Indicates the start of initialization code for variable *xxx*
INITIALIZATION CODE FOR OPTIMIZED LOOP FOLLOWS	Indicates that some of the code that follows was moved from within a loop by the optimization process
INTERLANGUAGE PROCEDURE *xxx*	Identifies the start of an implicitly generated ILC procedure *xxx*
METHOD OR ORDER OF CALCULATING EXPRESSIONS CHANGED	Indicates that the order of the code following was changed to optimize the object code
ON-UNIT BLOCK NUMBER *n*	Indicates the start of an ON-unit block with number *n*
ON-UNIT BLOCK END	Indicates the end of the ON-unit block
PROCEDURE *xxx*	Identifies the start of the procedure labeled *xxx*
PROCEDURE BASE	Identifies the address loaded into the base register for the procedure
PROGRAM ADDRESSABILITY REGION BASE	Identifies the address where the routine base is updated if the routine size exceeds 4096 bytes and consequently cannot be addressed from one base
PROLOGUE BASE	Identifies the start of the prolog code common to all entry points into that procedure
REAL ENTRY	Precedes the actual executable entry point for a procedure

Table 20. Comments in a PL/I for MVS & VM object code listing (continued)

Comment	Function
STATEMENT LABEL *xxx*	Identifies the position of source program statement label *xxx*
STATEMENT NUMBER *n*	Identifies the start of code generated for statement number *n* in the source listing

In certain cases the compiler uses mnemonics to identify the type of operand in an instruction and, where applicable, follows the mnemonic by the name of a PL/I for MVS & VM variable.

Table 21. PL/I for MVS & VM mnemonics

Mnemonic	Explanation
A..*xxx*	Address constant for *xxx*
ADD..*xxx*	Aggregate descriptor for *xxx*
BASE..*xxx*	Base address of variable *xxx*
BLOCK.*n*	Identifier created for an otherwise unlabeled block
CL.*n*	Compiler-generated label number *n*
D..*xxx*	Descriptor for *xxx*
DED..*xxx*	Data element descriptor for *xxx*
HOOK...ENTRY	Debugging tool block entry hook
HOOK...BLOCK-EXIT	Debugging tool block exit hook
HOOK...PGM-EXIT	Debugging tool program exit hook
HOOK...PRE-CALL	Debugging tool pre-call hook
HOOK...INFO	Additional pre-call hook information
HOOK...POST-CALL	Debugging tool post call hook
HOOK...STMT	Debugging tool statement hook
HOOK...IF-TRUE	Debugging tool IF true hook
HOOK...IF-FALSE	Debugging tool ELSE hook
HOOK...WHEN	Debugging tool WHEN true hook
HOOK...OTHERWISE	Debugging tool OTHERWISE true hook
HOOK...LABEL	Debugging tool label hook
HOOK...DO	Debugging tool iterative DO hook
HOOK...ALLOC	Debugging tool ALLOCATE controlled hook
WSP.*n*	Workspace, followed by identifying number *n*
L..*xxx*	Length of variable *xxx*
PR..*xxx*	Pseudoregister vector slot for *xxx*
LOCATOR..*xxx*	Locator for *xxx*
RKD..*xxx*	Record or key descriptor for *xxx*
VO..*xxx*	Virtual origin for *xxx* (the address where element 0 is held for a one-dimensional array, element 0,0 for a two-dimensional array, and so on)

Generating a Language Environment dump of a PL/I for MVS & VM routine

To generate a dump of a PL/I for MVS & VM routine, you can call either the Language Environment callable service CEE3DMP or PLIDUMP. For information about calling CEE3DMP, see “Generating a Language Environment dump with CEE3DMP” on page 35.

PLIDUMP syntax and options

PLIDUMP calls intermediate PL/I for MVS & VM library routines, which convert most PLIDUMP options to CEE3DMP options. The following list contains PLIDUMP options and the corresponding CEE3DMP option, if applicable.

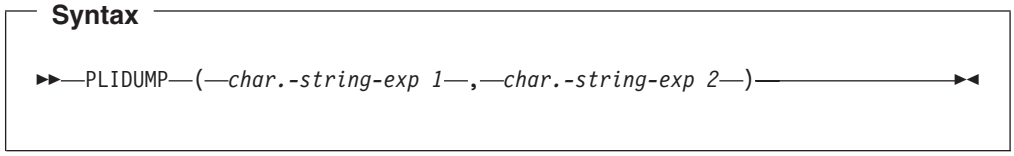
Some PLIDUMP options do not have corresponding CEE3DMP options, but continue to function as PL/I for MVS & VM default options. The list following the syntax diagram provides a description of those options.

PLIDUMP now conforms to National Language Support standards.

PLIDUMP can supply information across multiple Language Environment enclaves. If an application running in one enclave fetches a main procedure (an action that creates another enclave), PLIDUMP contains information about both procedures.

The syntax and options for PLIDUMP are shown below.

Syntax



char.-string-exp 1

A dump options character string consisting of one or more of the following:

A All. Results in a dump of all tasks including the ones in the WAIT state.

B BLOCKS (PL/I for MVS & VM hexadecimal dump). Dumps the control blocks used in Language Environment and member language libraries. For PL/I for MVS & VM, this includes the DSA for every routine on the call chain and PL/I for MVS & VM ″global″ control blocks, such as Tasking Implementation Appendage (TIA), Task Communication Area (TCA), and the PL/I Tasking Control Block (PTCB). PL/I file control blocks and file buffers are also dumped if the F option is specified.

C Continue. The routine continues after the dump.

E Exit. The enclave terminates after the dump. In a multitasking environment, if PLIDUMP is called from the main task, the enclave terminates after the dump. If PLIDUMP is called from a subtask, the subtask and any subsequent tasks created from the subtask terminate after the dump. In a multithreaded environment, if PLIDUMP is called from the Initial Process Thread (IPT), the enclave terminates after the dump. If PLIDUMP is called from a non-IPT, only the non-IPT terminates after the dump.

F FILE INFORMATION. A set of attributes for all open files is given. The contents of the file buffers are displayed if the B option is specified.

H STORAGE in hexadecimal. A SNAP dump of the region is produced. A ddname of CEESNAP must be provided to direct the CEESNAP dump report.

K BLOCKS (when running under CICS). The Transaction Work Area is included.

Note: This option is not supported under Enterprise PL/I.

NB NOBLOCKS.

NF NOFILES.

NH NOSTORAGE.

NK NOBLOCKS (when running under CICS).

NT NOTRACEBACK.

O THREAD(CURRENT). Results in a dump of only the current task or current thread (the invoker of PLIDUMP).

S Stop. The enclave terminates after the dump. In a multitasking environment, regardless of whether PLIDUMP is called from the main task or a subtask, the enclave terminates after the dump. In a multithreaded environment, regardless of whether PLIDUMP is called from the IPT or a non-IPT, the enclave terminates after the dump (in which case there is no fixed order as to which thread terminates first).

T TRACEBACK. Includes a traceback of all routines on the call chain. The traceback shows transfers of control from either calls or exceptions. BEGIN blocks and ON-units are also control transfers and are included in the trace. The traceback extends backwards to the main program of the current thread.

T, F, C, and A are the default options.

char.-string-exp 2
A user-identified character string up to 80 characters long that is printed as the dump header.

PLIDUMP usage notes

If you use PLIDUMP, the following considerations apply:

- If a routine calls PLIDUMP a number of times, use a unique user-identifier for each PLIDUMP invocation. This simplifies identifying the beginning of each dump.
- In MVS or TSO, you can use ddnames of CEEDUMP, PLIDUMP, or PL1DUMP to direct dump output. If no ddname is specified, CEEDUMP is used.
- The data set defined by the PLIDUMP, PL1DUMP, or CEEDUMP DD statement should specify a logical record length (LRECL) of at least 131 to prevent dump records from wrapping.
- When you specify the H option in a call to PLIDUMP, the PL/I for MVS & VM library issues an OS SNAP macro to obtain a dump of virtual storage. The first invocation of PLIDUMP results in a SNAP identifier of 0. For each successive invocation, the ID is increased by one to a maximum of 256, after which the ID is reset to 0.
- Support for SNAP dumps using PLIDUMP is provided only under MVS. SNAP dumps are not produced in a CICS environment.

– If the SNAP does not succeed, the CEE3DMP DUMP file displays the message:

```
Snap was unsuccessful
```

Failure to define a CEESNAP data set is the most likely cause of an unsuccessful CEESNAP.

– If the SNAP is successful, CEE3DMP displays the message:

```
Snap was successful; snap ID = nnn
```

where *nnn* corresponds to the SNAP identifier described above. An unsuccessful SNAP does not result in an incrementation of the identifier.

- To ensure portability across system platforms, use PLIDUMP to generate a dump of your PL/I for MVS & VM routine.

Finding PL/I for MVS & VM information in a dump

The following sections discuss PL/I-specific information located in the following sections of a Language Environment dump:

- Traceback
- Control Blocks for Active Routines
- Control Block Associated with the Thread
- File Status and Attributes

Traceback

Examine the traceback section of the dump, shown in Figure 110 on page 292, for condition information about your routine and information about the statement number and address where the exception occurred.

```
CEE3DMP V1 R9.0: Plidump called from error On-unit                              02/27/07 11:45:20 AM           Page:    1
ASID: 003E   Job ID: JOB21950   Job name: LEDGSMP1   Step name: GO        UserID: HEALY

CEE3845I CEEDUMP Processing started.
PLIDUMP was called from statement number 6 at offset +000000D6 from ERR  ON-unit with entry address 20900C58

Information for enclave EXAMPLE

  Information for thread 8000000000000000

  Traceback:
    DSA   Entry       E  Offset  Statement   Load Mod            Program Unit                  Service  Status
    1     CEEKKMRA    +0000081C              CEEPLPKA            CEEKKMRA                      D1908    Call
    2     IBMRKDM     +000000C2              IBMREV10            IBMRKDM                                Call
    3     ERR  ON-unit+000000D6  6           EXAMPLE             EXAMPLE                                Call
    4     IBMRERPL    +0000065A              IBMRLIB1            IBMRERPL                               Call
    5     CEEEV010    +0000013A              IBMREV10            CEEEV010                               Call
    6     CEEHDSP     +000017D0              CEEPLPKA            CEEHDSP                       D1908    Call
    7     IBMRERRI    +0000045A              IBMRLIB1            IBMRERRI                               Exception
    8     LABL1: BEGIN+000000BE  11          EXAMPLE             EXAMPLE                                Call
    9     EXAMPLE     +000000C8  8           EXAMPLE             EXAMPLE                                Call
    10    IBMRPMIA    +0000051E              IBMRLIB1            IBMRPMIA                               Call
    11    CEEEV010    +00000310              IBMREV10            CEEEV010                               Call
    12    CEEBBEXT    +000001B6              CEEPLPKA            CEEBBEXT                      D1908    Call

    DSA   DSA Addr   E  Addr    PU Addr    PU Offset  Comp Date  Compile Attributes
    1     20B45B88   209F0420   209F0420   +0000081C  20061214   CEL
    2     00025670   20B1C0A0   20B1C0A0   +000000C2  ********   OS PL/I
    3     20B45A88   20900C58   20900B70   +000001BE  ********   OS PL/I
    4     20B45850   00019F50   00019F50   +0000065A  20061213   LIBRARY
    5     20B457C8   20B02998   20B02998   +0000013A  20061213   LIBRARY
    6     20B426A8   209BF068   209BF068   +000017D0  20061215   CEL
    7     20B42500   0001B328   0001B328   +0000045A  20061213   LIBRARY
    8     20B42430   20900D48   20900B70   +00000296  ********   OS PL/I
    9     20B42330   20900B78   20900B70   +000000D0  ********   OS PL/I
    10    20B42178   000201D0   000201D0   +0000051E  20061214   LIBRARY
    11    20B420F0   20B02998   20B02998   +00000310  20061213   LIBRARY
    12    20B42030   2098DDB8   2098DDB8   +000001B6  20061215   CEL

  Condition Information for Active Routines
    Condition Information for IBMRERRI (DSA address 20B42500)
      CIB Address: 20B42FC8
      Current Condition:
        IBM0281S A prior condition was promoted to the ERROR condition.
      Original Condition:
        IBM0421S  ONCODE=520  The SUBSCRIPTRANGE condition was raised.
      Location:
        Program Unit: IBMRERRI Entry: IBMRERRI Statement:  Offset: +0000045A

    Storage dump near condition, beginning at location: 0001B772
     +000000 0001B772  5050D080 58A0C2B8 58F0A01C 4110D080  05EF9108 404F4710 B4709104 404F47E0  |&&....B..0........j. |....j. |..|
⋮
```

Figure 110. Traceback section of dump

PL/I for MVS & VM task traceback

A task traceback table is produced for multitasking programs showing the task invocation sequence (trace). For each task, the thread ID, CAA address (identified by TCA address in the dump), event variable address, task variable address, and absolute priority appear in the traceback table. An example is shown in Figure 111 on page 293.

```
CEE3DMP V1 R9.0: called from SUBTSK2                                    02/27/07 2:23:10 PM              Page:    1
ASID: 01D2   Job ID: J0020927   Job name: LEDGSMP5   Step name: GO        PID: 33555395   Parent PID: 1   User name: PERFORM

CEE3845I CEEDUMP Processing started.
PLIDUMP was called from statement number 5 at offset +000000E6 from SUBTSK2 within task SUBTSK2

PL/I Task Traceback:
  Task     Attached by  Thread ID         TCA Addr   EV Addr    TV Addr   Absolute Priority
  SUBTSK2  SUBTSK1      1171C16000000003  11489BD8   11200AA0   00035290  000
  SUBTSK1  SUBTASK      1171943000000002  11480BD8   11200AE0   000266F8  000
  SUBTASK  TASKING      1171761000000001  11440D48   11200B20   00025D70  000
  TASKING               1170C15000000000  1120F9C0   000255D4   0002523C  254

Information for enclave TASKING

  Information for thread 1171C16000000003

  Traceback:
    DSA   Entry       E  Offset  Statement   Load Mod             Program Unit                 Service  Status
    1     CEEKKMRA    +0000081C              CEEPLPKA             CEEKKMRA                     D1908    Call
    2     IBMRKDM     +000000C2              IBMREV10             IBMRKDM                               Call
    3     SUBTSK2     +000000E6  5           GO                   SUBTSK2                               Call
    4     IBMUPTMM    +0000014E              IBMRLIB1             IBMUPTMM                              Call
    5     CEEOPCMM    +00000908              CEEBINIT             CEEOPCMM                     D1908    Call

    DSA   DSA Addr   E  Addr    PU Addr    PU Offset  Comp Date  Compile Attributes
    1     00036430   112FD268   112FD268   +0000081C  20061214   CEL       POSIX
    2     000352E8   1141D0A0   1141D0A0   +000000C2  ********   OS PL/I   POSIX
    3     00036308   11201048   11201040   +000000EE  ********   OS PL/I   POSIX
    4     00036040   00021900   00021900   +0000014E  20061214   LIBRARY    POSIX
    5     1148DEE0   0000E460   0000E460   +00000908  20061215   CEL       POSIX

⋮

  Information for thread 1170C15000000000

  Traceback:
    DSA   Entry       E  Offset  Statement   Load Mod             Program Unit                 Service  Status
    1     IBMUJWTP    +00000146              IBMREV10             IBMUJWTP                              Call
    2     IBMUJWT     +0000027A              IBMRLIB1             IBMUJWT                               Call
    3     TASKING     +00000106  11          GO                   TASKING                               Call
    4     IBMRPMIA    +0000051E              IBMRLIB1             IBMRPMIA                              Call
    5     CEEEV010    +00000310              IBMREV10             CEEEV010                              Call
    6     CEEBBEXT    +000001B6              CEEPLPKA             CEEBBEXT                     D1908    Call

    DSA   DSA Addr   E  Addr    PU Addr    PU Offset  Comp Date  Compile Attributes
    1     11443530   1143A850   1143A850   +00000146  20061214   LIBRARY    POSIX
    2     11443438   00020E28   00020E28   +0000027A  ********   OS PL/I   POSIX
    3     11443330   11200728   11200720   +0000010E  ********   OS PL/I   POSIX
    4     11443178   000201D0   000201D0   +0000051E  20061214   LIBRARY    POSIX
    5     114430F0   11403998   11403998   +00000310  20061213   LIBRARY    POSIX
    6     11443030   112B1BF8   112B1BF8   +000001B6  20061215   CEL       POSIX

⋮
  Information for thread 1171943000000002

  Traceback:
    DSA   Entry       E  Offset  Statement   Load Mod             Program Unit                 Service  Status
    1     IBMUJWTP    +00000146              IBMREV10             IBMUJWTP                              Call
    2     IBMUJWT     +0000027A              IBMRLIB1             IBMUJWT                               Call
    3     SUBTSK1     +000000D6  13          GO                   SUBTSK1                               Call
    4     IBMUPTMM    +0000014E              IBMRLIB1             IBMUPTMM                              Call
    5     CEEOPCMM    +00000908              CEEBINIT             CEEOPCMM                     D1908    Call

    DSA   DSA Addr   E  Addr    PU Addr    PU Offset  Comp Date  Compile Attributes
    1     00030508   1143A850   1143A850   +00000146  20061214   LIBRARY    POSIX
    2     00030410   00020E28   00020E28   +0000027A  ********   OS PL/I   POSIX
    3     00030308   11200DD8   11200DD0   +000000DE  ********   OS PL/I   POSIX
    4     00030040   00021900   00021900   +0000014E  20061214   LIBRARY    POSIX
    5     11485EE0   0000E460   0000E460   +00000908  20061215   CEL       POSIX

⋮
```

Figure 111. Task traceback section (Part 1 of 2)

```
Information for thread 1171761000000001

Traceback:
  DSA   Entry       E  Offset  Statement   Load Mod             Program Unit                  Service  Status
  1     IBMUJWTP    +00000146               IBMREV10             IBMUJWTP                               Call
  2     IBMUJWT     +0000027A               IBMRLIB1             IBMUJWT                                Call
  3     SUBTASK     +000000D6  13           GO                   SUBTASK                                Call
  4     IBMUPTMM    +0000014E               IBMRLIB1             IBMUPTMM                               Call
  5     CEEOPCMM    +00000908               CEEBINIT             CEEOPCMM                      D1908    Call

  DSA   DSA Addr   E  Addr    PU Addr    PU Offset  Comp Date  Compile Attributes
  1     00029508   1143A850   1143A850   +00000146  20061214   LIBRARY    POSIX
  2     00029410   00020E28   00020E28   +0000027A  ********   OS PL/I   POSIX
  3     00029308   11200B68   11200B60   +000000DE  ********   OS PL/I   POSIX
  4     00029040   00021900   00021900   +0000014E  20061214   LIBRARY    POSIX
  5     11479EE0   0000E460   0000E460   +00000908  20061215   CEL       POSIX
```

⋮

Figure 111. Task traceback section (Part 2 of 2)

Condition information

If the dump was called from an ON-unit, the type of ON-unit is identified in the traceback as part of the entry information. For ON-units, the values of any relevant condition built-in functions (for example, ONCHAR and ONSOURCE for conversion errors) appear. In cases where the cause of entry into the ON-unit is not stated, usually when the ERROR ON-unit is called, the cause of entry appears in the condition information.

Statement number and address where error occurred

This information, which is the point at which the condition that caused entry to the ON-unit occurred, can be found in the traceback section of the dump.

If the condition occurs in compiled code, and you compiled your routine with either GOSTMT or GONUMBER, the statement numbers appear in the dump. To identify the assembler instruction that caused the error, use the traceback information in the dump to find the program unit (PU) offset of the statement number in which the error occurred. Then find that offset and the corresponding instruction in the object code listing.

Control blocks for active routines

This section shows the stack frames for all active routines, and the static storage. Use this section of the dump to identify variable values, determine the contents of parameter lists, and locate the timestamp.

Figure 112 on page 295 shows this section of the dump.

```
Control Blocks for Active Routines:
  DSA for CEEKKMRA: 20B45B88
    +000000  FLAGS.... 0000      member... 4040      BKC...... 00025670  FWC...... 20B46080  R14...... A09F0C3E
    +000010  R15...... A09EB5B8  R0....... 00000000  R1....... 20B45C18  R2....... 000251E8  R3....... 00000000
    +000024  R4....... 00000001  R5....... 20B45E17  R6....... 00025030  R7....... 00000000  R8....... A09104D0
    +000038  R9....... 00000000  R10...... 209F141F  R11...... A09F0420  R12...... 2090E9C0  reserved. 00025760
    +00004C  NAB...... 20B46080  PNAB..... 20B40050  reserved. 00500007  00000000
    +000064  reserved. 00000000  reserved. 00000000  MODE..... 00000000  reserved. 00000000
    +000078  reserved. 00000000  reserved. 8000C3C5
  DSA for IBMRKDM: 00025670
    +000000  FLAGS.... 0800      member... 01E0      BKC...... 20B45A88  FWC...... 20B45B88  R14...... A0B1C164
    +000010  R15...... A09F0420  R0....... 80007810  R1....... 20900EBC  R2....... 20B45A88  R3....... A0B1C0A6
    +000024  R4....... 00000064  R5....... 00000000  R6....... 20900EBC  R7....... 20B45938  R8....... 20B45B58
    +000038  R9....... 20B45B7C  R10...... 00000000  R11...... 0001AF4F  R12...... 2090E9C0  reserved. 00025760
    +00004C  NAB...... 20B45B88  PNAB..... 00000000  reserved. 00000000  00000000
    +000064  reserved. 00000000  reserved. 00000000  MODE..... 00000000  reserved. 00000000
    +000078  reserved. 00000000  reserved. 00000000
  Library Work Space: 00025670
    +000000 00025670  080001E0 20B45A88 20B45B88 A0B1C164  A09F0420 80007810 20900EBC 20B45A88  |......!h..$h..A.............!h|
    +000020 00025690  A0B1C0A6 00000064 00000000 20900EBC  20B45938 20B45B58 20B45B7C 00000000  |...w.................$...$@....|
    +000040 000256B0  0001AF4F 2090E9C0 00025760 20B45B88  00000000 00000000 00000000 00000000  |...|..Z....-..$h.............|
    +000060 000256D0  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
    +000080 000256F0 - +00009F 0002570F             same as above
  DSA for ERR  ON-unit: 20B45A88
    +000000  FLAGS.... CC25      member... 4040      BKC...... 20B45850  FWC...... 40404040  R14...... A0900D30
    +000010  R15...... A0B1C0A0  R0....... 20B45B88  R1....... 20900EBC  R2....... A0900CE4  R3....... 20900E40
    +000024  R4....... 00000064  R5....... 00000000  R6....... 20B45B40  R7....... 20B45938  R8....... 20B45B58
    +000038  R9....... 20B45B7C  R10...... 00000000  R11...... 0001AF4F  R12...... D6D940C7  reserved. 00025670
    +00004C  NAB...... 20B45B88  PNAB..... 20B45B88  reserved. 91E091E0  20900F00
    +000064  reserved. 40404040  reserved. 40404040  MODE..... 40404040  reserved. 20B45B40
    +000078  reserved. 40404040  reserved. 40404040
  Dynamic save area (ERR  ON-unit): 20B45A88
    +000000 20B45A88  CC254040 20B45850 40404040 A0900D30  A0B1C0A0 20B45B88 20900EBC A0900CE4  |..  ...&    ..........$h.......U|
    +000020 20B45AA8  20900E40 00000064 00000000 20B45B40  20B45938 20B45B58 20B45B7C 00000000  |... ..........$ ......$...$@....|
    +000040 20B45AC8  0001AF4F D6D940C7 00025670 20B45B88  20B45B88 91E091E0 20B42330 20900F00  |...|OR G......$h..$hj.j.........|
    +000060 20B45AE8  40404040 40404040 40404040 40404040  20B45B40 40400240 40404040 40404040  |                ..$   .         |
    +000080 20B45B08  40404040 40404040 40404040 40404040  40404040 40404040 40404040 40404040  |                                |
    +0000A0 20B45B28  40404040 40404040 40404040 40404040  40404040 40404040 0C014040 40404040  |                             ..  |
    +0000C0 20B45B48  A3829586 A2404040 20B45B48 00050000  D7938984 A4949740 83819393 85844086  |tbnfs   ..$.....Plidump called f|
    +0000E0 20B45B68  99969440 85999996 9940D695 60A49589  A3404040 20B45B58 00210000 40404040  |rom error On-unit   ..$.....    |
  Static for procedure EXAMPLE    Timestamp: 27 FEB 07  11:45:18
  Starting from: 20900E40
    +000000 20900E40  E00001E0 20900B78 20900C20 20900C30  20900C58 20900CE4 20900D48 20900DBE  |.....................U........|
    +000020 20900E60  20900DBE 20900DBE 20900DBE 20901E40  B0000002 1F800004 00000000 20900E94  |.............. ..............m|
    +000040 20900E80  00000000 00050000 00000000 00210000  91E091E0 00000004 00000004 0000000A  |................j.j.............|
    +000060 20900EA0  00000001 91A091A0 00000014 00000001  0A200000 0000000A 00000002 20B45B50  |....j.j.....................$&|
    +000080 20900EC0  A0B45B7C 20901368 A3829586 A2D79389  84A49497 40838193 93858440 86999694  |..$@....tbnfsPlidump called from|
    +0000A0 20900EE0  40859999 969940D6 9560A495 89A30000  20900C34 20900C30 0C160000 20900C58  | error On-unit.................|
    +0000C0 20900F00  0C960000 00000000 20901038 00000000  00000000 20900F3C 20900F50 20900F6C  |.o.....................&...%|
    +0000E0 20900F20  20900F84 00000000 20900F08 00000000  20900F14 00000000 20900F14 85000001  |...d.....................e...|
    +000100 20900F40  20900E72 000000C8 00000000 0001C900  85000001 20900E72 000000CC 00000000  |.......H......I.e..............|
    +000120 20900F60  0009C1D9 D9C1E86D C5D5C400 81000101  20900E72 000000C0 00000000 0005C1D9  |..ARRAY_END.a.................AR|
    +000140 20900F80  D9C1E800 0D020001 20900E70 20900EF0  00000000 0005D3C1 C2D3F100 00000001  |RAY.............0......LABL1.....|
    +000160 20900FA0  20900B78 000000DE 20900FC0 00000001  00B90004 00BD0008 00CF000E 00E00004  |.............................|
    +000180 20900FC0  20900C58 000000E8 20900FE0 00000004  008D0005 00910006 00D90007 00E80008  |.......Y.............j...R...Y..|
    +0001A0 20900FE0  20900D48 000000F6 20901008 00000008  00770009 0083000A 009F000B 00D1000C  |.......6.............c.......J..|
    +0001C0 20901000  00ED000D 00EC000D 0E0E0E0E F2F740C6  C5C240F0 F74040F1 F17AF4F5 7AF1F840  |............27 FEB 07  11:45:18 |
    +0001E0 20901020  80000117 20900AF0 01000001 20900B78  20901340 00000000 1D020000 20901054  |.......0........... ............|
⋮
  DSA for IBMRERRI: 20B42500
    +000000  FLAGS.... 8800      member... 0000      BKC...... 20B42430  FWC...... 20B425C0  R14...... 8001B784
    +000010  R15...... A09D0B48  R0....... 0000000B  R1....... 20B42580  R2....... 0000000A  R3....... 20900EB0
    +000024  R4....... 00025470  R5....... 000254C4  R6....... 20B42330  R7....... 20B42330  R8....... 00000028
    +000038  R9....... 00000008  R10...... A09104D0  R11...... 0001B328  R12...... 2090E9C0  reserved. 00025290
    +00004C  NAB...... 20B425C0  PNAB..... 008FF4E8  reserved. 2090D658  20AF22BC
    +000064  reserved. 2090E9C0  reserved. 20B420F0  MODE..... 20B2FA47  reserved. A09104D0
    +000078  reserved. 00000000  reserved. 20B42838
```

Figure 112. Control blocks for active routines section of the dump (Part 1 of 3)

```
   CIB for IBMRERRI: 20B42FC8
     +000000 20B42FC8  C3C9C240 00000000 00000000 010C0004  00000000 00000000 00030119 59C9C2D4  |CIB .......................IBM|
     +000020 20B42FE8  00000000 20B430D8 000301A5 59C9C2D4  00000001 00000015 20B42330 A0B02998  |.......Q...v.IBM.............q|
     +000040 20B43008  00000000 20B42500 8001B784 2090B6F0  0000000A 20B42430 00000000 00000000  |...........d...0.............|
     +000060 20B43028  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |............................|
     +000080 20B43048 - +00009F 20B43067             same as above
     +0000A0 20B43068  00000000 00000000 00000000 00000000  06230000 00000FC6 00000001 00000000  |.....................F........|
     +0000C0 20B43088  00000000 00000000 20B42430 20B42500  0001B782 00000000 00000000 00000001  |..................b...........|
     +0000E0 20B430A8  20B42330 0000000A 00000064 00000000  FFFFFFFC 00000000 00000000 00000000  |............................|
     +000100 20B430C8  00000000 2090B908 00000000 00000000  E9D4C3C8 02000001 0000000B 20B42580  |.............ZMCH............|

   Dynamic save area (IBMRERRI): 20B42500
     +000000 20B42500  88000000 20B42430 20B425C0 8001B784  A09D0B48 0000000B 20B42580 0000000A  |h.............d.............|
     +000020 20B42520  20900EB0 00025470 000254C4 20B42330  20B42330 00000028 00000008 A09104D0  |...........D.................j..|
     +000040 20B42540  0001B328 2090E9C0 00025290 20B425C0  008FF4E8 2090D658 00000000 20AF22BC  |......Z...........4Y..O.....|
     +000060 20B42560  A0997C20 2090E9C0 20B420F0 20B2FA47  A09104D0 2090E9C0 00000000 20B42838  |.r@...Z....0.....j....Z.....|
     +000080 20B42580  000254C4 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |...D........................|
     +0000A0 20B425A0  16000000 20909DB0 00000000 80010000  00000000 209D4520 20B2F7B4 2090E200  |.........................7...S.|
   DSA for LABL1: BEGIN: 20B42430
     +000000  FLAGS.... 8425      member... 0000      BKC...... 20B42330  FWC...... 20B42500  R14...... A0900E08
     +000010  R15...... 0001B328  R0....... 0000000B  R1....... 20900EB0  R2....... A0900DBE  R3....... 20900E40
     +000024  R4....... 00000001  R5....... 20B42330  R6....... 20B42330  R7....... 20B42330  R8....... 00000028
     +000038  R9....... 00000008  R10...... 20B420B0  R11...... 2090102C  R12...... 2090E9C0  reserved. 00025290
     +00004C  NAB...... 20B42500  PNAB..... 20B42500  reserved. 91A091A0  00000000
     +000064  reserved. 00000000  reserved. 00000000  MODE..... 00000000  reserved. 00000000
     +000078  reserved. 00000000  reserved. 20B42030
   Dynamic save area (LABL1: BEGIN): 20B42430
     +000000 20B42430  84250000 20B42330 20B42500 A0900E08  0001B328 0000000B 20900EB0 A0900DBE  |d...........................|
     +000020 20B42450  20900E40 00000001 20B42330 20B42330  20B42330 00000028 00000008 20B420B0  |... ........................|
     +000040 20B42470  2090102C 2090E9C0 00025290 20B42500  20B42500 91A091A0 20B42330 00000000  |......Z.............j.j.......|
     +000060 20B42490  00000000 00000000 00000000 00000000  00000000 00000200 00000000 20B42030  |............................|
     +000080 20B424B0  20B42530 A0B02CEC 20B2EA48 00000800  20B420F0 20B420F0 A0B02998 20901340  |...................0...0...q...|
     +0000A0 20B424D0  2090E880 0000000A 00000000 00000000  20AF2CD6 00000027 A0AF0CD8 2090E9C0  |..Y................O.......Q..Z.|
     +0000C0 20B424F0  20B42330 20B42618 00000014 00000000  88000000 20B42430 20B425C0 8001B784  |................h.............d|
   DSA for EXAMPLE: 20B42330
     +000000  FLAGS.... C025      member... 0000      BKC...... 20B42178  FWC...... 00000000  R14...... A0900C42
     +000010  R15...... 20900D48  R0....... 20B42430  R1....... 20B42330  R2....... A0900C30  R3....... 20900E40
     +000024  R4....... 00000001  R5....... 20B42330  R6....... 20B42400  R7....... 00000005  R8....... 20900EF8
     +000038  R9....... 00000008  R10...... 20B420B0  R11...... 2090102C  R12...... 2090E9C0  reserved. 00025290
     +00004C  NAB...... 20B42430  PNAB..... 20B42430  reserved. 91E091A0  20900EF8
     +000064  reserved. 00000000  reserved. 00000000  MODE..... 00000000  reserved. 20B423E8
     +000078  reserved. 00000000  reserved. 00000000
   Dynamic save area (EXAMPLE): 20B42330
     +000000 20B42330  C0250000 20B42178 00000000 A0900C42  20900D48 20B42430 20B42330 A0900C30  |............................|
     +000020 20B42350  20900E40 00000001 20B42330 20B42400  00000005 20900EF8 00000008 20B420B0  |... ...................8.......|
     +000040 20B42370  2090102C 2090E9C0 00025290 20B42430  20B42430 91E091A0 00000000 20900EF8  |......Z.............j.j........8|
     +000060 20B42390  00000000 00000000 00000000 00000000  20B423E8 00000200 00000000 00000000  |....................Y.....|
     +000080 20B423B0  20B42124 20B42128 20B4212C 20B42130  20B42138 20B42134 20B4213C 00000000  |............................|
     +0000A0 20B423D0  00000000 00000000 00000000 00000000  00000000 00000000 0C010000 00000000  |............................|
     +0000C0 20B423F0  20B42400 20900E94 0000000B 00000014  00000002 00000002 00000002 00000002  |.......m....................|
     +0000E0 20B42410  00000002 00000002 00000002 00000002  00000002 00000002 00000000 00000000  |............................|
⋮
   Dynamic save area (IBMRERRI): 20B42500
     +000000 20B42500  88000000 20B42430 20B425C0 8001B784  A09D0B48 0000000B 20B42580 0000000A  |h.............d.............|
     +000020 20B42520  20900EB0 00025470 000254C4 20B42330  20B42330 00000028 00000008 A09104D0  |...........D.................j..|
     +000040 20B42540  0001B328 2090E9C0 00025290 20B425C0  008FF4E8 2090D658 00000000 20AF22BC  |......Z...........4Y..O.....|
     +000060 20B42560  A0997C20 2090E9C0 20B420F0 20B2FA47  A09104D0 2090E9C0 00000000 20B42838  |.r@...Z....0.....j....Z.....|
     +000080 20B42580  000254C4 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |...D........................|
     +0000A0 20B425A0  16000000 20909DB0 00000000 80010000  00000000 209D4520 20B2F7B4 2090E200  |.........................7...S.|
   DSA for LABL1: BEGIN: 20B42430
     +000000  FLAGS.... 8425      member... 0000      BKC...... 20B42330  FWC...... 20B42500  R14...... A0900E08
     +000010  R15...... 0001B328  R0....... 0000000B  R1....... 20900EB0  R2....... A0900DBE  R3....... 20900E40
     +000024  R4....... 00000001  R5....... 20B42330  R6....... 20B42330  R7....... 20B42330  R8....... 00000028
     +000038  R9....... 00000008  R10...... 20B420B0  R11...... 2090102C  R12...... 2090E9C0  reserved. 00025290
     +00004C  NAB...... 20B42500  PNAB..... 20B42500  reserved. 91A091A0  00000000
     +000064  reserved. 00000000  reserved. 00000000  MODE..... 00000000  reserved. 00000000
     +000078  reserved. 00000000  reserved. 20B42030
```

Figure 112. Control blocks for active routines section of the dump (Part 2 of 3)

```
Dynamic save area (LABL1: BEGIN): 20B42430
  +000000 20B42430  84250000 20B42330 20B42500 A0900E08  0001B328 0000000B 20900EB0 A0900DBE  |d...............................|
  +000020 20B42450  20900E40 00000001 20B42330 20B42330  20B42330 00000028 00000008 20B420B0  |... ...........................|
  +000040 20B42470  2090102C 2090E9C0 00025290 20B42500  20B42500 91A091A0 20B42330 00000000  |......Z.............j.j.........|
  +000060 20B42490  00000000 00000000 00000000 00000000  00000000 00000200 00000000 20B42030  |................................|
  +000080 20B424B0  20B42530 A0B02CEC 20B2EA48 00000800  20B420F0 20B420F0 A0B02998 20901340  |...................0...0...q...  |
  +0000A0 20B424D0  2090E880 0000000A 00000000 00000000  20AF2CD6 00000027 A0AF0CD8 2090E9C0  |..Y................O.......Q..Z.|
  +0000C0 20B424F0  20B42330 20B42618 00000014 00000000  88000000 20B42430 20B425C0 8001B784  |................h.............d|
DSA for EXAMPLE: 20B42330
  +000000  FLAGS.... C025      member... 0000      BKC...... 20B42178  FWC...... 00000000  R14...... A0900C42
  +000010  R15...... 20900D48  R0....... 20B42430  R1....... 20B42330  R2....... A0900C30  R3....... 20900E40
  +000024  R4....... 00000001  R5....... 20B42330  R6....... 20B42400  R7....... 00000005  R8....... 20900EF8
  +000038  R9....... 00000008  R10...... 20B420B0  R11...... 2090102C  R12...... 2090E9C0  reserved. 00025290
  +00004C  NAB...... 20B42430  PNAB..... 20B42430  reserved. 91E091A0  20900EF8
  +000064  reserved. 00000000  reserved. 00000000  MODE..... 00000000  reserved. 20B423E8
  +000078  reserved. 00000000  reserved. 00000000
Dynamic save area (EXAMPLE): 20B42330
  +000000 20B42330  C0250000 20B42178 00000000 A0900C42  20900D48 20B42430 20B42330 A0900C30  |................................|
  +000020 20B42350  20900E40 00000001 20B42330 20B42400  00000005 20900EF8 00000008 20B420B0  |... ...................8........|
  +000040 20B42370  2090102C 2090E9C0 00025290 20B42430  20B42430 91E091A0 00000000 20900EF8  |......Z.............j.j........8|
  +000060 20B42390  00000000 00000000 00000000 00000000  20B423E8 00000200 00000000 00000000  |...................Y............|
  +000080 20B423B0  20B42124 20B42128 20B4212C 20B42130  20B42138 20B42134 20B4213C 00000000  |................................|
  +0000A0 20B423D0  00000000 00000000 00000000 00000000  00000000 00000000 0C010000 00000000  |................................|
  +0000C0 20B423F0  20B42400 20900E94 0000000B 00000014  00000002 00000002 00000002 00000002  |.......m........................|
  +0000E0 20B42410  00000002 00000002 00000002 00000002  00000002 00000002 00000000 00000000  |................................|
⋮
```

Figure 112. Control blocks for active routines section of the dump (Part 3 of 3)

Automatic variables

To find automatic variables, use an offset from the stack frame of the block in which they are declared. This information appears in the variable storage map generated when the MAP compiler option is in effect. If you have not used the MAP option, you can determine the offset by studying the listing of compiled code instructions.

Static variables

If your routine is compiled with the MAP option, you can find static variables by using an offset in the variable storage map. If the MAP option is not in effect, you can determine the offset by studying the listing of compiled code.

Based variables

To locate based variables, use the value of the defining pointer. Find this value by using one of the methods described above to find static and automatic variables. If the pointer is itself based, you must find its defining pointer and follow the chain until you find the correct value.

The following is an example of typical code for X BASED (P), with P AUTOMATIC:

```
58 60 D 0C8        L 6,P

58 E0 6 000        L 14,X
```

P is held at offset X'C8' from register 13. This address points to X.

Take care when examining a based variable to ensure that the pointers are still valid.

Area variables

Area variables are located using one of the methods described above, according to their storage class.

The following is an example of typical code: for an area variable A declared AUTOMATIC:

```
41 60 D 0F8        LA 6,A
```

The area starts at offset X'F8' from register 13.

Variables in areas

To find variables in areas, locate the area and use the offset to find the variable.

Contents of parameter lists

To find the contents of a passed parameter list, first find the register 1 value in the save area of the calling routine's stack frame. Use this value to locate the parameter list in the dump. If R1=0, no parameters passed. For additional information about parameter lists, see *PL/I for MVS & VM Programming Guide*.

Timestamp

If the TSTAMP compiler installation option is in effect, the date and time of compilation appear within the last 32 bytes of the static internal control section. The last three bytes of the first *word* give the offset to this information. The offset indicates the end of the timestamp. Register 3 addresses the static internal control section. If the BLOCK option is in effect, the timestamp appears in the static storage section of the dump.

Control blocks associated with the thread

This section of the dump, shown in Figure 113 on page 299, includes information about PL/I for MVS & VM fields of the CAA and other control block information.

```
  Control Blocks Associated with the Thread:
    CAA: 2090E9C0
      +000000 2090E9C0  00000000 00025658 20B42018 20B62018  00000000 2090E9D0 00000000 000251B0  |.....................Z.........|
      +000020 2090E9E0  00000000 00000000 00025030 00000000  00025240 00000000 00025208 00000000  |.........&........ ............|
      +000040 2090EA00  000251D0 00000000 00020028 00000000  00020AB0 00019D38 00000000 00000000  |..............................|
      +000060 2090EA20  00000000 00019CB8 00025658 0001FB70  0001FEE0 80014608 0001B328 70002323  |..............................|
:
    DUMMY DSA: 2090F360
      +000000  FLAGS.... 0000      member... 0000      BKC...... 00006F60  FWC...... 20B42030  R14...... A0900D66
      +000010  R15...... A098DDB8  R0....... 7D000008  R1....... 2090D778  R2....... 00000000  R3....... 00000000
      +000024  R4....... 00000000  R5....... 00000000  R6....... 00000000  R7....... A09104D0  R8....... 20900808
      +000038  R9....... 008DCCD0  R10...... 00000000  R11...... A0900C92  R12...... 2090E9C0  reserved. 00025290
      +00004C  NAB...... 20B42030  PNAB..... 20B42030  reserved. 00000000  00000000
      +000064  reserved. 00000000  reserved. 00000000  MODE..... 00000000  reserved. 00000000
      +000078  reserved. 00000000  reserved. 00000000
    PL/I TCA Appendage: 00025030
      +000000 00025030  00000000 00000000 00000000 00000030  00000000 00000000 00000000 00000000  |..............................|
      +000020 00025050  000251E8 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |...Y..........................|
      +000040 00025070  00000000 00000000 00000000 00000000  2090E9C0 00000000 00000000 00000000  |................Z.............|
      +000060 00025090  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |..............................|
      +000080 000250B0 - +0000BF 000250EF             same as above
      +0000C0 000250F0  00000000 00000000 00000000 00000000  00000000 00000000 20900838 00000000  |..............................|
      +0000E0 00025110  00000000 00000000 00000000 00000000  00000000 00000000 7FFFFFFF 00000000  |.........................".....|
      +000100 00025130  00000000 00000000 00000000 00000000  00000000 00000000 00000000 20B3E034  |.............................4|
      +000120 00025150  00000000 0000FB00 0002519D 00008000  0002519C 00010000 0002519D 00008000  |..............................|
      +000140 00025170  0002519D 00008000 0002519D 00008000  00000000 00000000 00000000 00000000  |..............................|
      +000160 00025190  00000000 00000000 00000000 40000000  00000000 00000000 00000000 00000000  |.......... ...................|
      +000180 000251B0  00010000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |..............................|
      +0001A0 000251D0  00000000 000076B6 00000000 00000000  00000000 00000000 80C16800 20B45A68  |.........................A....!.|
      +0001C0 000251F0  00000000 209004A8 00000000 00000000  00000000 00000000 00000000 00000000  |.......y......................|
      +0001E0 00025210  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |..............................|
      +000200 00025230 - +00023F 0002526F             same as above
      +000240 00025270  00000000 00000000 00000000 00000000  00000000 00000000 D7404040 E9D3E6E2  |........................P   ZLWS|
      +000260 00025290  080001E0 20B42460 00000000 5E007744  00CBA600 00027290 00029F78 A090055C  |.......-....;.....w............*|
      +000280 000252B0  800076BC 00028004 00000015 00029F78  00028004 00028090 00000008 00000010  |..............................|
      +0002A0 000252D0  20B42538 2090E9C0 00025380 20B42560  00000000 00000000 000000B4 00000000  |......Z........-..............|
      +0002C0 000252F0  00000000 00150000 00000000 00000000  00000000 00000000 00000000 00000000  |..............................|
      +0002E0 00025310  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |..............................|
      +000300 00025330 - +00033F 0002536F             same as above
      +000340 00025370  00000000 00000000 00000000 00000000  080000F0 00000000 00000000 00000000  |...................0..........|
      +000360 00025390  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |..............................|
      +000380 000253B0  00000000 00000000 00000000 00000000  00000000 00000000 00025380 00000000  |..............................|
      +0003A0 000253D0  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |..............................|
      +0003C0 000253F0 - +00043F 0002546F             same as above
      +000440 00025470  00025150 02000000 00000000 00000000  00000000 00010000 00000000 00000000  |...&..........................|
      +000460 00025490  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |..............................|
      +000480 000254B0  00000000 00000000 00000000 40000000  0000000C 00030119 59C9C2D4 00000000  |............ ............IBM....|
      +0004A0 000254D0  00000000 00025670 00000000 A0B1C156  8000FCD8 00025558 00025524 20B45940  |..............A....Q..........|
      +0004C0 000254F0  A0B1C0A6 00000064 00000000 209005A8  20B457F0 20B45A30 20B45A60 00000000  |...w..........y...0..!...!-....|
      +0004E0 00025510  0001AF4F 2090E9C0 00000000 00000000  8000FCD8 00025544 00025548 0002554C  |...|..Z............Q...........<|
      +000500 00025530  00025550 00025554 00025558 0002555C  00025560 20B1C220 00000008 00000000  |...&...........*...-..B........|
      +000520 00025550  00000000 800075B0 00000100 00000000  00000000 00000000 00000000 00000000  |..............................|
      +000540 00025570  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |..............................|
      +000560 00025590 - +00061F 0002564F             same as above
      +000620 00025650  00019CB8 00028004 00020AE8 00020AE8  00020AE8 00000000 00025000 00000248  |...........Y...Y...Y......&.....|

  Enclave Control Blocks:
    EDB: 2090D658
      +000000 2090D658  C3C5C5C5 C4C24040 C0000001 2090E880  2090DD60 00000000 00000000 00000000  |CEEEDB  ......Y....-............|
      +000020 2090D678  2090DB68 2090DB98 A09104D0 2090D1A8  00000000 00000000 2090D778 00000000  |.......q.j....Jy..........P.....|
      +000040 2090D698  00000000 00000000 00006F60 00000000  00000000 A0A2E878 20909880 2090D6B0  |..........?-.........sY...q...O.|
      +000060 2090D6B8  0000F460 00000000 00000000 00000000  00000000 00000000 20AEF660 2090E9C0  |..4-.....................6-..Z.|
      +000080 2090D6D8  40000000 0000FAF6 00000000 00000000  00000001 0002A060 00006FF8 008FF4E8  |  ......6.............-..?8..4Y|
      +0000A0 2090D6F8  00000001 00000100 20909988 2090D700  00000000 00000000 00000000 00000001  |..........rh..P...............|
    MEML: 2090E880
      +000000 2090E880  00000000 00000000 20990160 00000000  00000000 00000000 20990160 00000000  |.........r.-............r.-....|
      +000020 2090E8A0 - +00009F 2090E91F             same as above
      +0000A0 2090E920  00000000 00000000 A0B02998 00000000  00000000 00000000 20990160 00000000  |...........q............r.-....|
      +0000C0 2090E940  00000000 00000000 20990160 00000000  00000000 00000000 20990160 00000000  |.........r.-............r.-....|
      +0000E0 2090E960 - +00011F 2090E99F             same as above
```

Figure 113. Control blocks associated with the thread section of the dump (Part 1 of 2)

```
  File Status and Attributes:
    Attributes of file: SYSPRINT
     STREAM OUTPUT PRINT ENVIRONMENT( VB BLKSIZE(129) RECSIZE(125) BUFFERS(1) )
    Contents of buffers
    BUFFER: 00029F78
      +000000 00029F78  000E0000 40E2A482 F140E2A3 8199A389  95874087 40000000 00000000 00000000  |.... Sub1 Starting g ...........|
      +000020 00029F98  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
      +000040 00029FB8 - +00007F 00029FF7             same as above
      +000080 00029FF8  00000000 00000000 D4C4E2E3 01004000  00000000 0002C000 E2E8E2D6 E4E34040  |........MDST.. .........SYSOUT  |

  File Control Blocks:
    FILE CONTROL BLOCK (FCB): 00028004
      +000000 00028004  00000000 00000000 0001D170 000076B4  000280F4 00028090 00000000 00000000  |.........J........4.............|
      +000020 00028024  00000000 49291100 50000000 00000004  00810000 00000079 00029F78 E3E50114  |........&........a..........TV..|
      +000040 00028044  00000000 00000000 00000000 00029F8B  006A0001 003C0078 0002007D 00000000  |............................'....|
      +000060 00028064  00000000 00000000 00000000 20B42538  00000000 00000000 00000000 00000000  |................................|
    DATA CONTROL BLOCK (DCB): 00028090
      +000000 00028090  00000000 00000000 00000000 01000000  00020000 01029F70 00814000 00006DE0  |.........................a ..._.|
      +000020 000280B0  42007DB0 54000000 00540048 008CC038  92CBA600 00000001 000078D6 08090081  |..'.............k.w........O...a|
      +000040 000280D0  00000000 00006C80 00029FF5 00029FF5  0000007D 80000001 00000000 00000001  |......%....5...5...'............|
    DECLARE CONTROL BLOCK (DCLCB): 000280F4
      +000000 000280F4  FFFFFFFC 41201000 02D70F00 00000000  00000014 0008E2E8 E2D7D9C9 D5E30000  |.........P............SYSPRINT..|

Process Control Blocks:

  PCB: 2090D1A8
    +000000 2090D1A8  C3C5C5D7 C3C24040 03030288 00000000  00000000 00000000 2090D3E0 A0AF24D0  |CEEPCB  ...h.............L.....|
    +000020 2090D1C8  A0AE8B50 A0AEFA08 A0AEF528 20907AE8  2090CF78 00000000 00000000 2090D658  |...&......5...:Y.............O.|
    +000040 2090D1E8  A0AEF858 7F800000 00000000 000141D4  00000000 80000000 00000000 00000000  |..8."..........M...............|

  MEML: 2090D3E0
    +000000 2090D3E0  00000000 00000000 20990160 00000000  00000000 00000000 20990160 00000000  |.........r.-.............r.-....|
    +000020 2090D400 - +00009F 2090D47F             same as above
    +0000A0 2090D480  00024038 00000000 A0B02998 00000000  00000000 00000000 20990160 00000000  |.. ........q.............r.-....|
    +0000C0 2090D4A0  00000000 00000000 20990160 00000000  00000000 00000000 20990160 00000000  |.........r.-.............r.-....|
    +0000E0 2090D4C0 - +00011F 2090D4FF             same as above

  PL/I Process Control Block: 00024038
    +000000 00024038  E9D7D9C2 40404040 00024000 00028004  00000000 00000000 00019CB8 00000000  |ZPRB    .. ....................|
    +000020 00024058  00000000 00000000 00000000 80000000  00000000 00000000 00000000 00000000  |................................|
    +000040 00024078  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
CEE3846I CEEDUMP Processing completed.
```

Figure 113. Control blocks associated with the thread section of the dump (Part 2 of 2)

The CAA

The address of the CAA control block appears in this section of the dump. If the BLOCK option is in effect, the complete CAA (including the PL/I for MVS & VM implementation appendage) appears separately from the body of the dump. Register 12 addresses the CAA.

File status and attribute information

This part of the dump includes the following information:

- The default and declared attributes of all open files
- Buffer contents of all file buffers
- The contents of FCBs, DCBs, DCLCBs, IOCBs, and control blocks for the process or enclave

PL/I for MVS & VM contents of the Language Environment trace table

Language Environment provides three PL/I for MVS & VM trace table entry types that contain character data:

- Trace entry 100 occurs when a task is created.
- Trace entry 101 occurs when a task that contains the tasking CALL statements is terminated.

- Trace entry 102 occurs when a task that does not contain a tasking CALL statement is terminated.

The format for trace table entries 100, 101, and 102 is:

```
—>(100) NameOfCallingTask NameOfCalledTask OffsetOfCallStmt
            UserAgrPtr CalledTaskPtr TaskVarPtr EventVarPtr
            PriorityPtr CallingR2-R5 CallingR12-R14

—>(101) NameOfReturnTask ReturnerR2-R5 ReturnerR12-R14

—>(102) NameOfReturnTask
```

For more information about the Language Environment trace table format, see “Understanding the trace table entry (TTE)” on page 154.

Debugging example of PL/I for MVS & VM routines

This section contains examples of PL/I for MVS & VM routines and instructions for using information in the Language Environment dump to debug them. Important areas in the source code and in the dump for each routine are highlighted.

Subscript range error

Figure 114 on page 302 illustrates an error caused by an array subscript value outside the declared range. In this example, the declared array value is 10.

This routine was compiled with the options LIST, TEST, GOSTMT, and MAP. It was run with the TERMTHDACT(TRACE) option to generate a traceback for the condition.

```
5688-235 IBM PL/I for MVS & VM          Ver 1 Rel 1 Mod 1                          27 FEB 07   11:45:18     PAGE   1
OPTIONS SPECIFIED
*PROCESS  GOSTMT LIST S STG TEST MAP NOOPTIONS;
5688-235 IBM PL/I for MVS & VM          EXAMPLE:  PROC  OPTIONS(MAIN);                                        PAGE   2
                  SOURCE LISTING
    STMT

       1  EXAMPLE:  PROC  OPTIONS(MAIN);

       2      DCL Array(10) Fixed bin(31);
       3      DCL (I,Array_End)   Fixed bin(31);
       4      On error
                Begin;
       5          On error system;
       6          Call plidump('tbnfs','Plidump called from error On-unit');
       7        End;

       8      (subrg):              /* Enable subscriptrange condition */
              Labl1: Begin;
       9        Array_End = 20;
      10        Do I = 1 to Array_End;   /* Loop to initialize array */
      11          Array(I) = 2;    /* Set array elements to 2 */
      12        End;
      13      End Labl1;
      14   End Example;
.
.
.
5688-235 IBM PL/I for MVS & VM          EXAMPLE:  PROC  OPTIONS(MAIN);                                        PAGE   5
                              VARIABLE STORAGE MAP
IDENTIFIER                    LEVEL         OFFSET       (HEX)   CLASS     BLOCK

I                                 1            200          C8   AUTO      EXAMPLE
ARRAY_END                         1            204          CC   AUTO      EXAMPLE
ARRAY                             1            208          D0   AUTO      EXAMPLE
5688-235 IBM PL/I for MVS & VM          EXAMPLE:  PROC  OPTIONS(MAIN);                                        PAGE   6
```

Figure 114. Example of moving a value outside an array range

Figure 115 on page 303 shows sections of the dump generated by a call to PLIDUMP.

```
CEE3DMP V1 R9.0: Plidump called from error On-unit                              02/27/07 11:45:20 AM              Page:    1
ASID: 003E   Job ID: JOB21950   Job name: LEDGSMP1   Step name: GO        UserID: HEALY

CEE3845I CEEDUMP Processing started.
PLIDUMP was called from statement number 6 at offset +000000D6 from ERR  ON-unit with entry address 20900C58

Information for enclave EXAMPLE

  Information for thread 8000000000000000

  Traceback:
    DSA   Entry       E  Offset  Statement   Load Mod            Program Unit                  Service  Status
    1     CEEKKMRA    +0000081C              CEEPLPKA            CEEKKMRA                      D1908    Call
    2     IBMRKDM     +000000C2              IBMREV10            IBMRKDM                                Call
    3     ERR  ON-unit+000000D6  6           EXAMPLE             EXAMPLE                                Call
    4     IBMRERPL    +0000065A              IBMRLIB1            IBMRERPL                               Call
    5     CEEEV010    +0000013A              IBMREV10            CEEEV010                               Call
    6     CEEHDSP     +000017D0              CEEPLPKA            CEEHDSP                       D1908    Call
    7     IBMRERRI    +0000045A              IBMRLIB1            IBMRERRI                               Exception
    8     LABL1: BEGIN+000000BE  11          EXAMPLE             EXAMPLE                                Call
    9     EXAMPLE     +000000C8  8           EXAMPLE             EXAMPLE                                Call
    10    IBMRPMIA    +0000051E              IBMRLIB1            IBMRPMIA                               Call
    11    CEEEV010    +00000310              IBMREV10            CEEEV010                               Call
    12    CEEBBEXT    +000001B6              CEEPLPKA            CEEBBEXT                      D1908    Call

    DSA   DSA Addr   E  Addr    PU Addr    PU Offset  Comp Date  Compile Attributes
    1     20B45B88   209F0420   209F0420   +0000081C  20061214   CEL
    2     00025670   20B1C0A0   20B1C0A0   +000000C2  ********   OS PL/I
    3     20B45A88   20900C58   20900B70   +000001BE  ********   OS PL/I
    4     20B45850   00019F50   00019F50   +0000065A  20061213   LIBRARY
    5     20B457C8   20B02998   20B02998   +0000013A  20061213   LIBRARY
    6     20B426A8   209BF068   209BF068   +000017D0  20061215   CEL
    7     20B42500   0001B328   0001B328   +0000045A  20061213   LIBRARY
    8     20B42430   20900D48   20900B70   +00000296  ********   OS PL/I
    9     20B42330   20900B78   20900B70   +000000D0  ********   OS PL/I
    10    20B42178   000201D0   000201D0   +0000051E  20061214   LIBRARY
    11    20B420F0   20B02998   20B02998   +00000310  20061213   LIBRARY
    12    20B42030   2098DDB8   2098DDB8   +000001B6  20061215   CEL

  Condition Information for Active Routines
    Condition Information for IBMRERRI (DSA address 20B42500)
      CIB Address: 20B42FC8
      Current Condition:
        IBM0281S A prior condition was promoted to the ERROR condition.
      Original Condition:
        IBM0421S  ONCODE=520  The SUBSCRIPTRANGE condition was raised.
      Location:
        Program Unit: IBMRERRI Entry: IBMRERRI Statement:  Offset: +0000045A

    Storage dump near condition, beginning at location: 0001B772
      +000000 0001B772  5050D080 58A0C2B8 58F0A01C 4110D080  05EF9108 404F4710 B4709104 404F47E0  |&&....B..0........j. |....j. |..|

  Control Blocks for Active Routines:
⋮
    DSA for CEEHDSP: 20B426A8
      +000000  FLAGS.... 0808      member... CEE1      BKC...... 20B42500  FWC...... 20B457C8  R14...... A09C083A
      +000010  R15...... A0B02998  R0....... 00000020  R1....... 2090B2E8  R2....... 20B42FC8  R3....... 20B42330
      +000024  R4....... 209C3C94  R5....... FFFFFF20  R6....... 00000001  R7....... 00000007  R8....... A09C0542
      +000038  R9....... 20B446A6  R10...... 20B436A7  R11...... A09BF068  R12...... 2090E9C0  reserved. 00025670
      +00004C  NAB...... 20B457C8  PNAB..... 00000000  reserved. 00000000  20B4271C
      +000064  reserved. 00000000  reserved. 00000000  MODE..... 00000000  reserved. 00000000
      +000078  reserved. 00000000  reserved. 00000000
    DSA for IBMRERRI: 20B42500
      +000000  FLAGS.... 8800      member... 0000      BKC...... 20B42430  FWC...... 20B425C0  R14...... 8001B784
      +000010  R15...... A09D0B48  R0....... 0000000B  R1....... 20B42580  R2....... 0000000A  R3....... 20900EB0
      +000024  R4....... 00025470  R5....... 000254C4  R6....... 20B42330  R7....... 20B42330  R8....... 00000028
      +000038  R9....... 00000008  R10...... A09104D0  R11...... 0001B328  R12...... 2090E9C0  reserved. 00025290
      +00004C  NAB...... 20B425C0  PNAB..... 008FF4E8  reserved. 2090D658  20AF22BC
      +000064  reserved. 2090E9C0  reserved. 20B420F0  MODE..... 20B2FA47  reserved. A09104D0
      +000078  reserved. 00000000  reserved. 20B42838
```

Figure 115. Sections of the Language Environment dump (Part 1 of 2)

```
CIB for IBMRERRI: 20B42FC8
  +000000 20B42FC8  C3C9C240 00000000 00000000 010C0004  00000000 00000000 00030119 59C9C2D4  |CIB .......................IBM|
  +000020 20B42FE8  00000000 20B430D8 000301A5 59C9C2D4  00000001 00000015 20B42330 A0B02998  |.......Q...v.IBM.............q|
  +000040 20B43008  00000000 20B42500 8001B784 2090B6F0  0000000A 20B42430 00000000 00000000  |..........d...0.............|
  +000060 20B43028  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |............................|
  +000080 20B43048 - +00009F 20B43067             same as above
  +0000A0 20B43068  00000000 00000000 00000000 00000000  06230000 00000FC6 00000001 00000000  |.....................F........|
  +0000C0 20B43088  00000000 00000000 20B42430 20B42500  0001B782 00000000 00000000 00000001  |..................b...........|
  +0000E0 20B430A8  20B42330 0000000A 00000064 00000000  FFFFFFFC 00000000 00000000 00000000  |............................|
  +000100 20B430C8  00000000 2090B908 00000000 00000000  E9D4C3C8 02000001 0000000B 20B42580  |................ZMCH...........|
Dynamic save area (IBMRERRI): 20B42500
  +000000 20B42500  88000000 20B42430 20B425C0 8001B784  A09D0B48 0000000B 20B42580 0000000A  |h.............d.............|
  +000020 20B42520  20900EB0 00025470 000254C4 20B42330  20B42330 00000028 00000008 A09104D0  |...........D.................j..|
  +000040 20B42540  0001B328 2090E9C0 00025290 20B425C0  008FF4E8 2090D658 00000000 20AF22BC  |......Z...........4Y..O.........|
  +000060 20B42560  A0997C20 2090E9C0 20B420F0 20B2FA47  A09104D0 2090E9C0 00000000 20B42838  |.r@...Z....0.....j....Z........|
  +000080 20B42580  000254C4 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |...D............................|
  +0000A0 20B425A0  16000000 20909DB0 00000000 80010000  00000000 209D4520 20B2F7B4 2090E200  |.......................7...S.|
DSA for LABL1: BEGIN: 20B42430
  +000000  FLAGS.... 8425      member... 0000      BKC...... 20B42330  FWC...... 20B42500  R14...... A0900E08
  +000010  R15...... 0001B328  R0....... 0000000B  R1....... 20900EB0  R2....... A0900DBE  R3....... 20900E40
  +000024  R4....... 00000001  R5....... 20B42330  R6....... 20B42330  R7....... 20B42330  R8....... 00000028
  +000038  R9....... 00000008  R10...... 20B420B0  R11...... 2090102C  R12...... 2090E9C0  reserved. 00025290
  +00004C  NAB...... 20B42500  PNAB..... 20B42500  reserved. 91A091A0  00000000
  +000064  reserved. 00000000  reserved. 00000000  MODE..... 00000000  reserved. 00000000
  +000078  reserved. 00000000  reserved. 20B42030
Dynamic save area (LABL1: BEGIN): 20B42430
  +000000 20B42430  84250000 20B42330 20B42500 A0900E08  0001B328 0000000B 20900EB0 A0900DBE  |d...........................|
  +000020 20B42450  20900E40 00000001 20B42330 20B42330  20B42330 00000028 00000008 20B420B0  |... ........................|
  +000040 20B42470  2090102C 2090E9C0 00025290 20B42500  20B42500 91A091A0 20B42330 00000000  |......Z.............j.j.....|
  +000060 20B42490  00000000 00000000 00000000 00000000  00000000 00000200 00000000 20B42030  |............................|
  +000080 20B424B0  20B42530 A0B02CEC 20B2EA48 00000800  20B420F0 20B420F0 A0B02998 20901340  |...................0...0...q... |
  +0000A0 20B424D0  2090E880 0000000A 00000000 00000000  20AF2CD6 00000027 A0AF0CD8 2090E9C0  |..Y................O.......Q..Z.|
  +0000C0 20B424F0  20B42330 20B42618 00000014 00000000  88000000 20B42430 20B425C0 8001B784  |................h.............d|
DSA for EXAMPLE: 20B42330
  +000000  FLAGS.... C025      member... 0000      BKC...... 20B42178  FWC...... 00000000  R14...... A0900C42
  +000010  R15...... 20900D48  R0....... 20B42430  R1....... 20B42330  R2....... A0900C30  R3....... 20900E40
  +000024  R4....... 00000001  R5....... 20B42330  R6....... 20B42400  R7....... 00000005  R8....... 20900EF8
  +000038  R9....... 00000008  R10...... 20B420B0  R11...... 2090102C  R12...... 2090E9C0  reserved. 00025290
  +00004C  NAB...... 20B42430  PNAB..... 20B42430  reserved. 91E091A0  20900EF8
  +000064  reserved. 00000000  reserved. 00000000  MODE..... 00000000  reserved. 20B423E8
  +000078  reserved. 00000000  reserved. 00000000
Dynamic save area (EXAMPLE): 20B42330
  +000000 20B42330  C0250000 20B42178 00000000 A0900C42  20900D48 20B42430 20B42330 A0900C30  |............................|
  +000020 20B42350  20900E40 00000001 20B42330 20B42400  00000005 20900EF8 00000008 20B420B0  |... ...................8.......|
  +000040 20B42370  2090102C 2090E9C0 00025290 20B42430  20B42430 91E091A0 00000000 20900EF8  |......Z.............j.j........8|
  +000060 20B42390  00000000 00000000 00000000 00000000  20B423E8 00000200 00000000 00000000  |...................Y............|
  +000080 20B423B0  20B42124 20B42128 20B4212C 20B42130  20B42138 20B42134 20B4213C 00000000  |............................|
  +0000A0 20B423D0  00000000 00000000 00000000 00000000  00000000 00000000 0C010000 00000000  |............................|
  +0000C0 20B423F0  20B42400 20900E94 0000000B 00000014  00000002 00000002 00000002 00000002  |.......m....................|
  +0000E0 20B42410  00000002 00000002 00000002 00000002  00000002 00000002 00000000 00000000  |............................|
⋮
```

Figure 115. Sections of the Language Environment dump (Part 2 of 2)

To debug this routine, use the following steps:

1. In the dump, PLIDUMP was called by the ERROR ON-unit in statement 6. The traceback information in the dump shows that the exception occurred following statement 11.
2. Locate the Original Condition message in the Condition Information for Active Routines section of the dump. The message is `IBM0421S ONCODE=520 The SUBSCRIPTRANGE condition was raised.` This message indicates that the exception occurred when an array element value exceeded the subscript range value (in this case, 10). For more information about this message, see *z/OS Language Environment Run-Time Messages*.
3. Locate statement 9 in the routine in Figure 114 on page 302. The instruction is `Array_End = 20`. This statement assigns a 20 value to the variable `Array_End`.
4. Statement 10 begins the DO-loop instruction `Do I = 1 to Array_End`. Since the previous instruction (statement 9) specified that `Array_End = 20`, the loop in statement 10 should run until `I` reaches a 20 value.

The instruction in statement 2, however, declared a 10 value for the array range. Therefore, when the I value reached 11, the SUBSCRIPTRANGE condition was raised.

The following steps provide another method for finding the value that raised the SUBSCRIPTRANGE condition.

1. Locate the offset of variable I in the variable storage map in Figure 114 on page 302. Use this offset to find the I value at the time of the dump. In this example, the offset is X'C8'.
2. Now find offset X'C8' from the start of the stack frame for the entry EXAMPLE in Figure 115 on page 303.

   The block located at this offset contains the value that exceeded the array range, X'B' or 11.

Calling a nonexistent subroutine

Figure 116 demonstrates the error of calling a nonexistent subroutine. This routine was compiled with the LIST, MAP, and GOSTMT compiler options. It was run with the TERMTHDACT(DUMP) run-time option to generate a traceback.

```
5688-235 IBM PL/I for MVS & VM          Ver 1 Rel 1 Mod 1                          27 FEB 07   11:45:18     PAGE   1
OPTIONS SPECIFIED
*PROCESS  GOSTMT LIST S STG TEST MAP NOOPTIONS;
5688-235 IBM PL/I for MVS & VM          EXAMPLE1:  PROC  OPTIONS(MAIN);                                          PAGE   2
                  SOURCE LISTING
    STMT

       1  EXAMPLE1:  PROC  OPTIONS(MAIN);

       2      DCL Prog01 entry external;

       3      On error
                Begin;
       4          On error system;
       5          Call plidump('tbnfs','Plidump called from error On-unit');
       6        End;

       7      Call prog01;        /* Call enternal program PROG01 */

       8   End Example1;
5688-235 IBM PL/I for MVS & VM          EXAMPLE1:  PROC  OPTIONS(MAIN);                                          PAGE   3
                  STORAGE REQUIREMENTS
BLOCK, SECTION OR STATEMENT     TYPE                  LENGTH   (HEX)    DSA SIZE   (HEX)
EXAMLE11                        PROGRAM CSECT            444     1BC
EXAMLE12                        STATIC CSECT             292     124
EXAMPLE1                        PROCEDURE BLOCK          210      D2         192      C0
BLOCK 2      STMT 3             ON UNIT                  232      E8         256     100
5688-235 IBM PL/I for MVS & VM          EXAMPLE1:  PROC  OPTIONS(MAIN);                                          PAGE   4
                        STATIC INTERNAL STORAGE MAP
```

Figure 116. Example of calling a nonexistent subroutine

Figure 117 on page 306 shows the traceback and condition information from the dump.

```
CEE3DMP V1 R9.0: Plidump called from error On-unit                    02/27/07 11:45:20 AM           Page:    1
ASID: 00B5   Job ID: JOB21952   Job name: LEDGSMP2   Step name: GO        UserID: HEALY

CEE3845I CEEDUMP Processing started.
PLIDUMP was called from statement number 5 at offset +000000D6 from ERR  ON-unit with entry address 20900DF4

Information for enclave EXAMPLE1

  Information for thread 8000000000000000

  Traceback:
    DSA   Entry       E  Offset  Statement   Load Mod             Program Unit                  Service  Status
    1     CEEKKMRA    +0000081C              CEEPLPKA             CEEKKMRA                      D1908    Call
    2     IBMRKDM     +000000C2              IBMREV10             IBMRKDM                               Call
    3     ERR  ON-unit+000000D6  5           EXAMPLE1             EXAMPLE1                              Call
    4     IBMRERPL    +0000065A              IBMRLIB1             IBMRERPL                              Call
    5     CEEEV010    +0000013A              IBMREV10             CEEEV010                              Call
    6     CEEHDSP     +000017D0              CEEPLPKA             CEEHDSP                       D1908    Call
    7     EXAMPLE1    -20900D2C              EXAMPLE1             EXAMPLE1                              Exception
    8     IBMRPMIA    +0000051E              IBMRLIB1             IBMRPMIA                              Call
    9     CEEEV010    +00000310              IBMREV10             CEEEV010                              Call
    10    CEEBBEXT    +000001B6              CEEPLPKA             CEEBBEXT                      D1908    Call

    DSA   DSA Addr   E  Addr    PU Addr    PU Offset  Comp Date  Compile Attributes
    1     20B458D0   209F0420   209F0420   +0000081C  20061214   CEL
    2     00025670   20B1C0A0   20B1C0A0   +000000C2  ********   OS PL/I
    3     20B457D0   20900DF4   20900D20   +000001AA  ********   OS PL/I
    4     20B45598   00019F50   00019F50   +0000065A  20061213   LIBRARY
    5     20B45510   20B02998   20B02998   +0000013A  20061213   LIBRARY
    6     20B423F0   209BF068   209BF068   +000017D0  20061215   CEL
    7     20B42330   20900D2C   20900D20   -20900D20  ********   OS PL/I
    8     20B42178   000201D0   000201D0   +0000051E  20061214   LIBRARY
    9     20B420F0   20B02998   20B02998   +00000310  20061213   LIBRARY
    10    20B42030   2098DDB8   2098DDB8   +000001B6  20061215   CEL

  Condition Information for Active Routines
    Condition Information for EXAMPLE1 (DSA address 20B42330)
      CIB Address: 20B42D10
      Current Condition:
        CEE3201S The system detected an operation exception (System Completion Code=0C1).
      Location:
        Program Unit: EXAMPLE1 Entry: EXAMPLE1 Statement:  Offset: -20900D2C
        Possible Bad Branch:  Statement: 7  Offset: +000000C0
      Machine State:
        ILC..... 0002    Interruption Code..... 0001
        PSW..... 078D0E00 80000002
        GPR0..... 20B423F0  GPR1..... 00000000  GPR2..... A0900DD4  GPR3..... 20900EE0
        GPR4..... 00000001  GPR5..... 00000000  GPR6..... 20B423E8  GPR7..... 00000005
        GPR8..... 20900F50  GPR9..... 00000008  GPR10.... 20B420B0  GPR11.... 2090100C
        GPR12.... 2090E9C0  GPR13.... 20B42330  GPR14.... A0900DE2  GPR15.... 00000000

  Storage dump near condition, beginning at location: 00000000
    +000000 00000000  Inaccessible storage.
  GPREG STORAGE:
    Storage around GPR0 (20B423F0)
      -0020 20B423D0  00000000 00000000 00000000 00000000  00000000 00000000 0C010000 00000000 |................................|
      +0000 20B423F0  0808CEE1 20B42330 20B45510 A09C083A  A0B02998 00000020 2090B2E8 20B42D10 |..................q.......Y....|
      +0020 20B42410  20B42330 209C3C94 FFFFFF20 00000001  00000007 A09C0542 20B443EE 20B433EF |.......m........................|
    Storage around GPR1 (00000000)
      +0000 00000000    Inaccessible storage.
      +0020 00000020    Inaccessible storage.
      +0040 00000040    Inaccessible storage.
    Storage around GPR2 (20900DD4)
      -0020 20900DB4  92C01000 92251001 92021076 41D10000  41803070 5080D05C D203D054 30300520 |k...k...k....J......&..*K.......|
      +0000 20900DD4  920CD0B8 1B111B55 58F03040 05EF180D  58D0D004 58E0D00C 982CD01C 051E0707 |k........0. ............q.......|
      +0020 20900DF4  90ECD00C 47F0F02C 20900FC4 00000100  20900EE0 20900F78 20900D58 10000000 |.....00....D....................|
    Storage around GPR3 (20900EE0)
      -0020 20900EC0  1B554110 303458F0 303C05EF 180D58D0  D00458E0 D00C982C D01C051E 00000000 |.......0.............q.........|
      +0000 20900EE0  E000011C 20900D2C 20900DD4 20900DF4  20900E80 20900E80 20900E80 20900E80 |...........M...4................|
      +0020 20900F00  00000000 00050000 00000000 00210000  91E091E0 20B45898 A0B458C4 20901368 |..............j.j....q...D....|
    Storage around GPR4 (00000001)
      -0001 00000000    Inaccessible storage.
      +001F 00000020    Inaccessible storage.
      +003F 00000040    Inaccessible storage.
```

Figure 117. Sections of the Language Environment dump (Part 1 of 2)

```
  Storage around GPR5 (00000000)
    +0000 00000000    Inaccessible storage.
    +0020 00000020    Inaccessible storage.
    +0040 00000040    Inaccessible storage.
  Storage around GPR6 (20B423E8)
    -0020 20B423C8  20B4213C 00000000 00000000 00000000  00000000 00000000 00000000 00000000 |................................|
    +0000 20B423E8  0C010000 00000000 0808CEE1 20B42330  20B45510 A09C083A A0B02998 00000020 |.........................q....|
    +0020 20B42408  2090B2E8 20B42D10 20B42330 209C3C94  FFFFFF20 00000001 00000007 A09C0542 |...Y...........m................|
  Storage around GPR7 (00000005)
    -0005 00000000    Inaccessible storage.
    +001B 00000020    Inaccessible storage.
    +003B 00000040    Inaccessible storage.
  Storage around GPR8 (20900F50)
    -0020 20900F30  40838193 93858440 86999694 40859999  969940D6 9560A495 89A30000 00000000 | called from error On-unit......|
    +0000 20900F50  0C160000 20900DF4 0C960000 00000000  20901038 00000000 00000000 20901018 |.......4.o......................|
    +0020 20900F70  00000000 20900F60 00000000 20900F6C  20900F20 00000001 00000000 00000000 |.......-.......%................|
  Storage around GPR9 (00000008)
    -0008 00000000    Inaccessible storage.
    +0018 00000020    Inaccessible storage.
    +0038 00000040    Inaccessible storage.
  Storage around GPR10(20B420B0)
    -0020 20B42090  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000 |................................|
    +0000 20B420B0  2098E080 2090100C 20B420E0 2090D790  20B420D0 20B420D8 20B420D4 00000000 |.q............P........Q...M....|
    +0020 20B420D0  2090D778 00000000 00000000 00000000  00000001 00000000 00000000 00000000 |..P............................|
  Storage around GPR11(2090100C)
    -0020 20900FEC  C5C240F0 F74040F1 F17AF4F5 7AF1F840  80000117 20900CA0 00000000 01000001 |EB 07  11:45:18 ................|
    +0000 2090100C  20900D2C 20901340 00000000 1D020001  20901030 00000000 00000000 0006D7D9 |....... .......................PR|
    +0020 2090102C  D6C7F0F1 B4000A00 00000000 1D020000  20901054 20900D2C 00000000 0008C5E7 |OG01..........................EX|
  Storage around GPR12(2090E9C0)
    -0020 2090E9A0  00000000 00000000 C3C5C5C3 C1C14040  00000000 E9E3C3C1 000058C0 D0640CCC |........CEECAA  ....ZTCA........|
    +0000 2090E9C0  00000000 00025658 20B42018 20B62018  00000000 2090E9D0 00000000 000251B0 |.....................Z.........|
    +0020 2090E9E0  00000000 00000000 00025030 00000000  00025240 00000000 00025208 00000000 |..........&........ .............|
  Storage around GPR13(20B42330)
    -0020 20B42310  00000000 00000000 00000000 0000000E  0E000000 00000000 00000000 00000000 |................................|
    +0000 20B42330  C0250000 20B42178 00000000 80000002  00000000 20B423F0 00000000 A0900DD4 |.....................0.......M|
    +0020 20B42350  20900EE0 00000001 00000000 20B423E8  00000005 20900F50 00000008 20B420B0 |..............Y.......&........|
  Storage around GPR14(20900DE2)
    -0020 20900DC2  00004180 30705080 D05CD203 D0543030  0520920C D0B81B11 1B5558F0 304005EF |......&..*K.......k........0. ..|
    +0000 20900DE2  180D58D0 D00458E0 D00C982C D01C051E  070790EC D00C47F0 F02C2090 0FC40000 |..........q............00....D..|
    +0020 20900E02  01002090 0EE02090 0F782090 0D581000  00000002 02000000 00000000 00005830 |................................|
  Storage around GPR15(00000000)
    +0000 00000000    Inaccessible storage.
    +0020 00000020    Inaccessible storage.
    +0040 00000040    Inaccessible storage.
⋮
```

Figure 117. Sections of the Language Environment dump (Part 2 of 2)

To understand the traceback and debug this example routine, use the following steps:

1. Find the Current Condition message in the Condition Information for Active Routines section of the dump. The message is `CEE3201S. The system detected an Operation exception.` For more information about this message, see *z/OS Language Environment Run-Time Messages*.

   This section of the dump also provides such information as the name of the active routine and the current statement number at the time of the dump. The Location section indicates that the exception occurred at offset X'-20900D2C' within entry EXAMPLE1 and that there might have been a bad branch from offset X'+000000C0' statement 7 within entry EXAMPLE1 .
2. Locate statement 7 in the routine (Figure 116 on page 305). This statement calls subroutine Prog01. The message CEE3201S, which indicates an operations exception, was generated because of an unresolved external reference.
3. Check the linkage editor output for error messages.

Divide-by-zero error

Figure 118 on page 308 demonstrates a divide-by-zero error. In this example, the main PL/I for MVS & VM routine passed bad data to a PL/I for MVS & VM

subroutine. The bad data in this example is 0, and the error occurred when the subroutine SUB1 attempted to use this data as a divisor.

```
5688-235 IBM PL/I for MVS & VM          Ver 1 Rel 1 Mod 1                          27 FEB 07   13:57:59     PAGE   1
OPTIONS SPECIFIED
*PROCESS  GOSTMT LIST S STG TEST MAP NOOPTIONS;
5688-235 IBM PL/I for MVS & VM          SAMPLE: PROC  OPTIONS(MAIN) ;                                          PAGE   2
                  SOURCE LISTING
    STMT

       1  SAMPLE: PROC  OPTIONS(MAIN) ;
       2       On error
                 begin;
       3           On error system;        /* prevent nested error conditions */
       4           Call PLIDUMP('TBC','PLIDUMP called from error ON-unit');
       5           Put Data;               /* Display variables */
       6       End;

       7       DECLARE
                 A_number    Fixed Bin(31),
                 My_Name     Char(13),
                 An_Array(3) Fixed Bin(31) init(1,3,5);

       8       Put skip list('Sample Starting');
       9       A_number = 0;
      10       My_Name = 'Tery Gillaspy';

      11       Call Sub1(a_number, my_name, an_array);

      12    SUB1:  PROC(divisor, name1, Array1);
      13          Declare
                   Divisor   Fixed Bin(31),
                   Name1     Char(13),
                   Array1(3) Fixed Bin(31);
      14           Put skip list('Sub1 Starting');
      15           Array1(1) = Array1(2) / Divisor;
      16           Put skip list('Sub1 Ending');
      17    End SUB1;

      18      Put skip list('Sample Ending');

      19  End;
5688-235 IBM PL/I for MVS & VM          SAMPLE: PROC  OPTIONS(MAIN) ;                                          PAGE   3
                  STORAGE REQUIREMENTS
BLOCK, SECTION OR STATEMENT     TYPE                 LENGTH   (HEX)    DSA SIZE   (HEX)
*SAMPLE1                        PROGRAM CSECT          1060     424
*SAMPLE2                        STATIC CSECT            860     35C
SAMPLE                          PROCEDURE BLOCK         428     1AC         304     130
BLOCK 2      STMT 2             ON UNIT                 298     12A         296     128
SUB1                            PROCEDURE BLOCK         332     14C         256     100
5688-235 IBM PL/I for MVS & VM          SAMPLE: PROC  OPTIONS(MAIN) ;                                          PAGE   4
                        STATIC INTERNAL STORAGE MAP       0000F0  80000000             A..LOCATOR
```

Figure 118. PL/I for MVS & VM routine with a divide-by-zero error

Since variables are not normally displayed in a PLIDUMP dump, this routine included a PUT DATA statement, which generated a listing of arguments and variables used in the routine. Figure 119 shows this output.

```
1Sample Starting
 Sub1 Starting        A_NUMBER=             0 MY_NAME='Tery Gillaspy' AN_ARRAY(1)=  1
 AN_ARRAY(2)=          3                      AN_ARRAY(3)=             5;
```

Figure 119. Variables from routine SAMPLE

The routine in Figure 118 on page 308 was compiled with the LIST compiler option, which generated the object code listing shown in Figure 120.

```
* STATEMENT NUMBER  15
0003A2  58 B0 D 0C8              L     11,200(0,13)
0003A6  58 40 B 004              L     4,4(0,11)
0003AA  58 90 3 0B4              L     9,180(0,3)
0003AE  5C 80 4 004              M     8,4(0,4)
0003B2  58 70 3 0D4              L     7,212(0,3)
0003B6  5C 60 4 004              M     6,4(0,4)
0003BA  58 80 D 0C0              L     8,192(0,13)
0003BE  58 60 B 000              L     6,0(0,11)
0003C2  5F 60 4 000              SL    6,0(0,4)
0003C6  58 E7 6 000              L     14,VO..ARRAY1(7)
0003CA  8E E0 0 020              SRDA  14,32
0003CE  5D E0 8 000              D     14,DIVISOR
0003D2  50 F9 6 000              ST    15,VO..ARRAY1(9)
```

Figure 120. Object code listing from example PL/I for MVS & VM routine

Figure 121 on page 310 shows the Language Environment dump for routine SAMPLE.

```
CEE3DMP V1 R9.0: PLIDUMP called from error ON-unit                              02/27/07 1:58:02 PM                 Page:    1
ASID: 003E   Job ID: JOB29826   Job name: LEDGSMP3   Step name: GO        UserID: HEALY

CEE3845I CEEDUMP Processing started.
PLIDUMP was called from statement number 4 at offset +000000D6 from ERR  ON-unit with entry address 2090022C

Information for enclave SAMPLE

  Information for thread 8000000000000000

  Traceback:
    DSA   Entry       E  Offset  Statement   Load Mod            Program Unit                  Service  Status
    1     CEEKKMRA    +0000081C              CEEPLPKA            CEEKKMRA                      D1908    Call
    2     IBMRKDM     +000000C2              IBMREV10            IBMRKDM                                Call
    3     ERR  ON-unit+000000D6  4           SAMPLE              SAMPLE                                 Call
    4     IBMRERPL    +0000065A              IBMRLIB1            IBMRERPL                               Call
    5     CEEEV010    +0000013A              IBMREV10            CEEEV010                               Call
    6     CEEHDSP     +000017D0              CEEPLPKA            CEEHDSP                       D1908    Call
    7     SUB1        +000000EE  15          SAMPLE              SAMPLE                                 Exception
    8     SAMPLE      +00000154  11          SAMPLE              SAMPLE                                 Call
    9     IBMRPMIA    +0000051E              IBMRLIB1            IBMRPMIA                               Call
    10    CEEEV010    +00000310              IBMREV10            CEEEV010                               Call
    11    CEEBBEXT    +000001B6              CEEPLPKA            CEEBBEXT                      D1908    Call

    DSA   DSA Addr   E  Addr    PU Addr    PU Offset  Comp Date  Compile Attributes
    1     20B45A68   209F0420   209F0420   +0000081C  20061214   CEL
    2     00025670   20B1C0A0   20B1C0A0   +000000C2  ********   OS PL/I
    3     20B45940   2090022C   20900080   +00000282  ********   OS PL/I
    4     20B45708   00019F50   00019F50   +0000065A  20061213   LIBRARY
    5     20B45680   20B02998   20B02998   +0000013A  20061213   LIBRARY
    6     20B42560   209BF068   209BF068   +000017D0  20061215   CEL
    7     20B42460   20900360   20900080   +000003CE  ********   OS PL/I
    8     20B42330   20900088   20900080   +0000015C  ********   OS PL/I
    9     20B42178   000201D0   000201D0   +0000051E  20061214   LIBRARY
    10    20B420F0   20B02998   20B02998   +00000310  20061213   LIBRARY
    11    20B42030   2098DDB8   2098DDB8   +000001B6  20061215   CEL

  Condition Information for Active Routines
    Condition Information for SAMPLE (DSA address 20B42460)
      CIB Address: 20B42E80
      Current Condition:
        IBM0281S A prior condition was promoted to the ERROR condition.
      Original Condition:
        CEE3209S The system detected a fixed-point divide exception (System Completion Code=0C9).
      Location:
        Program Unit: SAMPLE Entry: SUB1 Statement: 15 Offset: +000000EE
      Machine State:
        ILC..... 0004    Interruption Code..... 0009
        PSW..... 078D2E00 A0900452
        GPR0..... 20B42560  GPR1..... 20B42538  GPR2..... A09003E4  GPR3..... 209004A8
        GPR4..... 2090056C  GPR5..... 20B42330  GPR6..... 20B42404  GPR7..... 00000008
        GPR8..... 20B42400  GPR9..... 00000004  GPR10.... 20B420B0  GPR11.... 20B423F8
        GPR12.... 2090E9C0  GPR13.... 20B42460  GPR14.... 00000000  GPR15.... 00000003

    Storage dump near condition, beginning at location: 2090043E
      +000000 2090043E  5860B000 5F604000 58E76000 8EE00020  5DE08000 50F96000 41E0D0D8 50E0312C  |.-..^- ..X-.....)...&9-....Q&...|
    GPREG STORAGE:
      Storage around GPR0 (20B42560)
        -0020 20B42540  20909DB0 A090055C 00409D00 00028004  008FF4E8 2090D658 00010000 00025470  |.......*. ........4Y..O.........|
        +0000 20B42560  0808CEE1 20B42460 20B45680 A09C083A  A0B02998 00000020 2090B2E8 20B42E80  |.......-...........q.......Y....|
        +0020 20B42580  20B42330 209C3C94 FFFFFF20 00000001  00000007 A09C0542 20B4455E 20B4355F  |.......m...................;...^|
⋮
```

Figure 121. Language Environment dump from example PL/I for MVS & VM routine (Part 1 of 3)

```
  Control Blocks for Active Routines:
:
    DSA for ERR  ON-unit: 20B45940
      +000000  FLAGS.... CC25      member... 4040      BKC...... 20B45708  FWC...... 40404040  R14...... A0900304
      +000010  R15...... A0B1C0A0  R0....... 20B45A68  R1....... 209005A8  R2....... A09002B8  R3....... 209004A8
      +000024  R4....... 00000064  R5....... 00000000  R6....... 20B459F8  R7....... 20B457F0  R8....... 20B45A30
      +000038  R9....... 20B45A60  R10...... 00000000  R11...... 0001AF4F  R12...... D6D940C7  reserved. 00025670
      +00004C  NAB...... 20B45A68  PNAB..... 20B45A68  reserved. 91E091E0  20900650
      +000064  reserved. 40404040  reserved. 40404040  MODE..... 40404040  reserved. 20B459F8
      +000078  reserved. 40404040  reserved. 40404040
    Dynamic save area (ERR  ON-unit): 20B45940
      +000000 20B45940  CC254040 20B45708 40404040 A0900304  A0B1C0A0 20B45A68 209005A8 A09002B8  |..  ....    .........!....y....|
      +000020 20B45960  209004A8 00000064 00000000 20B459F8  20B457F0 20B45A30 20B45A60 00000000  |...y..........8...0..!...!-....|
      +000040 20B45980  0001AF4F D6D940C7 00025670 20B45A68  20B45A68 91E091E0 20B42330 20900650  |...|OR G......!...!.j.j........&|
      +000060 20B459A0  40404040 40404040 40404040 40404040  20B459F8 40400240 40404040 40404040  |                ...8  .         |
      +000080 20B459C0  20B42E80 00025470 A0B1120A A0B11190  20B42560 20B457D8 00025470 A0B11190  |..................-...Q........|
      +0000A0 20B459E0  209C3C94 20B42E80 00025470 20B42E80  2090E880 00016038 0C010027 20B1218F  |...m.............Y...-.........|
      +0000C0 20B45A00  2090E9C0 40404040 40404040 40404040  40404040 40404040 40404040 40404040  |..Z.                            |
      +0000E0 20B45A20  40404040 40404040 40404040 40404040  E3C2C340 20B45A30 00030000 D7D3C9C4  |               TBC ..!.....PLID|
      +000100 20B45A40  E4D4D740 83819393 85844086 99969440  85999996 9940D6D5 60A49589 A32C0000  |UMP called from error ON-unit...|
      +000120 20B45A60  20B45A3C 00210000 0000F3C3 00025670  20B45F60 A09F0C3E A09EB5B8 00000000  |..!.......3C......^-............|
    Static for procedure SAMPLE    Timestamp: 27 FEB 07  13:57:59
    Starting from: 209004A8
      +000000 209004A8  E0000354 20900088 20900130 20900166  2090022C 209002B8 20900360 209003E4  |.......h...................-...U|
      +000020 209004C8  209003E4 209003E4 209003E4 20900C78  20900C60 20900C48 20900C30 20900C18  |...U...U...U.......-............|
      +000040 209004E8  20900C00 20901BF8 20901BE0 20900BE8  20901BC8 20901BB0 20900BD0 20900BB8  |.......8.......Y...H............|
      +000060 20900508  B4000A00 20000002 1F800000 00000000  209005DC 000F0000 00000000 000D0000  |................................|
      +000080 20900528  00000000 2090056C 209005F8 000D0000  00000000 00030000 00000000 00210000  |.......%...8....................|
      +0000A0 20900548  20900629 000D0000 20900636 000B0000  91E091E0 00000001 00000003 00000005  |................j.j.............|
      +0000C0 20900568  00000000 00000004 00000004 00000003  00000001 00000002 20900838 20900838  |................................|
      +0000E0 20900588  20B42438 A090055C 20B42400 20B423F0  A0B423F8 20900838 00000000 A090055C  |.......*.......0...8..........*|
      +000100 209005A8  20B45A34 A0B45A60 20900BA0 20900838  80000000 00000000 A0900658 20900838  |..!...!-........................|
      +000120 209005C8  20B42538 A090055C 20900838 00000000  A090055C E2819497 938540E2 A38199A3  |.......*...........*Sample Start|
      +000140 209005E8  899587E3 8599A840 C7899393 81A297A8  E2819497 938540C5 95848995 87E3C2C3  |ingTery GillaspySample EndingTBC|
      +000160 20900608  D7D3C9C4 E4D4D740 83819393 85844086  99969440 85999996 9940D6D5 60A49589  |PLIDUMP called from error ON-uni|
      +000180 20900628  A3E2A482 F140E2A3 8199A389 9587E2A4  82F140C5 95848995 87000000 00000000  |tSub1 StartingSub1 Ending.......|
      +0001A0 20900648  0C160000 2090022C 0C960000 00000000  2090066C 20900688 209006A4 00000000  |.........o.........%...h...u....|
      +0001C0 20900668  00000000 85000001 2090050E 000000D0  00000000 0008C16D D5E4D4C2 C5D90000  |....e.................A_NUMBER..|
      +0001E0 20900688  81000001 2090050C 000000C0 00000000  0007D4E8 6DD5C1D4 C5000000 81000101  |a.................MY_NAME...a....|
      +000200 209006A8  2090050E 000000C8 00000000 0008C1D5  6DC1D9D9 C1E80000 20900818 00000000  |.......H......AN_ARRAY.........|
      +000220 209006C8  00000000 2090066C 20900688 209006A4  20900750 20900858 00000000 209006C0  |.......%...h...u...&...........|
      +000240 209006E8  00000000 209006CC 20900704 20900720  20900738 00000000 209006CC A5000002  |.............................v...|
      +000260 20900708  2090050E 000000C0 00000000 0007C4C9  E5C9E2D6 D9000000 A1000002 2090050C  |.............DIVISOR...........|
      +000280 20900728  000000C4 00000000 0005D5C1 D4C5F100  A1000102 2090050E 000000C8 00000000  |...D......NAME1............H....|
      +0002A0 20900748  0006C1D9 D9C1E8F1 0D020001 20900508  20900360 00000000 0004E2E4 C2F10000  |..ARRAY1...........-......SUB1..|
      +0002C0 20900768  00000001 20900088 000001A4 2090079C  00000001 00DF0002 00E30008 01210009  |.......h...u.............T......|
      +0002E0 20900788  0129000A 012F000B 01570012 01950013  01A40002 2090022C 0000012A 209007C0  |.............n...u..............|
      +000300 209007A8  00000002 008D0003 00910004 00D90005  011B0006 012C000C 20900360 00000144  |.........j...R.............-....|
      +000320 209007C8  209007E4 0000000C 0085000E 00C3000F  00F70010 01350011 01340011 0E0E0E0E  |...U.....e...C...7..............|
      +000340 209007E8  F2F740C6 C5C240F0 F74040F1 F37AF5F7  7AF5F940 80000117 20900000 00000000  |27 FEB 07  13:57:59 ............|
:
    DSA for CEEHDSP: 20B42560
      +000000  FLAGS.... 0808      member... CEE1      BKC...... 20B42460  FWC...... 20B45680  R14...... A09C083A
      +000010  R15...... A0B02998  R0....... 00000020  R1....... 2090B2E8  R2....... 20B42E80  R3....... 20B42330
      +000024  R4....... 209C3C94  R5....... FFFFFF20  R6....... 00000001  R7....... 00000007  R8....... A09C0542
      +000038  R9....... 20B4455E  R10...... 20B4355F  R11...... 209BF068  R12...... 2090E9C0  reserved. 00025670
      +00004C  NAB...... 20B45680  PNAB..... 00000000  reserved. 20B424F0  20B424F0
      +000064  reserved. A0AF2F14  reserved. 00010280  MODE..... 000272F0  reserved. 20B4269C
      +000078  reserved. 20B42598  reserved. 20900838
    DSA for SUB1: 20B42460
      +000000  FLAGS.... 8025      member... 0000      BKC...... 20B42330  FWC...... 00000000  R14...... A0900452
      +000010  R15...... 00000003  R0....... 20B42560  R1....... 20B42538  R2....... A09003E4  R3....... 209004A8
      +000024  R4....... 2090056C  R5....... 20B42330  R6....... 20B42404  R7....... 00000008  R8....... 20B42400
      +000038  R9....... 00000004  R10...... 20B420B0  R11...... 20B423F8  R12...... 2090E9C0  reserved. 00025290
      +00004C  NAB...... 20B42560  PNAB..... 20B42560  reserved. 91E091E0  00000800
      +000064  reserved. 20B420F0  reserved. A0B02998  MODE..... 20900B78  reserved. 2090E880
      +000078  reserved. 00000000  reserved. 00000000
    CIB for SUB1: 20B42E80
      +000000 20B42E80  C3C9C240 00000000 00000000 010C0004  00000000 00000000 00030119 59C9C2D4  |CIB .........................IBM|
      +000020 20B42EA0  00000000 20B42F90 00030C89 59C3C5C5  00000001 00000005 20B42330 A0B02998  |...........i.CEE..............q|
      +000040 20B42EC0  00000000 20B42460 20900452 2090B6F0  0000000A 20B42460 00000000 00000000  |.......-.......0.......-........|
      +000060 20B42EE0  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
      +000080 20B42F00 - +00009F 20B42F1F             same as above
      +0000A0 20B42F20  00000000 00000000 00000000 00000000  44230000 940C9000 00000009 00000000  |....................m...........|
      +0000C0 20B42F40  00000000 00000000 20B42460 20B42460  2090044E 00000000 00000000 00000001  |...........-...-...+............|
      +0000E0 20B42F60  20B42330 0000000A 00000064 00000000  FFFFFFFC 00000000 00000000 00000000  |................................|
      +000100 20B42F80  00000000 2090B908 00000000 00000000  E9D4C3C8 02000001 20B42560 20B42538  |................ZMCH.......-....|
```

Figure 121. Language Environment dump from example PL/I for MVS & VM routine (Part 2 of 3)

```
Dynamic save area (SUB1): 20B42460
  +000000 20B42460  80250000 20B42330 00000000 A0900452  00000003 20B42560 20B42538 A09003E4  |.....................-.......U|
  +000020 20B42480  209004A8 2090056C 20B42330 20B42404  00000008 20B42400 00000004 20B420B0  |...y...%.....................|
  +000040 20B424A0  20B423F8 2090E9C0 00025290 20B42560  20B42560 91E091E0 20B42330 00000800  |...8..Z........-...-j.j.....|
  +000060 20B424C0  20B420F0 20B420F0 A0B02998 20900B78  2090E880 0000020A 00000000 00000000  |...0...0...q......Y.........|
  +000080 20B424E0  20AF2CD6 C9C2D4D9 D6D7C1C1 209005DC  000F0000 00027258 20B425B8 A0B2C18E  |...OIBMROPAA..............A.|
  +0000A0 20B42500  A0AF24D0 000272F0 20B42570 000272F0  A0B2C0F0 20900838 00000001 2090D1A8  |.......0.......0...0.........Jy|
  +0000C0 20B42520  20B42400 20B423F0 20B423F8 00000001  20B42538 20B420B0 20900548 2090050C  |.......0...8.................|
  +0000E0 20B42540  20909DB0 A090055C 00409D00 00028004  008FF4E8 2090D658 00010000 00025470  |.......*. ........4Y..O.....|
DSA for SAMPLE: 20B42330
  +000000  FLAGS.... C025      member... 0000      BKC...... 20B42178  FWC...... 00000000  R14...... A09001DE
  +000010  R15...... 20900360  R0....... 20B42460  R1....... 20900590  R2....... A0900166  R3....... 209004A8
  +000024  R4....... 00000005  R5....... 20B42330  R6....... 20B42408  R7....... 20B423F8  R8....... 00000001
  +000038  R9....... 00000008  R10...... 20B420B0  R11...... 2090080C  R12...... 2090E9C0  reserved. 00025290
  +00004C  NAB...... 20B42460  PNAB..... 20B42460  reserved. 91E091E0  20900648
  +000064  reserved. 00000000  reserved. 00000000  MODE..... 00000000  reserved. 20B423E8
  +000078  reserved. 00000000  reserved. 00000000
Dynamic save area (SAMPLE): 20B42330
  +000000 20B42330  C0250000 20B42178 00000000 A09001DE  20900360 20B42460 20900590 A0900166  |...................-...-........|
  +000020 20B42350  209004A8 00000005 20B42330 20B42408  20B423F8 00000001 00000008 20B420B0  |...y..............8...........|
  +000040 20B42370  2090080C 2090E9C0 00025290 20B42460  20B42460 91E091E0 00000000 20900648  |......Z........-...-j.j.....|
  +000060 20B42390  00000000 00000000 00000000 00000000  20B423E8 00000200 00000000 00000000  |...................Y...........|
  +000080 20B423B0  20B42124 20B42128 20B4212C 20B42130  20B42138 20B42134 20B4213C 00000000  |...............................|
  +0000A0 20B423D0  00000000 00000000 00000000 00000000  00000000 00000000 0C010000 00000000  |...............................|
  +0000C0 20B423F0  20B42414 000D0000 20B42408 2090056C  00000000 00000000 00000001 00000003  |..............%.............|
  +0000E0 20B42410  00000005 E38599A8 40C78993 9381A297  A8000000 00000000 00000000 00000000  |....Tery Gillaspy............|
  +000100 20B42430  20B42438 00000000 20900518 2090050C  00000000 A090055C 00400000 00028004  |.....................*. ......|
  +000120 20B42450  00000000 00000000 00010000 00025470  80250000 20B42330 00000000 A0900452  |...............................|
⋮
```

Figure 121. Language Environment dump from example PL/I for MVS & VM routine (Part 3 of 3)

To understand the dump information and debug this routine, use the following steps:

1. Notice the title of the dump:`PLIDUMP called from error ON-unit`. This was the title specified when PLIDUMP was invoked, and it indicates that the ERROR condition was raised and PLIDUMP was called from within the ERROR ON-unit.
2. Locate the messages in the Condition Information section of the dump.

   There are two messages. The current condition message indicates that a prior condition was promoted to the ERROR condition. The promotion of a condition occurs when the original condition is left unhandled (no PL/I for MVS & VM ON-units are assigned to gain control). The original condition message is `CEE3209S. The system detected a Fixed Point divide exception`. The original condition usually indicates the actual problem. For more information about this message, see *z/OS Language Environment Run-Time Messages*.
3. In the traceback section, note the sequence of calls in the call chain. SAMPLE called SUB1 at statement 11, and SUB1 raised an exception at statement 15, PU offset X'3CE'.
4. Find the statement in the listing for SUB1 that raised the ZERODIVIDE condition. If SUB1 was compiled with GOSTMT and SOURCE, find statement 15 in the source listing.

   Since the object listing was generated in this example, you can also locate the actual assembler instruction causing the exception at offset X'3CE' in the object listing for this routine, shown in Figure 120 on page 309. Either method shows that *divisor* was used as the divisor in a divide operation.
5. You can see from the declaration of SUB1 that *divisor* is a parameter passed from SAMPLE. Because of linkage conventions, you can infer that register 1 in the SAMPLE save area points to a parameter list that was passed to SUB1. *divisor* is the first parameter in the list.
6. In the SAMPLE DSA, the R1 value is X'20900590'. This is the address of the parameter list, which is located in static storage.

7. Find the parameter list in the stack frame; the address of the first parameter is X'20B42400' and the value of the first parameter is X'00000000'. Thus, the exception occurred when SAMPLE passed a 0 value used as a divisor in subroutine SUB1.

Chapter 8. Debugging Enterprise PL/I routines

This chapter contains information that can help you debug applications that contain one or more Enterprise PL/I routines. Following a discussion about potential errors in Enterprise PL/I routines, the first part of this chapter discusses how to use compiler-generated listings to obtain information about Enterprise PL/I routines, and how to use PLIDUMP to generate a Language Environment dump of an Enterprise PL/I routine. The last part of the chapter provides examples of Enterprise PL/I routines and explains how to debug them using information contained in the traceback information provided in the dump. The topics covered are listed below.

- Determining the source of errors in Enterprise PL/I routines
- Using Enterprise PL/I compiler listings
- Generating a Language Environment dump of an Enterprise PL/I routine
- Finding Enterprise PL/I information in a dump
- Debugging example of Enterprise PL/I routines

Determining the source of errors in Enterprise PL/I routines

Most errors in Enterprise PL/I routines can be identified by the information provided in Enterprise PL/I run-time messages, which begin with the prefix IBM. For a list of these messages, see *z/OS Language Environment Run-Time Messages*.

A malfunction in running an Enterprise PL/I routine can be caused by:

- Logic errors in the source routine
- Invalid use of Enterprise PL/I
- Unforeseen errors
- Invalid input data
- Compiler or run-time routine malfunction
- System malfunction
- Unidentified routine malfunction
- Overlaid storage

Logic errors in the source routine

Errors of this type are often difficult to detect because they often appear as compiler or library malfunctions.

Some common errors in source routines are:

- Incorrect conversion from arithmetic data
- Incorrect arithmetic and string manipulation operations
- Unmatched data lists and format lists

Invalid use of Enterprise PL/I

A misunderstanding of the language or a failure to provide the correct environment for using Enterprise PL/I can result in an apparent malfunction of an Enterprise PL/I routine.

Any of the following, for example, might cause a malfunction:

- Using uninitialized variables
- Using controlled variables that have not been allocated
- Reading records into incorrect structures
- Misusing array subscripts
- Misusing pointer variables
- Incorrect conversion
- Incorrect arithmetic operations

© Copyright IBM Corp. 1991, 2009

- Incorrect string manipulation operations

Unforeseen errors

If an error is detected during run time and no ON-unit is provided in the routine to terminate the run or attempt recovery, the job terminates abnormally. However, the status of a routine at the point where the error occurred can be recorded by using an ERROR ON-unit that contains the statements:

```
ON ERROR
 BEGIN;
  ON ERROR SYSTEM;
  CALL PLIDUMP;         /*generates a dump*/
  PUT DATA;             /*displays variables*/
 END;
```

The statement ON ERROR SYSTEM ensures that further errors do not result in a permanent loop.

Invalid input data

A routine should contain checks to ensure that any incorrect input data is detected before it can cause the routine to malfunction.

Use the COPY option of the GET statement to check values obtained by stream-oriented input. The values are listed on the file named in the COPY option. If no file name is given, SYSPRINT is assumed.

Compiler or run-time routine malfunction

If you are certain that the malfunction is caused by a compiler or run-time routine error, you can either open a PMR or submit an APAR for the error. Meanwhile, you can try an alternative way to perform the operation that is causing the trouble. A bypass is often feasible, since the Enterprise PL/I language frequently provides an alternative method of performing operations.

System malfunction

System malfunctions include machine malfunctions and operating system errors. System messages identify these malfunctions and errors to the operator.

Unidentified routine malfunction

In most circumstances, an unidentified routine malfunction does not occur when using the compiler. If your routine terminates abnormally without an accompanying Language Environment run-time diagnostic message, the error causing the termination might also be inhibiting the production of a message. Check for the following:

- Your job control statements might be in error, particularly in defining data sets.
- Your routine might overwrite main storage areas containing executable instructions. This can happen if you have accidentally:
  - Assigned a value to a nonexistent array element. For example:

    ```
    DCL ARRAY(10);

    ⋮
    DO I = 1 TO 100;
    ARRAY(I) = VALUE;
    ```

    To detect this type of error in a compiled module, set the SUBSCRIPTRANGE condition so that each attempt to access an element outside the declared

range of subscript values raises the SUBSCRIPTRANGE condition. If there is no ON-unit for this condition, a diagnostic message is printed and the ERROR condition is raised. This facility, though expensive in run time and storage space, is a valuable routine-testing aid.

– Used an incorrect locator value for a locator (pointer or offset) variable. This type of error can occur if a locator value is obtained by means of record-oriented transmission. Ensure that locator values created in one routine, transmitted to a data set, and subsequently retrieved for use in another routine, are valid for use in the second routine.

– Attempted to free a nonbased variable. This can happen when you free a based variable after its qualifying pointer value has been changed. For example:

```
DCL A STATIC,B BASED (P);
ALLOCATE B;
P = ADDR(A);
FREE B;
```

– Used the SUBSTR pseudovariable to assign a string to a location beyond the end of the target string. For example:

```
DCL X CHAR(3);
I=3
SUBSTR(X,2,I) = 'ABC';
```

To detect this type of error, enable the STRINGRANGE condition during compilation.

Storage overlay problems

If you suspect an error in your Enterprise PL/I application is a storage overlay problem, check for the following:

- The use of a subscript outside the declared bounds (check the SUBSCRIPTRANGE condition)
- An attempt to assign a string to a target with an insufficient maximum length (check the STRINGSIZE condition)
- The failure of the arguments to a SUBSTR reference to comply with the rules described for the SUBSTR built-in function (check the STRINGRANGE condition)
- The loss of significant last high-order (left-most) binary or decimal digits during assignment to an intermediate result or variable or during an input/output operation (check the SIZE condition)
- The reading of a variable-length file into a variable
- The misuse of a pointer variable
- The invocation of a Language Environment callable service with fewer arguments than are required

The first four situations are associated with the listed Enterprise PL/I conditions, all of which are disabled by default. If you suspect one of these problems exists in your routine, use the appropriate condition prefix on the suspected statement or on the BEGIN or PROCEDURE statement of the containing block.

The fifth situation occurs when you read a data record into a variable that is too small. This type of problem only happens with variable-length files. You can often isolate the problem by examining the data in the file information and buffer.

The sixth situation occurs when you misuse a pointer variable. This type of storage overlay is particularly difficult to isolate. There are a number of ways pointer variables can be misused:

- When a READ statement runs with the SET option, a value is placed in a pointer. If you then run a WRITE statement or another READ SET option with another pointer, you overlay your storage if you try to use the original pointer.
- When you try to use a pointer to allocate storage that has already been freed, you can also cause a storage overlay.
- When you attempt to use a pointer set with the ADDR built-in function as a base for data with different attributes, you can cause a storage overlay.

The seventh situation occurs when a Language Environment callable service is passed fewer arguments than its interface requires. The following example might cause a storage overlay because Language Environment assumes that the fourth item in the argument list is the address of a feedback code, when in reality it could be residue data pointing anywhere in storage.

Invalid calls:

```
DCL CEEDATE ENTRY OPTIONS(ASM);
CALL CEEDATE(x,y,z);      /* invalid */
```

Valid calls:

```
DCL CEEDATE ENTRY(*,*,*,* OPTIONAL) OPTIONS(ASM);
CALL CEEDATE(x,y,z,*);    /* valid   */
CALL CEEDATE(x,y,z,fc);   /* valid   */
```

Using Enterprise PL/I compiler listings

The following sections explain how to generate listings that contain information about your routine. Enterprise PL/I listings show machine instructions, constants, and external or internal addresses that the linkage editor resolves. This information can help you find other information, such as variable values, in a dump of an Enterprise PL/I routine.

Note: Enterprise PL/I shares a common compiler back-end with C/C++. The Enterprise PL/I assembler listing will, consequently, have a similar form to those from the XL C/C++ compiler.

The compiler listings included below are from the Enterprise PL/I product.

Generating Enterprise PL/I listings and maps

The following table shows compiler-generated listings that you might find helpful when you use information in dumps to debug Enterprise PL/I routines.

Table 22. Compiler-generated PL/I listings and their contents

Name	Contents	Compiler Option
Source program	Source program statements	SOURCE
Cross reference	Cross reference of names with attributes	XREF and ATTRIBUTES
Aggregate table	Names and layouts of structures and arrays	AGGREGATE
Variable map	Offsets of automatic and static internal variables (from their defining base)	MAP
Object code	Contents of the program control section in hexadecimal notation and translated into a pseudo-assembler format.	LIST

Table 22. Compiler-generated PL/I listings and their contents (continued)

Name	Contents	Compiler Option
Variable map, object code, static storage	Same as MAP and LIST options above, plus contents of static internal and static external control sections in hexadecimal notation with comments	MAP and LIST

Finding information in Enterprise PL/I listings

Figure 122 shows the first two pages of an example Enterprise PL/I routine that was compiled with the LIST, MAP and SOURCE options.

```
5655-H31  IBM(R) Enterprise PL/I for z/OS       V3.R6.M0 (Built:20070119)
                    Options Specified
  Install:
  Command: s
  Line.File Process Statements
     1.0    *PROCESS SOURCE LIST MAP;
  Install:

5655-H31  IBM(R) Enterprise PL/I for z/OS
 Compiler Source
    Line.File
       2.0
       3.0      EXAMPLE: PROC OPTIONS(MAIN);
       4.0        DCL EXTR ENTRY EXTERNAL;
       5.0        DCL A FIXED BIN(31);
       6.0        DCL B(2,2)  FIXED BIN(31) STATIC EXTERNAL INIT((4)0);
       7.0        DCL C CHAR(20) STATIC INIT('SAMPLE CONSTANT');
       8.0        DCL D FIXED BIN(31) STATIC;
       9.0        DCL E FIXED BIN(31);
      10.0        FETCH EXTR;
      11.0        CALL EXTR(A,B,C,D,E);
      12.0        DISPLAY(C);
      13.0      END;
```

Figure 122. Enterprise PL/I routine compiled with LIST, MAP, and SOURCE

Figure 123 on page 320 shows the output generated by the LIST and MAP options for this routine, including the pseudo-assembly listing, the external symbol dictionary and reference, the storage offset listing and the static and automatic storage maps. The sections following this example describe the contents of each type of listing.

```
OFFSET OBJECT CODE        LINE#  FILE#    P S E U D O   A S S E M B L Y   L I S T I N G

                          Timestamp and Version Information
 000000  F2F0  F0F7                                    =C'2007'           Compiled Year
 000004  F0F2  F0F1                                    =C'0201'           Compiled Date MMDD
 000008  F1F5  F3F2  F5F0                              =C'153250'         Compiled Time HHMMSS
 00000E  F0F3  F0F6  F0F0                              =C'030600'         Compiler Version

 000014  002C  ****                                    Service String     20070122
                          Timestamp and Version End

 5655-H31  IBM(R) Enterprise PL/I for z/OS                                : EXAMPLE

 OFFSET OBJECT CODE        LINE#  FILE#    P S E U D O   A S S E M B L Y   L I S T I N G

 000000                    000003 |        EXAMPLE  DS    0D
 000000  47F0  F024        000003 |                 B     36(,r15)
 000004  01C3C5C5                                          CEE eyecatcher
 000008  000000C8                                          DSA size
 00000C  00000180                                          =A(PPA1-EXAMPLE)
 000010  47F0  F001        000003 |                 B     1(,r15)
 000014  58F0  C31C        000003 |                 L     r15,796(,r12)
 000018  184E              000003 |                 LR    r4,r14
 00001A  05EF              000003 |                 BALR  r14,r15
 00001C  00000000                                          =F'0'
 000020  A7F4  000C        000003 |                 J     *+24
 000024  90E8  D00C        000003 |                 STM   r14,r8,12(r13)
 000028  58E0  D04C        000003 |                 L     r14,76(,r13)
 00002C  4100  E0C8        000003 |                 LA    r0,200(,r14)
 000030  5500  C314        000003 |                 CL    r0,788(,r12)
 000034  A724  FFF0        000003 |                 JH    *-32
 000038  58F0  C280        000003 |                 L     r15,640(,r12)
 00003C  90F0  E048        000003 |                 STM   r15,r0,72(r14)
 000040  9210  E000        000003 |                 MVI   0(r14),16
 000044  50D0  E004        000003 |                 ST    r13,4(,r14)
 000048  18DE              000003 |                 LR    r13,r14
 00004A  C030  0000  008A  000003 |                 LARL  r3,F'138'
 000050                    End of Prolog

 000050  5860  3002        000000 |                 L     r6,=A(EXAMPLE2)(,r3,2)
 000054  C070  0000  0092  000000 |                 LARL  r7,F'146'
 00005A  4110  6008        000003 |                 LA    r1,EXTR(,r6,8)
 00005E  4100  0000        000003 |                 LA    r0,0
 000062  5000  1000        000003 |                 ST    r0,_shadow3(,r1,0)
 000066  4110  6008        000010 |                 LA    r1,EXTR(,r6,8)
 00006A  5800  1000        000010 |                 L     r0,_shadow2(,r1,0)
 00006E  1200              000010 |                 LTR   r0,r0
 000070  A774  0012        000010 |                 JNE   @1L2
 000074  4100  6018        000010 |                 LA    r0,_Dsc_000002(,r6,24)
 000078  4120  6008        000010 |                 LA    r2,EXTR(,r6,8)
 00007C  58F0  3006        000010 |                 L     r15,=V(IBMQFRG)(,r3,6)
 000080  4110  D098        000010 |                 LA    r1,#MX_TEMP1(,r13,152)
 000084  5020  D098        000010 |                 ST    r2,#MX_TEMP1(,r13,152)
 000088  1827              000010 |                 LR    r2,r7
 00008A  5020  D09C        000010 |                 ST    r2,#MX_TEMP1(,r13,156)
 00008E  5000  D0A0        000010 |                 ST    r0,#MX_TEMP1(,r13,160)
 000092  05EF              000010 |                 BALR  r14,r15
 000094                    000010 |        @1L2     DS    0H
 000094  5800  300A        000011 |                 L     r0,=A(B)(,r3,10)
 000098  5000  D0C0        000011 |                 ST    r0,192(,r13)
 00009C  4100  6040        000011 |                 LA    r0,_Dsc_000005(,r6,64)
 0000A0  5000  D0C4        000011 |                 ST    r0,196(,r13)
 0000A4  4100  6028        000011 |                 LA    r0,C(,r6,40)
 0000A8  5000  D0B8        000011 |                 ST    r0,184(,r13)
 0000AC  4110  6004        000011 |                 LA    r1,_Dsc_000003(,r6,4)
 0000B0  5800  1000        000011 |                 L     r0,_shadow1(,r1,0)
 0000B4  5000  D0BC        000011 |                 ST    r0,_temp1(,r13,188)
 0000B8  4110  6008        000011 |                 LA    r1,EXTR(,r6,8)
 0000BC  5800  1000        000011 |                 L     r0,_shadow2(,r1,0)
 0000C0  1200              000011 |                 LTR   r0,r0
```

Figure 123. Compiler-generated listings from example Enterprise PL/I routine (Part 1 of 4)

```
5655-H31  IBM(R) Enterprise PL/I for z/OS                                  : EXAMPLE

OFFSET OBJECT CODE        LINE#  FILE#    P S E U D O   A S S E M B L Y   L I S T I N G

0000C2  A774  0012        000011 |                 JNE   @1L3
0000C6  4100  6018        000011 |                 LA    r0,_Dsc_000002(,r6,24)
0000CA  4120  6008        000011 |                 LA    r2,EXTR(,r6,8)
0000CE  58F0  3006        000011 |                 L     r15,=V(IBMQFRG)(,r3,6)
0000D2  4110  D098        000011 |                 LA    r1,#MX_TEMP1(,r13,152)
0000D6  5020  D098        000011 |                 ST    r2,#MX_TEMP1(,r13,152)
0000DA  1827              000011 |                 LR    r2,r7
0000DC  5020  D09C        000011 |                 ST    r2,#MX_TEMP1(,r13,156)
0000E0  5000  D0A0        000011 |                 ST    r0,#MX_TEMP1(,r13,160)
0000E4  05EF              000011 |                 BALR  r14,r15
0000E6                    000011 |         @1L3    DS    0H
0000E6  4110  6008        000011 |                 LA    r1,EXTR(,r6,8)
0000EA  58F0  1000        000011 |                 L     r15,_shadow2(,r1,0)
0000EE  4100  D0B4        000011 |                 LA    r0,E(,r13,180)
0000F2  1826              000011 |                 LR    r2,r6
0000F4  4140  D0B8        000011 |                 LA    r4,_temp1(,r13,184)
0000F8  4150  D0C0        000011 |                 LA    r5,_temp2(,r13,192)
0000FC  4180  D0B0        000011 |                 LA    r8,A(,r13,176)
000100  4110  D098        000011 |                 LA    r1,#MX_TEMP1(,r13,152)
000104  5080  D098        000011 |                 ST    r8,#MX_TEMP1(,r13,152)
000108  5050  D09C        000011 |                 ST    r5,#MX_TEMP1(,r13,156)
00010C  5040  D0A0        000011 |                 ST    r4,#MX_TEMP1(,r13,160)
000110  5020  D0A4        000011 |                 ST    r2,#MX_TEMP1(,r13,164)
000114  5000  D0A8        000011 |                 ST    r0,#MX_TEMP1(,r13,168)
000118  05EF              000011 |                 BALR  r14,r15
00011A  4120  6010        000012 |                 LA    r2,_Dsc_000001(,r6,16)
00011E  4100  6020        000012 |                 LA    r0,_Dsc_000004(,r6,32)
000122  4140  6028        000012 |                 LA    r4,C(,r6,40)
000126  58F0  300E        000012 |                 L     r15,=V(IBMQJDSB)(,r3,14)
00012A  4110  D098        000012 |                 LA    r1,#MX_TEMP1(,r13,152)
00012E  5040  D098        000012 |                 ST    r4,#MX_TEMP1(,r13,152)
000132  5000  D09C        000012 |                 ST    r0,#MX_TEMP1(,r13,156)
000136  4100  0000        000012 |                 LA    r0,0
00013A  5000  D0A0        000012 |                 ST    r0,#MX_TEMP1(,r13,160)
00013E  5020  D0A4        000012 |                 ST    r2,#MX_TEMP1(,r13,164)
000142  5000  D0A8        000012 |                 ST    r0,#MX_TEMP1(,r13,168)
000146  05EF              000012 |                 BALR  r14,r15
000148                    000013 |         @1L1    DS    0H
000148  58F0  3012        000013 |                 L     r15,=V(IBMQEFSH)(,r3,18)
00014C  05EF              000013 |                 BALR  r14,r15
00014E                    000013 |         @1L4    DS    0H

00014E                    Start of Epilog
00014E  58D0  D004        000013 |                 L     r13,4(,r13)
000152  58E0  D00C        000013 |                 L     r14,12(,r13)
000156  9828  D01C        000013 |                 LM    r2,r8,28(r13)
00015A  051E              000013 |                 BALR  r1,r14
00015C  0707              000013 |                 NOPR  7
00015E  0000

000160                    Start of Literals
000160  00000000                                        =A(EXAMPLE2)
000164  00000000                                        =V(IBMQFRG)
000168  00000000                                        =A(B)
00016C  00000000                                        =V(IBMQJDSB)
```

Figure 123. Compiler-generated listings from example Enterprise PL/I routine (Part 2 of 4)

```
5655-H31  IBM(R) Enterprise PL/I for z/OS                              : EXAMPLE

OFFSET OBJECT CODE        LINE#  FILE#    P S E U D O   A S S E M B L Y   L I S T I N G

000170  00000000                                      =V(IBMQEFSH)
000174                    End of Literals

                          ***   General purpose registers used: 1111111110001111
                          ***   Floating point  registers used: 1111111100000000
                          ***   Size of register spill area: 512(max) 0(used)
                          ***   Size of dynamic storage: 200
                          ***   Size of executable code: 350
                          ***   CSECT Offset: 72 : 0x48

0001BC  0000  0000

                          Constant Area
000000  0004C5E7 E3D9                        |..EXTR          |
5655-H31  IBM(R) Enterprise PL/I for z/OS

OFFSET OBJECT CODE        LINE#  FILE#    P S E U D O   A S S E M B L Y   L I S T I N G

                          PPA1: Entry Point Constants
000000  1CCEA166                                      =F'483303782'      Flags
000004  000001C8                                      =A(PPA2-EXAMPLE)
000008  00000000                                      =F'0'              No PPA3
00000C  00000000                                      =F'0'              No EPD
000010  FFE00000                                      =F'-2097152'       Register save mask
000014  00000000                                      =F'0'              Member flags
000018  90                                            =AL1(144)          Flags
000019  000000                                        =AL3(0)            Callee's DSA use/8
00001C  0040                                          =H'64'             Flags
00001E  0012                                          =H'18'             Offset/2 to CDL
000020  00000000                                      =F'0'              State variable location
000024  500000AF                                      =F'1342177455'     CDL function length/2
000028  FFFFFE80                                      =F'-384'           CDL function EP offset
00002C  38280000                                      =F'942145536'      CDL prolog
000030  400800A7                                      =F'1074266279'     CDL epilog
000034  00000000                                      =F'0'              CDL end
000038  0007  ****                                    AL2(7),C'EXAMPLE'
                          PPA1 End

                          PPA2: Compile Unit Block
000000  0B00  3203                                    =F'184562179'      Flags
000004  FFFF  FDF0                                    =A(CEESTART-PPA2)
000008  0000  0000                                    =F'0'              No PPA4
00000C  FFFF  FDF0                                    =A(TIMESTMP-PPA2)
000010  0000  0000                                    =F'0'              No primary
000014  0200  0000                                    =F'33554432'       Flags
                          PPA2 End
5655-H31  IBM(R) Enterprise PL/I for z/OS

                               E X T E R N A L   S Y M B O L   D I C T I O N A R Y

          NAME        TYPE  ID  ADDR    LENGTH           NAME        TYPE  ID  ADDR    LENGTH

          EXAMPLE1     SD    1 000000   000228           EXAMPLE2     SD    2 000000   00005C
          @EXAMPLE     SD    3 000000   000004           B            SD    4 000000   000010
          EXAMPLE      LD    0 000048   000001           CEESG011     ER    5 000000
          IBMQFRG      ER    6 000000                    IBMQJDSB     ER    7 000000
          IBMQEFSH     ER    8 000000                    CEESTART     ER    9 000000
          CEEMAIN      SD   10 000000   00000C           IBMPINPL     ER   11 000000
          EXAMPLE      ER   12 000000
5655-H31  IBM(R) Enterprise PL/I for z/OS

                             E X T E R N A L   S Y M B O L   C R O S S   R E F E R E N C E

          ORIGINAL NAME                                  EXTERNAL SYMBOL NAME

          EXAMPLE1                                       EXAMPLE1
          EXAMPLE2                                       EXAMPLE2
          _EXAMPLE                                       @EXAMPLE
          B                                              B
          EXAMPLE                                        EXAMPLE
          CEESG011                                       CEESG011
          IBMQFRG                                        IBMQFRG
          IBMQJDSB                                       IBMQJDSB
          IBMQEFSH                                       IBMQEFSH
          CEESTART                                       CEESTART
          CEEMAIN                                        CEEMAIN
          IBMPINPL                                       IBMPINPL
```

Figure 123. Compiler-generated listings from example Enterprise PL/I routine (Part 3 of 4)

```
5655-H31  IBM(R) Enterprise PL/I for z/OS

                          * * * * *  S T O R A G E  O F F S E T  L I S T I N G  * * * * *

IDENTIFIER          DEFINITION      ATTRIBUTES
                                    <SEQNBR>-<FILE NO="">:<FILE LINE="">

A                   1-0:5           Class = automatic,           Location = 176 : 0xB0(r13),                Length = 4

B                   1-0:6           Class = external definition, Location = CSECT B,                        Length = 16

C                   1-0:7           Class = static,              Location = 40 : 0x28 + CSECT EXAMPLE2,     Length = 20

D                   1-0:8           Class = static,              Location = 0 : 0x0 + CSECT EXAMPLE2,       Length = 4

E                   1-0:9           Class = automatic,           Location = 180 : 0xB4(r13),                Length = 4

EXTR                1-0:4           Class = static,              Location = 8 : 0x8 + CSECT EXAMPLE2,       Length = 8

                      * * * * *  E N D  O F  S T O R A G E  O F F S E T  L I S T I N G  * * * * *
5655-H31  IBM(R) Enterprise PL/I for z/OS

                                    * * * * *  S T A T I C  M A P  * * * * *

OFFSET (HEX)   LENGTH (HEX)   NAME

          0              4    D
          4              4    _Dsc_000003
          8              8    EXTR
         10              8    _Dsc_000001
         18              8    _Dsc_000002
         20              8    _Dsc_000004
         28             14    C
         40             1C    _Dsc_000005

                             * * * * *  E N D  O F  S T A T I C  M A P  * * * * *
5655-H31  IBM(R) Enterprise PL/I for z/OS

                                  * * * * *  A U T O M A T I C  M A P  * * * * *

Block name: EXAMPLE

OFFSET (HEX)   LENGTH (HEX)   NAME

         98             18    #MX_TEMP1
         B0              4    A
         B4              4    E
         B8              8    _temp1
         C0              8    _temp2

                              * * * * *  E N D  O F  A U T O M A T I C  M A P  * * * * *
```

Figure 123. Compiler-generated listings from example Enterprise PL/I routine (Part 4 of 4)

Pseudo assembly listing

The pseudo assembly listing consists of the machine instructions and a translation of these instructions into a form that resembles assembler code.

This listing always starts with a small section of non-executable data that records the date and time when the object was produced as well as the version of the compiler used to produce the object. This section ends with a service string which in the listing is followed by the build date for the compiler back-end that generated this part of the listing (and this date may be different from the build date for the compiler front-end that generated the first pages of the listing).

The majority of the pseudo assembly listing consists of the object code arranged in columns that specify for each instructions:

- Its offset.
- the instruction in object code format.
- Its associated line number.
- Its associated file number if non-zero (i.e. if from an include file).

- the instruction in mnemonic format.

External symbol dictionary

The external symbol dictionary lists all the external symbols generated for this compilation. For each symbol, it also lists its linkage type and size (in hex).

External symbol cross reference

The external symbol dictionary cross reference shows for each external symbol the name that will be visible externally to the linker.

Storage offset listing

Each line of the storage offset listing contains the following information for each user variable:

- Its name.
- the number of the block in which it was declared.
- the number of the file in which it was declared.
- the number of the line in which it was declared.
- Its class (automatic, static, etc).
- Its location (as appropriate for its class).
- Its byte length in decimal.

This list is sorted by block number and then by name within each block.

Static map

Each line of the static storage map contains the following information for each internal static variable:

- Its hexadecimal offset.
- Its byte length in hex.
- Its name.

This list is sorted by the offset of the variables in static.

This list of variables may also include compiler-generated variables.

Automatic map

Each line of the automatic storage map contains the following information, grouped by named block, for each automatic variable in that block:

- Its hexadecimal offset.
- Its byte length in hex.
- Its name.

These lists are sorted by the offset of the variables in automatic for each block.

These lists of variables may also include compiler-generated variables.

Generating a Language Environment dump of an Enterprise PL/I routine

To generate a dump of an Enterprise PL/I routine, you can call either the Language Environment callable service CEE3DMP or PLIDUMP. For information about calling CEE3DMP, see “Generating a Language Environment dump with CEE3DMP” on page 35.

PLIDUMP syntax and options

PLIDUMP calls intermediate Enterprise PL/I library routines, which convert most PLIDUMP options to CEE3DMP options. The following list contains PLIDUMP options and the corresponding CEE3DMP option, if applicable.

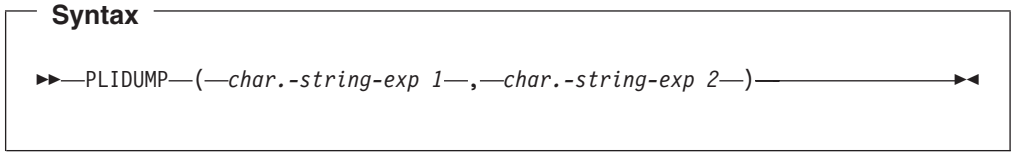
Some PLIDUMP options do not have corresponding CEE3DMP options, but continue to function as Enterprise PL/I default options. The list following the syntax diagram provides a description of those options.

PLIDUMP now conforms to National Language Support standards.

PLIDUMP can supply information across multiple Language Environment enclaves. If an application running in one enclave fetches a main procedure (an action that creates another enclave), PLIDUMP contains information about both procedures.

The syntax and options for PLIDUMP are shown below.

Syntax



char.-string-exp 1

A dump options character string consisting of one or more of the following:

A All. Results in a dump of all tasks including the ones in the WAIT state.

B BLOCKS (Enterprise PL/I hexadecimal dump). Dumps the control blocks used in Language Environment and member language libraries. For Enterprise PL/I, this includes the DSA for every routine on the call chain and Enterprise PL/I ″global″ control blocks, such as Tasking Implementation Appendage (TIA), Task Communication Area (TCA), and the PL/I Tasking Control Block (PTCB). Enterprise PL/I file control blocks and file buffers are also dumped if the F option is specified.

C Continue. The routine continues after the dump.

E Exit. The enclave terminates after the dump. In a multitasking environment, if PLIDUMP is called from the main task, the enclave terminates after the dump. If PLIDUMP is called from a subtask, the subtask and any subsequent tasks created from the subtask terminate after the dump. In a multithreaded environment, if PLIDUMP is called from the Initial Process Thread (IPT), the enclave terminates after the dump. If PLIDUMP is called from a non-IPT, only the non-IPT terminates after the dump.

F FILE INFORMATION. A set of attributes for all open files is given. The contents of the file buffers are displayed if the B option is specified.

H STORAGE in hexadecimal. A SNAP dump of the region is produced. A ddname of CEESNAP must be provided to direct the CEESNAP dump report.

K BLOCKS (when running under CICS). The Transaction Work Area is included.

Note: This option is not supported under Enterprise PL/I.

NB NOBLOCKS.

NF NOFILES.

NH NOSTORAGE.

NK NOBLOCKS (when running under CICS).

NT NOTRACEBACK.

O THREAD(CURRENT). Results in a dump of only the current task or current thread (the invoker of PLIDUMP).

S Stop. The enclave terminates after the dump. In a multitasking environment, regardless of whether PLIDUMP is called from the main task or a subtask, the enclave terminates after the dump. In a multithreaded environment, regardless of whether PLIDUMP is called from the IPT or a non-IPT, the enclave terminates after the dump (in which case there is no fixed order as to which thread terminates first).

T TRACEBACK. Includes a traceback of all routines on the call chain. The traceback shows transfers of control from either calls or exceptions. BEGIN blocks and ON-units are also control transfers and are included in the trace. The traceback extends backwards to the main program of the current thread.

T, F, C, and A are the default options.

char.-string-exp 2
A user-identified character string up to 80 characters long that is printed as the dump header.

PLIDUMP usage notes

If you use PLIDUMP, the following considerations apply:

- If a routine calls PLIDUMP a number of times, use a unique user-identifier for each PLIDUMP invocation. This simplifies identifying the beginning of each dump.
- In MVS or TSO, you can use ddnames of CEEDUMP, PLIDUMP, or PL1DUMP to direct dump output. If no ddname is specified, CEEDUMP is used.
- The data set defined by the PLIDUMP, PL1DUMP, or CEEDUMP DD statement should specify a logical record length (LRECL) of at least 131 to prevent dump records from wrapping.
- When you specify the H option in a call to PLIDUMP, the Enterprise PL/I library issues an OS SNAP macro to obtain a dump of virtual storage. The first invocation of PLIDUMP results in a SNAP identifier of 0. For each successive invocation, the ID is increased by one to a maximum of 256, after which the ID is reset to 0.
- Support for SNAP dumps using PLIDUMP is provided only under MVS. SNAP dumps are not produced in a CICS environment.
  - If the SNAP does not succeed, the CEE3DMP DUMP file displays the message:

    ```
    Snap was unsuccessful
    ```

    Failure to define a CEESNAP data set is the most likely cause of an unsuccessful CEESNAP.
  - If the SNAP is successful, CEE3DMP displays the message:

    ```
    Snap was successful; snap ID = nnn
    ```

where *nnn* corresponds to the SNAP identifier described above. An unsuccessful SNAP does not result in an incrementation of the identifier.

- To ensure portability across system platforms, use PLIDUMP to generate a dump of your Enterprise PL/I routine.

Finding Enterprise PL/I information in a dump

The following sections discuss Enterprise PL/I-specific information located in the following sections of a Language Environment dump:

- Traceback
- Control Blocks for Active Routines
- Control Block Associated with the Thread
- File Status and Attributes

Traceback

Examine the traceback section of the dump, shown in Figure 124 on page 328, for condition information about your routine and information about the statement number and address where the exception occurred.

```
CEE3DMP V1 R9.0: Plidump called from error On-unit          01/31/07 3:59:39 PM                Page:    1
ASID: 010E   Job ID: J0009410   Job name: LEDGSMP1   Step name: GO         UserID: BARBARA

CEE3845I CEEDUMP Processing started.
PLIDUMP was called from statement number 9 at offset +000000D2 from _ON_Begin_7_Blk_2 with entry address 11200240

Information for enclave EXAMPLE

  Information for thread 8000000000000000

  Traceback:
    DSA   Entry       E  Offset  Statement   Load Mod             Program Unit                  Service  Status
    1     IBMPDUMP    +000002AE              IBMPEV11                                           PQ78306  Call
    2     _ON_Begin_7_Blk_2
                      +000000D2  9           EXAMPLE              _Begin_12_Blk_3                       Call
    3     IBMPEONR    +000002A2              IBMPEV11                                           PQ76426  Call
    4     IBMPEBOP    +000004DC              IBMPEV11                                           LE19BAS  Call
    5     CEEEV011    +00000132              IBMPEV11             CEEEV011                              Call
    6     CEEHDSP     +000017D0              CEEPLPKA             CEEHDSP                       D1908    Call
    7     IBMBERRI    +000000AA              IBMPEV11                                           LE19BAS  Exception
    8     ERR_RAISE_COND
                      +00000090              IBMPEV11                                           LE19BAS  Call
    9     IBMPERSU    +00000082              IBMPEV11                                           LE19BAS  Call
    10    _Begin_12_Blk_3
                      +00000100  16          EXAMPLE              _Begin_12_Blk_3                       Call
    11    EXAMPLE     +000000B0  12          EXAMPLE              _Begin_12_Blk_3                       Call
    12    IBMPMINV    +000004DE              IBMPEV11             IBMPMINV                              Call
    13    CEEEV011    +00000202              IBMPEV11             CEEEV011                              Call
    14    CEEBBEXT    +000001B6              CEEPLPKA             CEEBBEXT                      D1908    Call

    DSA   DSA Addr   E  Addr    PU Addr    PU Offset  Comp Date  Compile Attributes
    1     11A3DE50   114A4E38   114A4E38   +000002AE  20061214   LIBRARY   EBCDIC  HFP
    2     11A3DD70   11200240   112000D0   +00000242  20070131   ENT PL/I EBCDIC  HFP
    3     11A3DBD8   114A7B98   114A7B98   +000002A2  20061214   LIBRARY   EBCDIC  HFP
    4     11A3DA08   114AF390   114AF390   +000004DC  20061214   LIBRARY   EBCDIC  HFP
    5     11A3D978   114062E8   114062E8   +00000132  20061214   LIBRARY
    6     11A3A858   112C3238   112C3238   +000017D0  20061215   CEL
    7     11A3A6B8   114AAA18   114AAA18   +000000AA  20061214   LIBRARY   EBCDIC  HFP
    8     11A3A618   114A9FA8   114A9FA8   +00000090  20061214   LIBRARY   EBCDIC  HFP
    9     11A3A570   114AB120   114AB120   +00000082  20061214   LIBRARY   EBCDIC  HFP
    10    11A3A4A8   112000D0   112000D0   +00000100  20070131   ENT PL/I EBCDIC  HFP
    11    11A3A3B8   11200340   112000D0   +00000320  20070131   ENT PL/I EBCDIC  HFP
    12    11A3A180   114DD990   114DD990   +000004DE  20061214   LIBRARY
    13    11A3A0F0   114062E8   114062E8   +00000202  20061214   LIBRARY
    14    11A3A030   11291208   11291208   +000001B6  20061215   CEL

  Condition Information for Active Routines
    Condition Information for  (DSA address 11A3A6B8)
      CIB Address: 11A3B178
      Current Condition:
        IBM0281S A prior condition was promoted to the ERROR condition.
      Original Condition:
        IBM0421S  ONCODE=520  The SUBSCRIPTRANGE condition was raised.
      Location:
        Program Unit:  Entry: IBMBERRI Statement:  Offset: +000000AA

  Storage dump near condition, beginning at location: 114AAAB2
   +000000 114AAAB2  4110D098 5050D098 5040D09C 5040D0A0  05EF1F00 43002016 A7010080 A7840009  |...q&&.q& ..& ..........x...xd..|
⋮
```

Figure 124. Traceback section of dump

Condition information

If the dump was called from an ON-unit, the type of ON-unit is identified in the traceback as part of the entry information. For ON-units, the values of any relevant condition built-in functions (for example, ONCHAR and ONSOURCE for conversion errors) appear. In cases where the cause of entry into the ON-unit is not stated, usually when the ERROR ON-unit is called, the cause of entry appears in the condition information.

Statement number and address where error occurred

This information, which is the point at which the condition that caused entry to the ON-unit occurred, can be found in the traceback section of the dump.

If the condition occurs in compiled code, and you compiled your routine with either GOSTMT or GONUMBER, the statement numbers appear in the dump. To identify the assembler instruction that caused the error, use the traceback information in the dump to find the program unit (PU) offset of the statement number in which the error occurred. Then find that offset and the corresponding instruction in the object code listing.

Control blocks for active routines

This section shows the stack frames for all active routines, and the static storage. Use this section of the dump to identify variable values, determine the contents of parameter lists, and locate the timestamp.

Figure 125 on page 330 shows this section of the dump.

```
 Control Blocks for Active Routines:
⋮
   DSA for EXAMPLE: 11A3A3B8
     +000000  FLAGS.... 10A3      member... A12C      BKC...... 11A3A180  FWC...... 11A3A138  R14...... 912003F2
     +000010  R15...... 112000D0  R0....... 11A3A3B8  R1....... 11200240  R2....... 11211768  R3....... 1120037A
     +000024  R4....... 11A3A0D8  R5....... 11A3A3B8  R6....... 11200800  R7....... 00000000  R8....... 11211648
     +000038  R9....... 00000008  R10...... 11A3A0B0  R11...... 11200ACC  R12...... 112129B0  reserved. 00000000
     +00004C  NAB...... 11A3A4A8  PNAB..... 00000000  reserved. 00000000  00000000
     +000064  reserved. 00000000  reserved. 00000000  MODE..... 00000000  reserved. 00000000
     +000078  reserved. 00000000  reserved. 00000000
   Dynamic save area (EXAMPLE): 11A3A3B8
     +000000 11A3A3B8  10A3A12C 11A3A180 11A3A138 912003F2  112000D0 11A3A3B8 11200240 11211768  |.t...t...t..j..2.....tt.... ....|
     +000020 11A3A3D8  1120037A 11A3A0D8 11A3A3B8 11200800  00000000 11211648 00000008 11A3A0B0  |...:.t.Q.tt.................t..|
     +000040 11A3A3F8  11200ACC 112129B0 00000000 11A3A4A8  00000000 00000000 00000000 00000000  |.............tuy................|
     +000060 11A3A418  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
     +000080 11A3A438  00000000 00000000 00000000 00000000  00000000 00000000 00100000 00000000  |................................|
     +0000A0 11A3A458  00180180 11A3A3B8 00000000 11200980  0B300000 11200240 11A3A3B8 00000000  |.....tt................ .tt.....|
     +0000C0 11A3A478  00000002 00000002 00000002 00000002  00000002 00000002 00000002 00000002  |................................|
     +0000E0 11A3A498  00000002 00000002 0000000B 00000014  10000000 11A3A3B8 11A3A7D8 912001D2  |.....................tt..txQj..K|
   ENTERPRISE PL/I OPTIONS:
    AFP, ARCH( 5), BACKREG(5), BIFPREC(15), CHECK(NOCONFORMANCE, NOSTORAGE), CMPAT(V2), CODEPAGE( 1140), COMMON,
    NOCOMPACT, CSECT, CSECTCUT( 4) CURRENCY( $), NODBCS, DECIMAL( FOFLONASGN, NOFORCEDSIGN), DEFAULT( IBM, ASSIGNABLE,
    NOINITFILL, NONCONNECTED, DESCRIPTOR, DESCLOCATOR, DUMMY(ALIGNED), ORDINAL(MIN), BYADDR, RETURNS(BYADDR),
    LINKAGE(OPTLINK), NORETCODE, NOINLINE, ORDER, NOOVERLAP, NONRECURSIVE, ALIGNED, NULL370, EVENDEC, SHORT(HEXADEC),
    EBCDIC, HEXADEC, NATIVE, NATIVEADDR, E(HEXADEC) ), DISPLAY(WTO), NODLLINIT, EXTRN(FULL), NOGRAPHIC, NOINITAUTO,
    NOINITBASED, NOINITCTL, NOINITSTATIC, NOINTERRUPT, LIMITS( EXTNAME( 7), FIXEDBIN( 31, 31), FIXEDDEC( 15, 15), NAME( 100
    )), OPTIMIZE( 0), PREFIX( CONVERSION, FIXEDOVERFLOW, INVALIDOP, OVERFLOW, PRECTYPE(ANS), NOSIZE, NOSTRINGRANGE,
    NOSTRINGSIZE, NOSUBSCRIPTRANGE, UNDERFLOW, ZERODIVIDE), REDUCE, NORENT, RESEXP, RESPECT(), RULES(IBM), NOSTDSYS,
    NOSCHEDULER, STRINGOFGRAPHIC(GRAPHIC), SYSTEM(MVS), TEST(ALL ,SYM ,HOOK ,NOSEPARATE), TUNE( 5), USAGE( ROUND(IBM),
    UNSPEC(IBM)), WIDECHAR(BIGENDIAN), WINDOW( 1950), WRITABLE, XINFO(NODEF, NOXML)
   Static for procedure EXAMPLE    Timestamp: 2007.01.31 15:59:36 V03.R06.M00: 11200800
     +000000 11200800  02020240 00000005 02020240 00000021  00000000 11200898 00000000 11200830  |... ....... ...........q........|
     +000020 11200820  00000000 11200898 00000000 11200830  00000000 11200838 00000000 00000000  |.......q........................|
     +000040 11200840  31010001 00000000 00000000 00000000  00000010 00000000 00000000 00000000  |................................|
     +000060 11200860  112008B0 00000000 00000000 00000000  00000004 00000004 0000000A 00000001  |................................|
     +000080 11200880  0000001B 00000024 0000002D 00000032  00000000 00000000 112008D0 112008F0  |.............................0..|
     +0000A0 112008A0  11200910 11200930 00000000 11200860  02002200 11200340 00000000 00000000  |...............-....... ........|
     +0000C0 112008C0  11200840 11200438 00090107 00000000  42002201 000000A2 00000000 00000000  |... ...................s........|
     +0000E0 112008E0  30000000 11200444 00090105 00000000  48012401 D00000C0 11200870 00000000  |.....................<........|
     +000100 11200900  00001F80 1120044C 00010105 00000000  40002401 D00000E8 00000000 00000000  |.......<........ ......Y........|
     +000120 11200920  00001F80 11200454 00010101 00000000  40002401 D00000EC 00000000 00000000  |................ ................|
     +000140 11200940  00001F80 11200458 00010109 00000000  00000003 00000010 00000002 0000002D  |................................|
     +000160 11200960  00000024 0000000F 00000002 0000002D  00000032 0000000E 00000001 00000032  |................................|
     +000180 11200980  D0000098 00100000 6E3BFFE0 00000000  11200898 11200A80 11200830 90010000  |...q....>.........q.............|
     +0001A0 112009A0  11200340 00000000 00000000 00000004  11200880 00000000 112009C0 00000000  |... ............................|
     +0001C0 112009C0  D00000A8 00100000 6E3BFFE0 00000000  11200820 11200A80 11200828 83010000  |...y....>..................c...|
     +0001E0 112009E0  11200240 11200980 11200A00 00000000  00000000 00000000 00000000 00000000  |... ............................|
     +000200 11200A00  D0000098 00000000 6E7BFFE0 00000000  11200810 11200A80 11200818 01000000  |...q....>#......................|
     +000220 11200A20  112000D0 11200980 00000000 00000000  00000000 11200950 00000000 00000000  |.......................&........|
     +000240 11200A40  00000000 00000000 00000000 00000000  00010007 C5E7C1D4 D7D3C500 010005D3  |...................EXAMPLE....L|
     +000260 11200A60  C1C2D3F1 00010005 C1D9D9C1 E8000100  01C90001 0009C1D9 D9C1E86D C5D5C400  |ABL1....ARRAY....I....ARRAY_END.|
     +000280 11200A80  00000000 11200464 E1100FF2 F0F0F7F0  F1F3F1F1 F5F5F9F3 F6F0F0F0 0000003F  |...........20070131155936000....|
     +0002A0 11200AA0  11200A40 11200860 11200838 00000001  11200850 00220000 00000000 11200980  |... ...-...........&............|
     +0002C0 11200AC0  11200438 00000000 01000001 11200340  11200FC0 00000000 18AF47F0 A016C3C5  |.............. ...........0..CE|
⋮
```

Figure 125. Control blocks for active routines section of the dump

Automatic variables

To find automatic variables, use an offset from the stack frame of the block in which they are declared. This information appears in the variable storage map generated when the MAP compiler option is in effect. If you have not used the MAP option, you can determine the offset by studying the listing of compiled code instructions.

Static variables

If your routine is compiled with the MAP option, you can find static variables by using an offset in the variable storage map. If the MAP option is not in effect, you can determine the offset by studying the listing of compiled code.

Based variables

To locate based variables, use the value of the defining pointer. Find this value by using one of the methods described above to find static and automatic variables. If the pointer is itself based, you must find its defining pointer and follow the chain until you find the correct value.

The following is an example of typical code for X BASED (P), with P AUTOMATIC:

```
58 60 D 0C8        L 6,P

58 E0 6 000        L 14,X
```

P is held at offset X'C8' from register 13. This address points to X.

Take care when examining a based variable to ensure that the pointers are still valid.

Area variables

Area variables are located using one of the methods described above, according to their storage class.

The following is an example of typical code: for an area variable A declared AUTOMATIC:

```
41 60 D 0F8        LA 6,A
```

The area starts at offset X'F8' from register 13.

Variables in areas

To find variables in areas, locate the area and use the offset to find the variable.

Contents of parameter lists

To find the contents of a passed parameter list, first find the register 1 value in the save area of the calling routine's stack frame. Use this value to locate the parameter list in the dump. If R1=0, no parameters passed.

Control blocks associated with the thread

This section of the dump, shown in Figure 126 on page 332, includes information about Enterprise PL/I fields of the CAA and other control block information.

```
  Control Blocks Associated with the Thread:
    CAA: 112139B0
      +000000 112139B0  00000800 00000000 11A3B018 11A5B018  00000000 00000000 00000000 00000000  |.........t...v.................|
      +000020 112139D0  00000000 00000000 11210A58 00000000  00000000 00000000 00000000 00000000  |.............................. |
      +000040 112139F0  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |.............................. |
      +000060 11213A10  00000000 00000000 00000000 00000000  00000000 80014608 00000000 00000000  |.............................. |
:
    DUMMY DSA: 11214350
      +000000  FLAGS.... 0000      member... 0000      BKC...... 00006F60  FWC...... 11A3B030  R14...... 9120132E
      +000010  R15...... 91292208  R0....... 7D000008  R1....... 11212768  R2....... 00000000  R3....... 00000000
      +000024  R4....... 00000000  R5....... 00000000  R6....... 00000000  R7....... 91215770  R8....... 11200FE0
      +000038  R9....... 008FF7D0  R10...... 00000000  R11...... 9120125A  R12...... 112139B0  reserved. 00000000
      +00004C  NAB...... 11A3B030  PNAB..... 11A3B030  reserved. 00000000  00000000
      +000064  reserved. 00000000  reserved. 00000000  MODE..... 00000000  reserved. 00000000
      +000078  reserved. 00000000  reserved. 00000000
:
    PL/I TCA Appendage: 11A5BCE8
      +000000 11A5BCE8  00000000 00000000 00000000 11A5BEF8  0000047B 00000000 00000000 00000000  |.............v.8...#.....  |
      +000020 11A5BD08  00000000 00000000 11A5BE48 1154AAC8  00000000 00009600 00000000 00000000  |.........v.....H......o.....|
      +000040 11A5BD28  00000000 00000000 00000000 00000000  11A5C960 11A3EAC0 00004000 00000000  |.................vI-.t.... .....|
      +000060 11A5BD48  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |.............................. |
      +000080 11A5BD68  114B38C8 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |...H.............................|
      +0000A0 11A5BD88  00000000 00000000 00000000 00000000  00000000 00000000 00000001 00000000  |.............................. |
      +0000C0 11A5BDA8  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |.............................. |
      +0000E0 11A5BDC8 - +0000FF 11A5BDE7             same as above
      +000100 11A5BDE8  00000000 00000000 00000000 11A5C380  00000002 00000000 00000000 00000000  |.............vC.................|
      +000120 11A5BE08  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |.............................. |
      +000140 11A5BE28 - +00015F 11A5BE47             same as above
      +000160 11A5BE48  11A5CFB0 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |.v.............................. |
      +000180 11A5BE68  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |.............................. |
      +0001A0 11A5BE88 - +0001BF 11A5BEA7             same as above
    PL/I OCA: 11A3EAC0
      +000000 11A3EAC0  D6C3C100 11A5CA28 000000FF 00000000  00000000 00000000 00000000 00000000  |OCA..v.......................... |
      +000020 11A3EAE0  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |.............................. |
      +000040 11A3EB00 - +0000BF 11A3EB7F             same as above
      +0000C0 11A3EB80  00000000 00000000 40404040 40404040  40404096 002C0000 A3404EF0 F0F0F0F0  |........          o....t +00000|
    PL/I OCA: 11A5CA28
      +000000 11A5CA28  D6C3C100 11A5C960 0B0220FF 00000000  01400030 00000200 00000000 00000000  |OCA..vI-..... .............. |
      +000020 11A5CA48  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |.............................. |
      +000040 11A5CA68 - +00005F 11A5CA87             same as above
      +000060 11A5CA88  00000000 00000000 00000000 00000000  00000000 00000000 00000000 11200952  |.............................. |
      +000080 11A5CAA8  02020000 00000004 11A3E978 00000000  00000000 00000000 00000000 00000000  |.........tZ..................... |
      +0000A0 11A5CAC8  00000000 00000000 00000000 00000000  00000000 00000000 00030119 59C9C2D4  |.............................IBM|
      +0000C0 11A5CAE8  00000000 00000000 11A5B018 00000040  C3C4D3D3 00000000 40000000 00000000  |.........v..... CDLL.... .....|
    PL/I OCA: 11A5C960
      +000000 11A5C960  D6C3C100 00000000 000000FF 00000000  0000FFFF 00000000 00000000 11A5BD40  |OCA.........................v. |
      +000020 11A5C980  02040000 00000000 11A5BD42 02020000  00000001 11A5BD40 02040000 00000000  |.........v...........v. ........|
      +000040 11A5C9A0  11A5BD40 02040000 00000000 11A5BD40  02040000 00000000 11A5BD40 02040000  |.v. .........v. .........v. ....|
      +000060 11A5C9C0  00000000 11A5BD40 020D0000 00000000  11A5BE1C 020D0000 00000001 11A5BD40  |.....v. .........v...........v. |
      +000080 11A5C9E0  02040000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |.............................. |
      +0000A0 11A5CA00  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |.............................. |
      +0000C0 11A5CA20  00000000 00000000 D6C3C100 11A5C960  0B0220FF 00000000 01400030 00000200  |........OCA..vI-......... .....|

  Enclave Control Blocks:
    EDB: 11212648
      +000000 11212648  C3C5C5C5 C4C24040 C0000001 11213870  11212D50 00000000 00000000 00000000  |CEEEDB  ...........&............|
      +000020 11212668  11212B58 11212B88 91215770 11212198  00000000 00000000 11212768 00000000  |.......hj......q................|
      +000040 11212688  00000000 00000000 00006F60 00000000  00000000 91333B58 1120A880 112126A0  |..........?-........j.....y.....|
      +000060 112126A8  0000F460 00000000 11211E58 00000000  11214550 00000000 113F4660 112139B0  |..4-...............&.......-....|
      +000080 112126C8  40000000 0000FAF6 00000000 00000000  00000001 0001F060 00006FF8 008CCE00  |  ......6.............0-..?8....|
      +0000A0 112126E8  00000001 00000100 1120A988 112126F0  00000000 00000000 00000000 00000001  |..........zh...0................|
    MEML: 11213870
      +000000 11213870  00000000 00000000 112945B0 00000000  00000000 00000000 112945B0 00000000  |.............................. |
      +000020 11213890  00000000 00000000 112945B0 00000000  1120F8D8 00000000 91575288 00000000  |.................8Q....j..h....|
      +000040 112138B0  00000000 00000000 112945B0 00000000  00000000 00000000 112945B0 00000000  |.............................. |
      +000060 112138D0 - +00009F 1121390F             same as above
      +0000A0 11213910  00000000 00000000 112945B0 00000000  00000000 00000000 914072E8 00000000  |.....................j .Y....|
      +0000C0 11213930  00000000 00000000 112945B0 00000000  00000000 00000000 112945B0 00000000  |.............................. |
      +0000E0 11213950 - +00011F 1121398F             same as above

    WSA address.................00000000
```

Figure 126. Control blocks associated with the thread section of the dump (Part 1 of 2)

```
  File Status and Attributes:
⋮
    Attributes of file: SYSPRINT
     STREAM OUTPUT PRINT ENVIRONMENT( CONSECUTIVE VB BLKSIZE( 129) RECSIZE( 125) LINESIZE( 120) PAGESIZE( 60) CTLASA )
    CURRENT RECORD IN BUFFER
    BUFFER: 11A5CF20
      +000000 11A5CF20  40E2A482 F140E2A3 8199A389 95874000  40000000 00000000 00000000 00000000  | Sub1 Starting . ..............|
      +000020 11A5CF40  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
      +000040 11A5CF60 - +00007F 11A5CF9F             same as above

  File Control Blocks:
    FILE CONTROL BLOCK (FCB): 11A5CB38
      +000000 11A5CB38  11A5CB38 00000000 11A5CFB0 114F5440  114F53E8 114F4FF0 114F53E8 114F4F50  |.v.......v...|. .|.Y.||0.|.Y.||&|
      +000020 11A5CB58  114F4ED8 1153CA88 114F5440 114F5440  114F5440 114F5440 114F5440 114F53E8  .|+Q...h.|. .|. .|. .|. .|. .|. .|.Y
      +000040 11A5CB78  114F53E8 11537648 114F53E8 114F4E20  114F53E8 114F53E8 114F53E8 114F46A0  .|.Y.....|.Y.|+..|.Y.|.Y.|.Y.|..
      +000060 11A5CB98  114F4618 114F4548 114F53E8 11A5CD20  00000000 00000000 00000000 00000000  .|...|...|.Y.v.................
      +000080 11A5CBB8  00000000 00454842 11A5D02C 00000000  000001DA 11A64024 11A5CF20 00000081  .........v..........w ..v.....a
      +0000A0 11A5CBD8  00000000 00000000 00000078 00000010  00000079 00000000 00000000 00000000  ................................
      +0000C0 11A5CBF8  00000000 00080150 20000720 000A6080  00000000 00000000 00000000 00000000  .......&......-.................
      +0000E0 11A5CC18  1154DA70 11A5CF21 00000000 00000000  11A3B5FC 1154AAC8 00000000 0000000E  .....v..........t.....H........
      +000100 11A5CC38  00000000 11A5CF20 00000001 00000001  00000002 003C0078 08000000 00000000  .....v.........................
      +000120 11A5CC58  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  ................................
      +000140 11A5CC78  00000000 00000000 00000000 003BA682  6B409985 8386947E E5C2C16B 40939985  .............wb, recfm=VBA, lre
      +000160 11A5CC98  83937EF1 F2F56B40 829392A2 89A9857E  F1F2F96B 40A3A897 857E9985 83969984  cl=125, blksize=129, type=record
      +000180 11A5CCB8  6B409596 A2858592 00000000 00000000  00000000 00000000 00000000 00000000  , noseek........................
      +0001A0 11A5CCD8  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
      +0001C0 11A5CCF8 - +0001DF 11A5CD17             same as above
    CURRENT ACTIVE ICO CONTROL BLOCK:
    ICO: 11A5CF21
      +000000 11A5CF21  E2A482F1 40E2A381 99A38995 87400040  00000000 00000000 00000000 00000000  |Sub1 Starting . ..............|
      +000020 11A5CF41  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
      +000040 11A5CF61 - +00007F 11A5CFA0             same as above

Process Control Blocks:

  PCB: 11212198
    +000000 11212198  C3C5C5D7 C3C24040 03030288 00000000  00000000 00000000 112123D0 913F74D0  |CEEPCB  ...h.............j...|
    +000020 112121B8  913EDB50 913F4A08 913F4528 11208AE8  11211F68 00000000 00000000 11212648  |j..&j...j......Y...............|
    +000040 112121D8  913F4858 7F800000 00000000 000141D4  00000000 80000000 00000000 00000000  |j..".........M.................|

  MEML: 112123D0
    +000000 112123D0  00000000 00000000 112945B0 00000000  00000000 00000000 112945B0 00000000  |................................|
    +000020 112123F0  00000000 00000000 112945B0 00000000  1120DE68 00000000 91575288 11A35000  |.....................j..h.t&.|
    +000040 11212410  00000000 00000000 112945B0 00000000  00000000 00000000 112945B0 00000000  |................................|
    +000060 11212430 - +00009F 1121246F             same as above
    +0000A0 11212470  00000000 00000000 112945B0 00000000  11A36000 00000000 914072E8 00000000  |................t-.....j .Y....|
    +0000C0 11212490  00000000 00000000 112945B0 00000000  00000000 00000000 112945B0 00000000  |................................|
    +0000E0 112124B0 - +00011F 112124EF             same as above

  PL/I Process Control Block: 11212198
    +000000 11212198  C3C5C5D7 C3C24040 03030288 00000000  00000000 00000000 112123D0 913F74D0  |CEEPCB  ...h.............j...|
    +000020 112121B8  913EDB50 913F4A08 913F4528 11208AE8  11211F68 00000000 00000000 11212648  |j..&j...j......Y...............|
⋮
```

Figure 126. Control blocks associated with the thread section of the dump (Part 2 of 2)

The CAA

The address of the CAA control block appears in this section of the dump. If the BLOCK option is in effect, the complete CAA (including the Enterprise PL/I implementation appendage) appears separately from the body of the dump. Register 12 addresses the CAA.

File status and attribute information

This part of the dump includes the following information:

- The default and declared attributes of all open files
- Buffer contents of all file buffers
- The contents of FCBs, DCBs, DCLCBs, IOCBs, and control blocks for the process or enclave

Enterprise PL/I contents of the Language Environment trace table

Language Environment provides three Enterprise PL/I trace table entry types that contain character data:

- Trace entry 100 occurs when a task is created.
- Trace entry 101 occurs when a task that contains the tasking CALL statements is terminated.
- Trace entry 102 occurs when a task that does not contain a tasking CALL statement is terminated.

The format for trace table entries 100, 101, and 102 is:

```
—>(100) NameOfCallingTask NameOfCalledTask OffsetOfCallStmt
           UserAgrPtr CalledTaskPtr TaskVarPtr EventVarPtr
           PriorityPtr CallingR2-R5 CallingR12-R14

—>(101) NameOfReturnTask ReturnerR2-R5 ReturnerR12-R14

—>(102) NameOfReturnTask
```

For more information about the Language Environment trace table format, see “Understanding the trace table entry (TTE)” on page 154.

Debugging example of Enterprise PL/I routines

This section contains examples of Enterprise PL/I routines and instructions for using information in the Language Environment dump to debug them. Important areas in the source code and in the dump for each routine are highlighted.

Subscript range error

Figure 127 on page 335 illustrates an error caused by an array subscript value outside the declared range. In this example, the declared array value is 10.

This routine was compiled with the options LIST, TEST, GONUMBER, and MAP. It was run with the TERMTHDACT(TRACE) option to generate a traceback for the condition.

```
5655-H31  IBM(R) Enterprise PL/I for z/OS       V3.R6.M0 (Built:20070119)                    2007.01.31 15:59:36   Page     1
                  Options Specified
  Install:
  Command:
  Line.File Process Statements
     1.0    *PROCESS  GONUMBER LIST S STG TEST MAP;
  Install:
5655-H31  IBM(R) Enterprise PL/I for z/OS       EXAMPLE:  PROC  OPTIONS(M                    2007.01.31 15:59:36   Page     2
 Compiler Source
    Line.File
       2.0      EXAMPLE:  PROC  OPTIONS(MAIN);
       3.0
       4.0          DCL Array(10) Fixed bin(31);
       5.0          DCL (I,Array_End)   Fixed bin(31);
       6.0          On error
       7.0            Begin;
       8.0              On error system;
       9.0              Call plidump('tbnfs','Plidump called from error On-unit');
      10.0            End;
      11.0
      12.0          (subrg):              /* Enable subscriptrange condition */
      13.0          Labl1: Begin;
      14.0            Array_End = 20;
      15.0            Do I = 1 to Array_End;   /* Loop to initialize array */
      16.0              Array(I) = 2;    /* Set array elements to 2 */
      17.0            End;
      18.0          End Labl1;
      19.0       End Example;
5655-H31  IBM(R) Enterprise PL/I for z/OS       EXAMPLE:  PROC  OPTIONS(M                    2007.01.31 15:59:36   Page     3
                  Block Name List
    Number  Name
         1  EXAMPLE
         2  _ON_Begin_7_Blk_2
         3  _Begin_12_Blk_3
5655-H31  IBM(R) Enterprise PL/I for z/OS       EXAMPLE:  PROC  OPTIONS(M                    2007.01.31 15:59:36   Page     4

OFFSET OBJECT CODE        LINE#  FILE#    P S E U D O   A S S E M B L Y   L I S T I N G

                          Timestamp and Version Information
000000  F2F0  F0F7                                    =C'2007'           Compiled Year
000004  F0F1  F3F1                                    =C'0131'           Compiled Date MMDD
000008  F1F5  F5F9  F3F6                              =C'155936'         Compiled Time HHMMSS
00000E  F0F3  F0F6  F0F0                              =C'030600'         Compiler Version

000014  0036  ****                                    Service String     20070122
                          Timestamp and Version End

5655-H31  IBM(R) Enterprise PL/I for z/OS       EXAMPLE:  PROC  OPTIONS(M  : _Begin_12_Blk_3   2007.01.31 15:59:36   Page     5

OFFSET OBJECT CODE        LINE#  FILE#    P S E U D O   A S S E M B L Y   L I S T I N G

⋮
5655-H31  IBM(R) Enterprise PL/I for z/OS       EXAMPLE:  PROC  OPTIONS(M                    2007.01.31 15:59:36   Page    17

                             * * * * *  S T O R A G E   O F F S E T   L I S T I N G  * * * * *

IDENTIFIER          DEFINITION      ATTRIBUTES
                                    <SEQNBR>-<FILE NO="">:<FILE LINE="">

ARRAY               1-0:4           Class = automatic,          Location = 192 : 0xC0(r13),                  Length = 40

ARRAY_END           1-0:5           Class = automatic,          Location = 236 : 0xEC(r13),                  Length = 4

I                   1-0:5           Class = automatic,          Location = 232 : 0xE8(r13),                  Length = 4

                         * * * * *  E N D   O F   S T O R A G E   O F F S E T   L I S T I N G  * * * * *
⋮
```

Figure 127. Example of moving a value outside an array range

Figure 128 on page 336 shows sections of the dump generated by a call to PLIDUMP.

```
CEE3DMP V1 R9.0: Plidump called from error On-unit                              01/31/07 3:59:39 PM                Page:    1
ASID: 010E   Job ID: J0009410   Job name: LEDGSMP1   Step name: GO        UserID: BARBARA

CEE3845I CEEDUMP Processing started.
PLIDUMP was called from statement number 9 at offset +000000D2 from _ON_Begin_7_Blk_2 with entry address 11200240

Information for enclave EXAMPLE

  Information for thread 8000000000000000

  Traceback:
    DSA   Entry       E  Offset  Statement   Load Mod            Program Unit                  Service  Status
    1     IBMPDUMP    +000002AE              IBMPEV11                                          PQ78306  Call
    2     _ON_Begin_7_Blk_2
                      +000000D2  9           EXAMPLE             _Begin_12_Blk_3                        Call
    3     IBMPEONR    +000002A2              IBMPEV11                                          PQ76426  Call
    4     IBMPEBOP    +000004DC              IBMPEV11                                          LE19BAS  Call
    5     CEEEV011    +00000132              IBMPEV11            CEEEV011                              Call
    6     CEEHDSP     +000017D0              CEEPLPKA            CEEHDSP                       D1908    Call
    7     IBMBERRI    +000000AA              IBMPEV11                                          LE19BAS  Exception
    8     ERR_RAISE_COND
                      +00000090              IBMPEV11                                          LE19BAS  Call
    9     IBMPERSU    +00000082              IBMPEV11                                          LE19BAS  Call
    10    _Begin_12_Blk_3
                      +00000100  16          EXAMPLE             _Begin_12_Blk_3                        Call
    11    EXAMPLE     +000000B0  12          EXAMPLE             _Begin_12_Blk_3                        Call
    12    IBMPMINV    +000004DE              IBMPEV11            IBMPMINV                              Call
    13    CEEEV011    +00000202              IBMPEV11            CEEEV011                              Call
    14    CEEBBEXT    +000001B6              CEEPLPKA            CEEBBEXT                      D1908    Call

    DSA   DSA Addr   E  Addr    PU Addr    PU Offset  Comp Date  Compile Attributes
    1     11A3DE50   114A4E38   114A4E38   +000002AE  20061214   LIBRARY   EBCDIC  HFP
    2     11A3DD70   11200240   112000D0   +00000242  20070131   ENT PL/I EBCDIC  HFP
    3     11A3DBD8   114A7B98   114A7B98   +000002A2  20061214   LIBRARY   EBCDIC  HFP
    4     11A3DA08   114AF390   114AF390   +000004DC  20061214   LIBRARY   EBCDIC  HFP
    5     11A3D978   114062E8   114062E8   +00000132  20061214   LIBRARY
    6     11A3A858   112C3238   112C3238   +000017D0  20061215   CEL
    7     11A3A6B8   114AAA18   114AAA18   +000000AA  20061214   LIBRARY   EBCDIC  HFP
    8     11A3A618   114A9FA8   114A9FA8   +00000090  20061214   LIBRARY   EBCDIC  HFP
    9     11A3A570   114AB120   114AB120   +00000082  20061214   LIBRARY   EBCDIC  HFP
    10    11A3A4A8   112000D0   112000D0   +00000100  20070131   ENT PL/I EBCDIC  HFP
    11    11A3A3B8   11200340   112000D0   +00000320  20070131   ENT PL/I EBCDIC  HFP
    12    11A3A180   114DD990   114DD990   +000004DE  20061214   LIBRARY
    13    11A3A0F0   114062E8   114062E8   +00000202  20061214   LIBRARY
    14    11A3A030   11291208   11291208   +000001B6  20061215   CEL

  Condition Information for Active Routines
    Condition Information for  (DSA address 11A3A6B8)
      CIB Address: 11A3B178
      Current Condition:
        IBM0281S A prior condition was promoted to the ERROR condition.
      Original Condition:
        IBM0421S  ONCODE=520  The SUBSCRIPTRANGE condition was raised.
      Location:
        Program Unit:  Entry: IBMBERRI Statement:  Offset: +000000AA

    Storage dump near condition, beginning at location: 114AAAB2
      +000000 114AAAB2  4110D098 5050D098 5040D09C 5040D0A0  05EF1F00 43002016 A7010080 A7840009  |...q&&.q& ..& .........x...xd..|


CEE3DMP V1 R9.0: Plidump called from error On-unit                              01/31/07 3:59:39 PM                Page:    2
ASID: 010E   Job ID: J0009410   Job name: LEDGSMP1   Step name: GO        UserID: BARBARA

  Control Blocks for Active Routines:
    DSA for IBMPDUMP: 11A3DE50
      +000000  FLAGS.... 1000      member... 0000      BKC..... 11A3DD70  FWC..... 11A3E150  R14..... 914A50E8
      +000010  R15..... 912EF898  R0..... 00000000  R1..... 11A3DEE8  R2..... 00000002  R3..... 114A5104
      +000024  R4..... 11A3DEFC  R5..... 11A3E04C  R6..... 11200800  R7..... 11200438  R8..... 11A3B264
      +000038  R9..... 00000014  R10..... 00000098  R11..... 11A3A468  R12..... 112129B0  reserved. 00000000
      +00004C  NAB..... 11A3E150  PNAB..... 00000000  reserved. 00000000  11A3DB34
      +000064  reserved. 926DF340  reserved. 81A340A2  MODE..... A381A385  reserved. 948595A3
      +000078  reserved. 81A34083  reserved. C6C5D5E4
    Dynamic save area (IBMPDUMP): 11A3DE50
      +000000 11A3DE50  10000000 11A3DD70 11A3E150 914A50E8  912EF898 00000000 11A3DEE8 00000002  |.....t...t.&j.&Yj.8q.....t.Y....|
      +000020 11A3DE70  114A5104 11A3DEFC 11A3E04C 11200800  11200438 11A3B264 00000014 00000098  |.....t...t.<.........t.........q|
      +000040 11A3DE90  11A3A468 112129B0 00000000 11A3E150  00000000 00000000 11A37B2E 11A3DB34  |.tu..........t.&.........t#..t..|
⋮
```

Figure 128. Sections of the Language Environment dump (Part 1 of 2)

```
DSA for _Begin_12_Blk_3: 11A3A4A8
  +000000  FLAGS.... 1000      member... 0000      BKC...... 11A3A3B8  FWC...... 11A3A7D8  R14...... 912001D2
  +000010  R15...... 914AB120  R0....... 0000000A  R1....... 11A3A478  R2....... 0000000B  R3....... 1120010A
  +000024  R4....... 11A3A0D8  R5....... 11A3A3B8  R6....... 11200800  R7....... 00000000  R8....... 11211648
  +000038  R9....... 00000008  R10...... 11A3A0B0  R11...... 11200ACC  R12...... 112129B0  reserved. 00000000
  +00004C  NAB...... 11A3A570  PNAB..... 00000000  reserved. 00000000  00000000
  +000064  reserved. 00000000  reserved. 00000000  MODE..... 00000000  reserved. 00000000
  +000078  reserved. 00000000  reserved. 00000000
Dynamic save area (_Begin_12_Blk_3): 11A3A4A8
  +000000 11A3A4A8  10000000 11A3A3B8 11A3A7D8 912001D2  914AB120 0000000A 11A3A478 0000000B  |.....tt..txQj..Kj........tu.....|
  +000020 11A3A4C8  1120010A 11A3A0D8 11A3A3B8 11200800  00000000 11211648 00000008 11A3A0B0  |.....t.Q.tt.................t..|
  +000040 11A3A4E8  11200ACC 112129B0 00000000 11A3A570  00000000 00000000 00000000 00000000  |.............tv.................|
  +000060 11A3A508  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
  +000080 11A3A528  11A3A120 9129B186 11A3A0F0 00000000  10A3A0F0 11A3A4A8 00000000 00000000  |.t..j..f.t.0.....t.0.tuy........|
  +0000A0 11A3A548  00180280 11A3A4A8 11A3A450 11200A00  00000014 11A3A3B8 0000000A 0000000B  |.....tuy.tu&.........tt.........|
  +0000C0 11A3A568  11A3A478 11200340 10A3A4A8 11A3A4A8  11200650 914AB1A4 114A9FA8 00000020  |.tu.... .tuy.tuy...&j..u...y....|
DSA for EXAMPLE: 11A3A3B8
  +000000  FLAGS.... 10A3      member... A12C      BKC...... 11A3A180  FWC...... 11A3A138  R14...... 912003F2
  +000010  R15...... 112000D0  R0....... 11A3A3B8  R1....... 11200240  R2....... 11211768  R3....... 1120037A
  +000024  R4....... 11A3A0D8  R5....... 11A3A3B8  R6....... 11200800  R7....... 00000000  R8....... 11211648
  +000038  R9....... 00000008  R10...... 11A3A0B0  R11...... 11200ACC  R12...... 112129B0  reserved. 00000000
  +00004C  NAB...... 11A3A4A8  PNAB..... 00000000  reserved. 00000000  00000000
  +000064  reserved. 00000000  reserved. 00000000  MODE..... 00000000  reserved. 00000000
  +000078  reserved. 00000000  reserved. 00000000
Dynamic save area (EXAMPLE): 11A3A3B8
  +000000 11A3A3B8  10A3A12C 11A3A180 11A3A138 912003F2  112000D0 11A3A3B8 11200240 11211768  |.t...t...t..j..2.....tt.... ....|
  +000020 11A3A3D8  1120037A 11A3A0D8 11A3A3B8 11200800  00000000 11211648 00000008 11A3A0B0  |...:.t.Q.tt.................t..|
  +000040 11A3A3F8  11200ACC 112129B0 00000000 11A3A4A8  00000000 00000000 00000000 00000000  |.............tuy................|
  +000060 11A3A418  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
  +000080 11A3A438  00000000 00000000 00000000 00000000  00000000 00000000 00100000 00000000  |................................|
  +0000A0 11A3A458  00180180 11A3A3B8 00000000 11200980  0B300000 11200240 11A3A3B8 00000000  |.....tt.............. .tt.....|
  +0000C0 11A3A478  00000002 00000002 00000002 00000002  00000002 00000002 00000002 00000002  |................................|
  +0000E0 11A3A498  00000002 00000002 0000000B 00000014  10000000 11A3A3B8 11A3A7D8 912001D2  |.....................tt..txQj..K|
ENTERPRISE PL/I OPTIONS:
 AFP, ARCH( 5), BACKREG(5), BIFPREC(15), CHECK(NOCONFORMANCE, NOSTORAGE), CMPAT(V2), CODEPAGE( 1140), COMMON,
 NOCOMPACT, CSECT, CSECTCUT( 4) CURRENCY( $), NODBCS, DECIMAL( FOFLONASGN, NOFORCEDSIGN), DEFAULT( IBM, ASSIGNABLE,
 NOINITFILL, NONCONNECTED, DESCRIPTOR, DESCLOCATOR, DUMMY(ALIGNED), ORDINAL(MIN), BYADDR, RETURNS(BYADDR),
 LINKAGE(OPTLINK), NORETCODE, NOINLINE, ORDER, NOOVERLAP, NONRECURSIVE, ALIGNED, NULL370, EVENDEC, SHORT(HEXADEC),
 EBCDIC, HEXADEC, NATIVE, NATIVEADDR, E(HEXADEC) ), DISPLAY(WTO), NODLLINIT, EXTRN(FULL), NOGRAPHIC, NOINITAUTO,
 NOINITBASED, NOINITCTL, NOINITSTATIC, NOINTERRUPT, LIMITS( EXTNAME( 7), FIXEDBIN( 31, 31), FIXEDDEC( 15, 15), NAME( 100
 )), OPTIMIZE( 0), PREFIX( CONVERSION, FIXEDOVERFLOW, INVALIDOP, OVERFLOW, PRECTYPE(ANS), NOSIZE, NOSTRINGRANGE,
 NOSTRINGSIZE, NOSUBSCRIPTRANGE, UNDERFLOW, ZERODIVIDE), REDUCE, NORENT, RESEXP, RESPECT(), RULES(IBM), NOSTDSYS,
 NOSCHEDULER, STRINGOFGRAPHIC(GRAPHIC), SYSTEM(MVS), TEST(ALL ,SYM ,HOOK ,NOSEPARATE), TUNE( 5), USAGE( ROUND(IBM),
 UNSPEC(IBM)), WIDECHAR(BIGENDIAN), WINDOW( 1950), WRITABLE, XINFO(NODEF, NOXML)
Static for procedure EXAMPLE    Timestamp: 2007.01.31 15:59:36 V03.R06.M00: 11200800
  +000000 11200800  02020240 00000005 02020240 00000021  00000000 11200898 00000000 11200830  |... ....... ..........q........|
  +000020 11200820  00000000 11200898 00000000 11200830  00000000 11200838 00000000 00000000  |.......q.......................|
  +000040 11200840  31010001 00000000 00000000 00000000  00000010 00000000 00000000 00000000  |................................|
  +000060 11200860  112008B0 00000000 00000000 00000000  00000004 00000004 0000000A 00000001  |................................|
  +000080 11200880  0000001B 00000024 0000002D 00000032  00000000 00000000 112008D0 112008F0  |...........................0....|
  +0000A0 112008A0  11200910 11200930 00000000 11200860  02002200 11200340 00000000 00000000  |..............-....... ........|
  +0000C0 112008C0  11200840 11200438 00090107 00000000  42002201 000000A2 00000000 00000000  |... ...................s........|
  +0000E0 112008E0  30000000 11200444 00090105 00000000  48012401 D00000C0 11200870 00000000  |................................|
  +000100 11200900  00001F80 1120044C 00010105 00000000  40002401 D00000E8 00000000 00000000  |.......<........ ......Y........|
  +000120 11200920  00001F80 11200454 00010101 00000000  40002401 D00000EC 00000000 00000000  |................ ................|
  +000140 11200940  00001F80 11200458 00010109 00000000  00000003 00000010 00000002 0000002D  |................................|
  +000160 11200960  00000024 0000000F 00000002 0000002D  00000032 0000000E 00000001 00000032  |................................|
  +000180 11200980  D0000098 00100000 6E3BFFE0 00000000  11200898 11200A80 11200830 90010000  |...q....>.........q.............|
  +0001A0 112009A0  11200340 00000000 00000000 00000004  11200880 00000000 112009C0 00000000  |... ................................|
  +0001C0 112009C0  D00000A8 00100000 6E3BFFE0 00000000  11200820 11200A80 11200828 83010000  |...y....>..................c...|
  +0001E0 112009E0  11200240 11200980 11200A00 00000000  00000000 00000000 00000000 00000000  |... ................................|
  +000200 11200A00  D0000098 00000000 6E7BFFE0 00000000  11200810 11200A80 11200818 01000000  |...q....>#......................|
  +000220 11200A20  112000D0 11200980 00000000 00000000  00000000 11200950 00000000 00000000  |.......................&........|
  +000240 11200A40  00000000 00000000 00000000 00000000  00010007 C5E7C1D4 D7D3C500 010005D3  |....................EXAMPLE....L|
  +000260 11200A60  C1C2D3F1 00010005 C1D9D9C1 E8000100  01C90001 0009C1D9 D9C1E86D C5D5C400  |ABL1....ARRAY....I....ARRAY_END.|
  +000280 11200A80  00000000 11200464 E1100FF2 F0F0F7F0  F1F3F1F1 F5F5F9F3 F6F0F0F0 0000003F  |...........20070131155936000....|
  +0002A0 11200AA0  11200A40 11200860 11200838 00000001  11200850 00220000 00000000 11200980  |... ...-...........&............|
  +0002C0 11200AC0  11200438 00000000 01000001 11200340  11200FC0 00000000 18AF47F0 A016C3C5  |.............. ...........0..CE|
⋮
```

Figure 128. Sections of the Language Environment dump (Part 2 of 2)

To debug this routine, use the following steps:

1. In the dump, PLIDUMP was called by the ERROR ON-unit in statement 9. The traceback information in the dump shows that the exception occurred following statement 16.

Note: In the LE dumps, the columns and messages refer to ″statements″, but the numbers are actually (for Enterprise PL/I) the line numbers from the source file.

2. Locate the Original Condition message in the Condition Information for Active Routines section of the dump. The message is `IBM0421S ONCODE=520 The SUBSCRIPTRANGE condition was raised.` This message indicates that the exception occurred when an array element value exceeded the subscript range value (in this case, 10). For more information about this message, see *z/OS Language Environment Run-Time Messages*.
3. Locate statement 14 in the routine in Figure 127 on page 335. The instruction is `Array_End = 20`. This statement assigns a 20 value to the variable `Array_End`.
4. Statement 15 begins the DO-loop instruction `Do I = 1 to Array_End`. Since the previous instruction (statement 14) specified that `Array_End = 20`, the loop in statement 10 should run until `I` reaches a 20 value.

   The instruction in statement 4, however, declared a 10 value for the array range. Therefore, when the I value reached 11, the SUBSCRIPTRANGE condition was raised.

The following steps provide another method for finding the value that raised the SUBSCRIPTRANGE condition.

1. Locate the offset of variable I in the storage offset listing in Figure 127 on page 335. Use this offset to find the I value at the time of the dump. In this example, the offset is X'E8'.
2. Now find offset X'E8' from the start of the stack frame for the entry EXAMPLE in Figure 128 on page 336.

   The block located at this offset contains the value that exceeded the array range, X'B' or 11.

Calling a nonexistent subroutine

Figure 129 on page 339 demonstrates the error of calling a nonexistent subroutine. This routine was compiled with the LIST, MAP, and GONUMBER compiler options. It was run with the TERMTHDACT(DUMP) run-time option to generate a traceback.

```
5655-H31  IBM(R) Enterprise PL/I for z/OS       V3.R6.M0 (Built:20070119)                    2007.01.31 16:02:29   Page     1
                   Options Specified
  Install:
  Command:
  Line.File Process Statements
     1.0    *PROCESS  GONUMBER LIST S STG TEST MAP;
  Install:
5655-H31  IBM(R) Enterprise PL/I for z/OS       EXAMPLE1:  PROC  OPTIONS(                    2007.01.31 16:02:29   Page     2
 Compiler Source
    Line.File
       2.0      EXAMPLE1:  PROC  OPTIONS(MAIN);
       3.0
       4.0          DCL Prog01 entry external;
       5.0
       6.0          On error
       7.0            Begin;
       8.0              On error system;
       9.0              Call plidump('tbnfs','Plidump called from error On-unit');
      10.0            End;
      11.0
      12.0          Call prog01;        /* Call enternal program PROG01 */
      13.0
      14.0       End Example1;
5655-H31  IBM(R) Enterprise PL/I for z/OS       EXAMPLE1:  PROC  OPTIONS(                    2007.01.31 16:02:29   Page     3
                   Block Name List
    Number  Name
         1  EXAMPLE1
         2  _ON_Begin_7_Blk_2
5655-H31  IBM(R) Enterprise PL/I for z/OS       EXAMPLE1:  PROC  OPTIONS(                    2007.01.31 16:02:29   Page     4

OFFSET OBJECT CODE        LINE#  FILE#    P S E U D O   A S S E M B L Y   L I S T I N G
⋮
```

Figure 129. Example of calling a nonexistent subroutine

Figure 130 on page 340 shows the traceback and condition information from the dump.

```
CEE3DMP V1 R9.0: Plidump called from error On-unit                              01/31/07 4:02:32 PM           Page:    1
ASID: 0065   Job ID: J0009417   Job name: LEDGSMP2   Step name: GO        UserID: BARBARA

CEE3845I CEEDUMP Processing started.
PLIDUMP was called from statement number 9 at offset +000000D2 from _ON_Begin_7_Blk_2 with entry address 0B9008A8

Information for enclave EXAMPLE1

  Information for thread 8000000000000000

  Traceback:
    DSA   Entry       E  Offset  Statement   Load Mod             Program Unit                  Service  Status
    1     IBMPDUMP    +000002AE              IBMPEV11                                           PQ78306  Call
    2     _ON_Begin_7_Blk_2
                      +000000D2  9           EXAMPLE1             _ON_Begin_7_Blk_2                   Call
    3     IBMPEONR    +000002A2              IBMPEV11                                           PQ76426  Call
    4     IBMPEBOP    +000004DC              IBMPEV11                                           LE19BAS  Call
    5     CEEEV011    +00000132              IBMPEV11             CEEEV011                              Call
    6     CEEHDSP     +000017D0              CEEPLPKA             CEEHDSP                       D1908    Call
    7     EXAMPLE1    -0B9009A8              EXAMPLE1             _ON_Begin_7_Blk_2                     Exception
    8     IBMPMINV    +000004DE              IBMPEV11             IBMPMINV                              Call
    9     CEEEV011    +00000202              IBMPEV11             CEEEV011                              Call
    10    CEEBBEXT    +000001B6              CEEPLPKA             CEEBBEXT                      D1908    Call

    DSA   DSA Addr   E  Addr    PU Addr    PU Offset  Comp Date  Compile Attributes
    1     0C13DA70   0BBA4E38   0BBA4E38   +000002AE  20061214   LIBRARY   EBCDIC  HFP
    2     0C13D990   0B9008A8   0B9008A8   +000000D2  20070131   ENT PL/I EBCDIC  HFP
    3     0C13D7F8   0BBA7B98   0BBA7B98   +000002A2  20061214   LIBRARY   EBCDIC  HFP
    4     0C13D628   0BBAF390   0BBAF390   +000004DC  20061214   LIBRARY   EBCDIC  HFP
    5     0C13D598   0BB062E8   0BB062E8   +00000132  20061214   LIBRARY
    6     0C13A478   0B9C3238   0B9C3238   +000017D0  20061215   CEL
    7     0C13A3B8   0B9009A8   0B9008A8   -0B9009A8  20070131   ENT PL/I EBCDIC  HFP
    8     0C13A180   0BBDD990   0BBDD990   +000004DE  20061214   LIBRARY
    9     0C13A0F0   0BB062E8   0BB062E8   +00000202  20061214   LIBRARY
    10    0C13A030   0B991208   0B991208   +000001B6  20061215   CEL

  Condition Information for Active Routines
    Condition Information for _ON_Begin_7_Blk_2 (DSA address 0C13A3B8)
      CIB Address: 0C13AD98
      Current Condition:
        CEE3201S The system detected an operation exception (System Completion Code=0C1).
      Location:
        Program Unit: _ON_Begin_7_Blk_2
        Entry:        EXAMPLE1 Statement:  Offset: -0B9009A8
        Possible Bad Branch:  Statement: 12  Offset: +000001AE
      Machine State:
        ILC..... 0002    Interruption Code..... 0001
        PSW..... 078D0600 80000002
        GPR0..... 0C13A3B8  GPR1..... 0B9008A8  GPR2..... 0B911768  GPR3..... 0B9009E2
        GPR4..... 0C13A0D8  GPR5..... 00000000  GPR6..... 0B900DA0  GPR7..... 00000000
        GPR8..... 0B911648  GPR9..... 00000008  GPR10.... 0C13A0B0  GPR11.... 0B900F1C
        GPR12.... 0B9129B0  GPR13.... 0C13A3B8  GPR14.... 8B900A58  GPR15.... 00000000
        FPC...... F0000000
        FPR0..... 26100000  00000000            FPR1..... 00000000  00000000
        FPR2..... 18000000  00000000            FPR3..... 00000000  00000000
        FPR4..... 00000000  00000000            FPR5..... 00000000  00000000
        FPR6..... 00000000  00000000            FPR7..... 00000000  00000000
        FPR8..... 00000000  00000000            FPR9..... 00000000  00000000
        FPR10.... 00000000  00000000            FPR11.... 00000000  00000000
        FPR12.... 00000000  00000000            FPR13.... 00000000  00000000
        FPR14.... 00000000  00000000            FPR15.... 00000000  00000000

    Storage dump near condition, beginning at location: 00000000
      +000000 00000000  Inaccessible storage.
    GPREG STORAGE:
      Storage around GPR0 (0C13A3B8)
       -0020 0C13A398  00000000 00000000 00000000 00000000  00000000 00000000 0C13A124 0C13A128 |................................|
       +0000 0C13A3B8  1013A12C 0C13A180 0C13A138 8B900A30  8BBA4490 0B000000 0C13A3B8 0B911768 |.........................t..j..|
       +0020 0C13A3D8  0B9009E2 0C13A0D8 00000000 0B900DA0  00000000 0B911648 00000000 00000000 |...S...Q.............j..........|
      Storage around GPR1 (0B9008A8)
       -0020 0B900888  36000301 0FCC0000 00240008 C5E7C1D4  D7D3C5F1 0B900DA0 0000016C 00000000 |............EXAMPLE1.......%....|
       +0000 0B9008A8  47F0F022 01C3C5C5 000000E0 00000330  47F0F001 58F0C31C 184E05EF 00000000 |.00..CEE.........00..0C..+......|
       +0020 0B9008C8  07F390E7 D00C58E0 D04C4100 E0E05500  C3144130 F03A4720 F01458F0 C28090F0 |.3.X.....<......C...0...0..0B..0|
      Storage around GPR2 (0B911768)
       -0020 0B911748  00000000 00000000 0B9095A8 0B909500  0B909450 00000000 00000106 00000000 |..........ny..n...m&............|
       +0000 0B911768  8B910E58 00000000 00000000 0B901410  00000000 8B9094C8 00030000 0003000B |.j...................mH........|
       +0020 0B911788  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000 |................................|
```

Figure 130. Sections of the Language Environment dump (Part 1 of 2)

```
Storage around GPR3 (0B9009E2)
 -0020 0B9009C2  05EF0000 000007F3 90E6D00C 58E0D04C  4100E0C0 5500C314 4130F03A 4720F014 |.......3.W.....<......C...0...0.|
 +0000 0B9009E2  58F0C280 90F0E048 9210E000 50D0E004  18DE5860 30AA5800 309E5000 D0984100 |.0B..0..k...&......-......&..q..|
 +0020 0B900A02  00005000 D09C5810 30A25010 D0A04110  60A85010 D0AC181D 5010D0A4 5000D0A8 |..&......s&.....-y&.....&..u&..y|
Storage around GPR4 (0C13A0D8)
 -0020 0C13A0B8  0C13A0E0 0B911780 0C13A0D0 0C13A0D8  0C13A0D4 00000000 0B911768 00000000 |.....j.........Q...M.....j......|
 +0000 0C13A0D8  00000000 00000000 00000001 00000000  00000000 00000000 880062CC 0C13A030 |.....................h.......|
 +0020 0C13A0F8  0C13A180 8BB064EC 0BBDD990 7D000008  0C13A0B0 0C13A0B0 8BB062E8 8B9912EC |..........R.'.............Y.r..|
Storage around GPR5 (00000000)
 +0000 00000000    Inaccessible storage.
 +0020 00000020    Inaccessible storage.
 +0040 00000040    Inaccessible storage.
Storage around GPR6 (0B900DA0)
 -0020 0B900D80  14380000 00000000 0B003203 FFFFFA50  FFFFFFB8 FFFFFAD0 00000000 02000000 |..............&...............|
 +0000 0B900DA0  02020240 00000005 02020240 00000021  00000000 0B900DC0 00000000 0B900DC8 |... ....... ...................H|
 +0020 0B900DC0  00000000 0B900DF8 00000000 0B900DD0  00000000 00000000 31010001 00000000 |.......8........................|
Storage around GPR7 (00000000)
 +0000 00000000    Inaccessible storage.
 +0020 00000020    Inaccessible storage.
 +0040 00000040    Inaccessible storage.
Storage around GPR8 (0B911648)
 -0020 0B911628  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000 |................................|
 +0000 0B911648  C3C5C5C5 C4C24040 C0000001 0B912870  0B911D50 00000000 00000000 00000000 |CEEEDB  .....j...j.&............|
 +0020 0B911668  0B911B58 0B911B88 8B914770 0B911198  00000000 00000000 0B911768 00000000 |.j...j.h.j...j.q........j......|
Storage around GPR9 (00000008)
 -0008 00000000    Inaccessible storage.
 +0018 00000020    Inaccessible storage.
 +0038 00000040    Inaccessible storage.
Storage around GPR10(0C13A0B0)
 -0020 0C13A090  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000 |................................|
 +0000 0C13A0B0  0B9914D0 0B900F1C 0C13A0E0 0B911780  0C13A0D0 0C13A0D8 0C13A0D4 00000000 |.r..........j.........Q...M....|
 +0020 0C13A0D0  0B911768 00000000 00000000 00000000  00000001 00000000 00000000 00000000 |.j..............................|
Storage around GPR11(0B900F1C)
 -0020 0B900EFC  00220000 00000000 0B900E48 0B900AA0  00000000 00000000 00000000 01000001 |................................|
 +0000 0B900F1C  0B9009A8 0B901410 00000000 18AF47F0  A016C3C5 C5D6D7C9 D7C9F1F2 61F1F561 |...y..........0..CEEOPIPI12/15/|
 +0020 0B900F3C  F0F65830 20005830 30009547 30004770  A06895CE 30054770 A0365830 300847F0 |06........n.......n............0|
Storage around GPR12(0B9129B0)
 -0020 0B912990  00000000 00000000 C3C5C5C3 C1C14040  00000000 00000000 000058C0 D0640CCC |........CEECAA  ................|
 +0000 0B9129B0  00000800 00000000 0C13A018 0C15A018  00000000 00000000 00000000 00000000 |................................|
 +0020 0B9129D0  00000000 00000000 0B90FA58 00000000  00000000 00000000 00000000 00000000 |................................|
Storage around GPR13(0C13A3B8)
 -0020 0C13A398  00000000 00000000 00000000 00000000  00000000 00000000 0C13A124 0C13A128 |................................|
 +0000 0C13A3B8  1013A12C 0C13A180 0C13A138 8B900A30  8BBA4490 0B000000 0C13A3B8 0B911768 |.......................t..j..|
 +0020 0C13A3D8  0B9009E2 0C13A0D8 00000000 0B900DA0  00000000 0B911648 00000000 00000000 |...S...Q.............j..........|
Storage around GPR14(0B900A58)
 -0020 0B900A38  9230D0B1 581030B2 180D5010 D0B45000  D0B84400 C1AC58F0 30B64400 C1C005EF |k.........&...&.....A..0....A...|
 +0000 0B900A58  4400C1C4 4400C1AC 4400C1B4 58F030BA  05EF4400 C1B858D0 D00458E0 D00C9826 |..AD..A...A..0......A.........q.|
 +0020 0B900A78  D01C051E 07070000 00100000 00180180  0B000000 0B900DA0 0B901438 0B9008A8 |................................y|
Storage around GPR15(00000000)
 +0000 00000000    Inaccessible storage.
 +0020 00000020    Inaccessible storage.
 +0040 00000040    Inaccessible storage.
⋮
```

Figure 130. Sections of the Language Environment dump (Part 2 of 2)

To understand the traceback and debug this example routine, use the following steps:

1. Find the Current Condition message in the Condition Information for Active Routines section of the dump. The message is `CEE3201S  The system detected an Operation exception.` For more information about this message, see *z/OS Language Environment Run-Time Messages*.

   This section of the dump also provides such information as the name of the active routine and the current statement number at the time of the dump. The Location section indicates that the exception occurred at offset X'-0B9009A8' within entry EXAMPLE1 and that there may have been a bad branch from offset X'+000001AE' statement 12 within entry EXAMPLE1 .
2. Locate statement 12 in the routine (Figure 129 on page 339). This statement calls subroutine Prog01. The message CEE3201S, which indicates an operations exception, was generated because of an unresolved external reference.

3. Check the linkage editor output for error messages.

Divide-by-zero error

Figure 131 demonstrates a divide-by-zero error. In this example, the main Enterprise PL/I routine passed bad data to an Enterprise PL/I subroutine. The bad data in this example is 0, and the error occurred when the subroutine SUB1 attempted to use this data as a divisor.

```
5655-H31  IBM(R) Enterprise PL/I for z/OS       V3.R6.M0 (Built:20070119)             2007.01.31 16:02:31   Page     1
                  Options Specified
  Install:
  Command:
  Line.File Process Statements
     1.0    *PROCESS  GONUMBER LIST S STG TEST MAP;
  Install:
5655-H31  IBM(R) Enterprise PL/I for z/OS       SAMPLE: PROC  OPTIONS(MAI             2007.01.31 16:02:31   Page     2
 Compiler Source
    Line.File
       2.0      SAMPLE: PROC  OPTIONS(MAIN) ;
       3.0           On error
       4.0             begin;
       5.0               On error system;        /* prevent nested error conditions */
       6.0               Call PLIDUMP('TBC','PLIDUMP called from error ON-unit');
      7.0                Put Data;               /* Display variables */
       8.0           End;
       9.0
      10.0           DECLARE
      11.0             A_number    Fixed Bin(31),
      12.0             My_Name     Char(13),
      13.0             An_Array(3) Fixed Bin(31) init(1,3,5);
      14.0
      15.0           Put skip list('Sample Starting');
      16.0           A_number = 0;
      17.0           My_Name = 'Tery Gillaspy';
      18.0
      19.0           Call Sub1(a_number, my_name, an_array);
      20.0
      21.0         SUB1:  PROC(divisor, name1, Array1);
      22.0              Declare
      23.0               Divisor   Fixed Bin(31),
      24.0               Name1     Char(13),
      25.0               Array1(3) Fixed Bin(31);
      26.0               Put skip list('Sub1 Starting');
      27.0               Array1(1) = Array1(2) / Divisor;
      28.0               Put skip list('Sub1 Ending');
      29.0         End SUB1;
      30.0
      31.0           Put skip list('Sample Ending');
      32.0
      33.0       End;
⋮
```

Figure 131. Enterprise PL/I routine with a divide-by-zero error

Since variables are not normally displayed in a PLIDUMP dump, this routine included a PUT DATA statement, which generated a listing of arguments and variables used in the routine. Figure 132 shows this output.

```
1Sample Starting
 Sub1 Starting        A_NUMBER=            0 MY_NAME='Tery Gillaspy' AN_ARRAY(1)=  1
 AN_ARRAY(2)=          3                     AN_ARRAY(3)=             5;
```

Figure 132. Variables from routine SAMPLE

The routine in Figure 131 on page 342 was compiled with the LIST compiler option, which generated the object code listing shown in Figure 133.

```
⋮
5655-H31  IBM(R) Enterprise PL/I for z/OS    SAMPLE: PROC  OPTIONS(MAI  : SUB1       2007.01.31 16:02:31   Page     5

OFFSET OBJECT CODE       LINE#  FILE#    P S E U D O   A S S E M B L Y   L I S T I N G

000000                   000021 |        SUB1     DS    0D
000000  47F0  F022       000021 |                 B     34(,r15)
000004  01C3C5C5                                       CEE eyecatcher
000008  00000160                                       DSA size
00000C  00000848                                       =A(PPA1-SUB1)
⋮
000136  5820  D14C       000027 |                 L     r2,#SR_PARM_3(,r13,332)
00013A  5820  2008       000027 |                 L     r2,_addrARRAY1(,r2,8)
00013E  5840  2000       000027 |                 L     r4,_shadow1(,r2,0)
000142  5820  D14C       000027 |                 L     r2,#SR_PARM_3(,r13,332)
000146  5820  2008       000027 |                 L     r2,_addrARRAY1(,r2,8)
00014A  5820  2004       000027 |                 L     r2,_shadow1(,r2,4)
00014E  5040  D150       000027 |                 ST    r4,#wtemp_1(,r13,336)
000152  5020  D144       000027 |                 ST    r2,_temp15(,r13,324)
000156  5820  D144       000027 |                 L     r2,_temp15(,r13,324)
00015A  5850  2004       000027 |                 L     r5,_shadow2(,r2,4)
00015E  5840  D150       000027 |                 L     r4,#wtemp_1(,r13,336)
000162  5820  D144       000027 |                 L     r2,_temp15(,r13,324)
000166  5820  2000       000027 |                 L     r2,_shadow2(,r2,0)
00016A  1382             000027 |                 LCR   r8,r2
00016C  5820  D14C       000027 |                 L     r2,#SR_PARM_3(,r13,332)
000170  5820  2008       000027 |                 L     r2,_addrARRAY1(,r2,8)
000174  5890  2000       000027 |                 L     r9,_shadow1(,r2,0)
000178  5820  D14C       000027 |                 L     r2,#SR_PARM_3(,r13,332)
00017C  5820  2008       000027 |                 L     r2,_addrARRAY1(,r2,8)
000180  5820  2004       000027 |                 L     r2,_shadow1(,r2,4)
000184  5090  D154       000027 |                 ST    r9,#wtemp_2(,r13,340)
000188  1E58             000027 |                 ALR   r5,r8
00018A  4145  4000       000027 |                 LA    r4,#AddressShadow(r5,r4,0)
00018E  5040  D158       000027 |                 ST    r4,#wtemp_3(,r13,344)
000192  5020  D140       000027 |                 ST    r2,_temp14(,r13,320)
000196  5820  D140       000027 |                 L     r2,_temp14(,r13,320)
00019A  5840  2004       000027 |                 L     r4,_shadow2(,r2,4)
00019E  8940  0001       000027 |                 SLL   r4,1
0001A2  5820  D154       000027 |                 L     r2,#wtemp_2(,r13,340)
0001A6  5850  D140       000027 |                 L     r5,_temp14(,r13,320)
0001AA  5850  5000       000027 |                 L     r5,_shadow2(,r5,0)
0001AE  1355             000027 |                 LCR   r5,r5
0001B0  1E45             000027 |                 ALR   r4,r5
0001B2  5884  2000       000027 |                 L     r8,_shadow2(r4,r2,0)
0001B6  5820  D14C       000027 |                 L     r2,#SR_PARM_3(,r13,332)
0001BA  5820  2000       000027 |                 L     r2,_addrDIVISOR(,r2,0)
0001BE  5820  2000       000027 |                 L     r2,_shadow2(,r2,0)
0001C2  8E80  0020       000027 |                 SRDA  r8,32
0001C6  1D82             000027 |                 DR    r8,r2
0001C8  1849             000027 |                 LR    r4,r9
0001CA  5820  D158       000027 |                 L     r2,#wtemp_3(,r13,344)
0001CE  5040  2000       000027 |                 ST    r4,_shadow2(,r2,0)
⋮
```

Figure 133. Object code listing from example Enterprise PL/I routine

Figure 134 on page 344 shows the Language Environment dump for routine SAMPLE.

```
CEE3DMP V1 R9.0: PLIDUMP called from error ON-unit                              01/31/07 4:02:34 PM                 Page:    1
ASID: 0142   Job ID: J0009418   Job name: LEDGSMP3   Step name: GO        UserID: BARBARA

CEE3845I CEEDUMP Processing started.
PLIDUMP was called from statement number 6 at offset +000000D4 from _ON_Begin_4_Blk_2 with entry address 11200340

Information for enclave SAMPLE

  Information for thread 8000000000000000

  Traceback:
    DSA   Entry       E  Offset  Statement   Load Mod            Program Unit                  Service  Status
    1     IBMPDUMP    +000002AE              IBMPEV11                                          PQ78306  Call
    2     _ON_Begin_4_Blk_2
                      +000000D4  6           SAMPLE              SUB1                                   Call
    3     IBMPEONR    +000002A2              IBMPEV11                                          PQ76426  Call
    4     IBMPEBOP    +000004DC              IBMPEV11                                          LE19BAS  Call
    5     CEEEV011    +00000132              IBMPEV11            CEEEV011                              Call
    6     CEEHDSP     +000017D0              CEEPLPKA            CEEHDSP                       D1908    Call
    7     SUB1        +000001C6  27          SAMPLE              SUB1                                   Exception
    8     SAMPLE      +000001CA  19          SAMPLE              SUB1                                   Call
    9     IBMPMINV    +000004DE              IBMPEV11            IBMPMINV                              Call
    10    CEEEV011    +00000202              IBMPEV11            CEEEV011                              Call
    11    CEEBBEXT    +000001B6              CEEPLPKA            CEEBBEXT                      D1908    Call

    DSA   DSA Addr   E  Addr    PU Addr    PU Offset  Comp Date  Compile Attributes
    1     11A3ED08   114A5E38   114A5E38   +000002AE  20061214   LIBRARY   EBCDIC  HFP
    2     11A3EBB0   11200340   112000D0   +00000344  20070131   ENT PL/I EBCDIC  HFP
    3     11A3EA18   114A8B98   114A8B98   +000002A2  20061214   LIBRARY   EBCDIC  HFP
    4     11A3E848   114B0390   114B0390   +000004DC  20061214   LIBRARY   EBCDIC  HFP
    5     11A3E7B8   114072E8   114072E8   +00000132  20061214   LIBRARY
    6     11A3B698   112C4238   112C4238   +000017D0  20061215   CEL
    7     11A3B538   112000D0   112000D0   +000001C6  20070131   ENT PL/I EBCDIC  HFP
    8     11A3B3B8   112004B8   112000D0   +000005B2  20070131   ENT PL/I EBCDIC  HFP
    9     11A3B180   114DE990   114DE990   +000004DE  20061214   LIBRARY
    10    11A3B0F0   114072E8   114072E8   +00000202  20061214   LIBRARY
    11    11A3B030   11292208   11292208   +000001B6  20061215   CEL

  Condition Information for Active Routines
    Condition Information for SUB1 (DSA address 11A3B538)
      CIB Address: 11A3BFB8
      Current Condition:
        IBM0281S A prior condition was promoted to the ERROR condition.
      Original Condition:
        CEE3209S The system detected a fixed-point divide exception (System Completion Code=0C9).
      Location:
        Program Unit: SUB1 Entry: SUB1 Statement: 27 Offset: +000001C6
      Machine State:
        ILC..... 0002    Interruption Code..... 0009
        PSW..... 078D2600 91200298
        GPR0..... 00000001  GPR1..... 00004A48  GPR2..... 00000000  GPR3..... 1120010A
        GPR4..... 00000004  GPR5..... FFFFFFFC  GPR6..... 11200BA8  GPR7..... 11200748
        GPR8..... 00000000  GPR9..... 00000003  GPR10.... 11A3B0B0  GPR11.... 11200FE4
        GPR12.... 112139B0  GPR13.... 11A3B538  GPR14.... 912001FE  GPR15.... 1153CF40
        FPC...... F0000000
        FPR0..... 26100000  00000000            FPR1..... 00000000  00000000
        FPR2..... 18000000  00000000            FPR3..... 00000000  00000000
        FPR4..... 00000000  00000000            FPR5..... 00000000  00000000
        FPR6..... 00000000  00000000            FPR7..... 00000000  00000000
        FPR8..... 00000000  00000000            FPR9..... 00000000  00000000
        FPR10.... 00000000  00000000            FPR11.... 00000000  00000000
        FPR12.... 00000000  00000000            FPR13.... 00000000  00000000
        FPR14.... 00000000  00000000            FPR15.... 00000000  00000000

    Storage dump near condition, beginning at location: 11200286
      +000000 11200286  5820D14C 58202000 58202000 8E800020  1D821849 5820D158 50402000 4400C1AC  |..J<.............b....J.& ....A.|
⋮
```

Figure 134. Language Environment dump from example Enterprise PL/I routine (Part 1 of 2)

```
  Control Blocks for Active Routines:
⋮
    DSA for CEEHDSP: 11A3B698
      +000000  FLAGS.... 0808      member... CEE1      BKC...... 11A3B538  FWC...... 11A3E7B8  R14...... 912C5A0A
      +000010  R15...... 914072E8  R0....... 00000010  R1....... 1120C2E8  R2....... 11A3BFB8  R3....... 11A3B3B8
      +000024  R4....... 112C8E64  R5....... FFFFFF30  R6....... 00000001  R7....... 00000007  R8....... 912C5712
      +000038  R9....... 11A3D696  R10...... 11A3C697  R11...... 112C4238  R12...... 112139B0  reserved. 00000000
      +00004C  NAB...... 11A3E7B8  PNAB..... 11A3B874  reserved. 11A3B9D8  00000000
      +000064  reserved. 11A3BE58  reserved. 00000000  MODE..... 00000000  reserved. 00000000
      +000078  reserved. 00000000  reserved. 00000000

    DSA for SUB1: 11A3B538
      +000000  FLAGS.... 10A3      member... B0F0      BKC...... 11A3B3B8  FWC...... 11A3B5F8  R14...... 912001FE
      +000010  R15...... 11537648  R0....... 11A3B668  R1....... 11A3B5D0  R2....... 00000001  R3....... 1120010A
      +000024  R4....... 00004A48  R5....... 11A3B3B8  R6....... 11200BA8  R7....... 11200748  R8....... 11A3B528
      +000038  R9....... 11A3B484  R10...... 11A3B0B0  R11...... 11200FE4  R12...... 112139B0  reserved. 00000000
      +00004C  NAB...... 11A3B698  PNAB..... 00000000  reserved. 00000000  00000000
      +000064  reserved. 00000000  reserved. 00000002  MODE..... 1120ADB0  reserved. 00000000
      +000078  reserved. 00000000  reserved. 112D96E0
    CIB for SUB1: 11A3BFB8
      +000000 11A3BFB8  C3C9C240 00000000 00000000 010C0004  00000001 00000000 00030119 59C9C2D4  |CIB .....................IBM|
      +000020 11A3BFD8  00000000 11A3C0C8 00030C89 59C3C5C5  00000001 00000005 11A3B3B8 914072E8  |.....t.H...i.CEE.........t..j .Y|
      +000040 11A3BFF8  00000000 11A3B538 11200298 1120C6F0  0000000B 11A3B538 00000000 00000000  |.....t.....q..F0.....t.........|
      +000060 11A3C018  00000000 00000000 11A64240 00000015  00000011 00000001 117537B0 00000011  |.........w. ....................|
      +000080 11A3C038  11200FE4 112139B0 00000000 11A3C0B0  114F9EBA 11A3C138 114F4338 00000007  |...U.........t...|...tA..|......|
      +0000A0 11A3C058  00000000 11A3C0F8 11A3C104 004F4327  44230000 940C9000 00000009 00000000  |.....t.8.tA..|......m...........|
      +0000C0 11A3C078  00000000 11200918 11A3B538 11A3B538  11200296 00000000 0000000A 00000001  |.........t...t.....o............|
      +0000E0 11A3C098  11A3B3B8 0000000B 00000064 00000014  00000003 00000000 10000000 00000000  |.t.............................|
      +000100 11A3C0B8  00000000 1120C908 11A3C104 11A3C0F8  E9D4C3C8 02000001 00000001 00004A48  |......I..tA..t.8ZMCH............|
    Dynamic save area (SUB1): 11A3B538
      +000000 11A3B538  10A3B0F0 11A3B3B8 11A3B5F8 912001FE  11537648 11A3B668 11A3B5D0 00000001  |.t.0.t...t.8j........t...t......|
      +000020 11A3B558  1120010A 00004A48 11A3B3B8 11200BA8  11200748 11A3B528 11A3B484 11A3B0B0  |.........t.....y.....t...t.d.t..|
      +000040 11A3B578  11200FE4 112139B0 00000000 11A3B698  00000000 00000000 00000000 00000000  |...U.........t.q................|
      +000060 11A3B598  00000000 00000000 00000002 1120ADB0  00000000 80010000 00000000 112D96E0  |.............................o.|
      +000080 11A3B5B8  00000000 00000000 00000000 00000000  00000000 00000000 11A3B668 00000000  |.........................t......|
      +0000A0 11A3B5D8  00000000 00000000 00180280 11A3B538  11A3B460 11200EE8 11A3B520 11A3B528  |............t...t.-...Y.t...t..|
      +0000C0 11A3B5F8  11A3B484 00000001 00000000 00000000  00000000 000005D8 112008D8 112008A4  |.t.d...................Q...Q...u|
      +0000E0 11A3B618  11200BC8 9153CE54 115476F8 00004A48  4A480100 01A30000 11A5CB38 00000001  |...Hj......8.........t...v......|
      +000100 11A3B638  11A5CB38 00000000 11200748 11212648  00000008 11A3B0B0 11200FE4 40404040  |.v..................t.....U    |
      +000120 11A3B658  00000000 11A3B7E0 40404040 40404040  40404040 11200CBC 11A3B5FC 40404040  |.....t..            .....t..    |
      +000140 11A3B678  11200C50 11200C50 11A3B3B8 11A3B450  11A3B498 11A3B498 11A3B498 00000010  |...&...&.t...t.&.t.q.t.q.t.q....|
    DSA for SAMPLE: 11A3B3B8
      +000000  FLAGS.... 10A3      member... B12C      BKC...... 11A3B180  FWC...... 11A3B138  R14...... 91200684
      +000010  R15...... 112000D0  R0....... 11A3B520  R1....... 11A3B450  R2....... 00000001  R3....... 112004F2
      +000024  R4....... 00004A48  R5....... 11A3B3B8  R6....... 11200BA8  R7....... 11200748  R8....... 11A3B528
      +000038  R9....... 11A3B484  R10...... 11A3B0B0  R11...... 11200FE4  R12...... 112139B0  reserved. 00000000
      +00004C  NAB...... 11A3B538  PNAB..... 00000000  reserved. 00000000  00000000
      +000064  reserved. 00000000  reserved. 00000000  MODE..... 00000000  reserved. 00000000
      +000078  reserved. 00000000  reserved. 00000000
    Dynamic save area (SAMPLE): 11A3B3B8
      +000000 11A3B3B8  10A3B12C 11A3B180 11A3B138 91200684  112000D0 11A3B520 11A3B450 00000001  |.t...t...t..j..d.....t...t.&....|
      +000020 11A3B3D8  112004F2 00004A48 11A3B3B8 11200BA8  11200748 11A3B528 11A3B484 11A3B0B0  |...2.....t.....y.....t...t.d.t..|
      +000040 11A3B3F8  11200FE4 112139B0 00000000 11A3B538  00000000 00000000 00000000 00000000  |...U.........t..................|
      +000060 11A3B418  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
      +000080 11A3B438  00000000 00000000 00000000 00000000  00000000 00000000 11A3B484 11A3B528  |.........................t.d.t..|
      +0000A0 11A3B458  11A3B520 00000000 00100000 00000000  00180180 11A3B3B8 00000000 11200E68  |.t...................t.........|
      +0000C0 11A3B478  0B300000 11200340 11A3B3B8 00000000  E38599A8 40C78993 9381A297 A8000000  |....... .t......Tery Gillaspy...|
      +0000E0 11A3B498  00000001 00000003 00000005 00000001  88000000 11A3B030 11A3B7D8 9140755E  |................h....t...t.Qj .;|
      +000100 11A3B4B8  112008A8 112008A4 11200BD0 11A3B0F0  914072E8 112014D8 4A480100 01000000  |...y...u.....t.0j .Y...Q........|
      +000120 11A3B4D8  11A5CB38 00000001 112014D8 00000000  11A3B308 112139B0 00000000 11A3B538  |.v.........Q.....t...........t..|
      +000140 11A3B4F8  00000000 00000000 00000000 00000000  00000000 00000000 00000000 11200CBC  |................................|
      +000160 11A3B518  11A3B4A4 00000000 11A3B498 11200C50  11A3B488 000D0002 11A3B4A0 00000000  |.t.u.....t.q...&.t.h.....t......|
    ENTERPRISE PL/I OPTIONS:
     AFP, ARCH( 5), BACKREG(5), BIFPREC(15), CHECK(NOCONFORMANCE, NOSTORAGE), CMPAT(V2), CODEPAGE( 1140), COMMON,
     NOCOMPACT, CSECT, CSECTCUT( 4) CURRENCY( $), NODBCS, DECIMAL( FOFLONASGN, NOFORCEDSIGN), DEFAULT( IBM, ASSIGNABLE,
     NOINITFILL, NONCONNECTED, DESCRIPTOR, DESCLOCATOR, DUMMY(ALIGNED), ORDINAL(MIN), BYADDR, RETURNS(BYADDR),
     LINKAGE(OPTLINK), NORETCODE, NOINLINE, ORDER, NOOVERLAP, NONRECURSIVE, ALIGNED, NULL370, EVENDEC, SHORT(HEXADEC),
     EBCDIC, HEXADEC, NATIVE, NATIVEADDR, E(HEXADEC) ), DISPLAY(WTO), NODLLINIT, EXTRN(FULL), NOGRAPHIC, NOINITAUTO,
     NOINITBASED, NOINITCTL, NOINITSTATIC, NOINTERRUPT, LIMITS( EXTNAME( 7), FIXEDBIN( 31, 31), FIXEDDEC( 15, 15), NAME( 100
     )), OPTIMIZE( 0), PREFIX( CONVERSION, FIXEDOVERFLOW, INVALIDOP, OVERFLOW, PRECTYPE(ANS), NOSIZE, NOSTRINGRANGE,
     NOSTRINGSIZE, NOSUBSCRIPTRANGE, UNDERFLOW, ZERODIVIDE), REDUCE, NORENT, RESEXP, RESPECT(), RULES(IBM), NOSTDSYS,
     NOSCHEDULER, STRINGOFGRAPHIC(GRAPHIC), SYSTEM(MVS), TEST(ALL ,SYM ,HOOK ,NOSEPARATE), TUNE( 5), USAGE( ROUND(IBM),
     UNSPEC(IBM)), WIDECHAR(BIGENDIAN), WINDOW( 1950), WRITABLE, XINFO(NODEF, NOXML)
    Static for procedure SAMPLE    Timestamp: 2007.01.31 16:02:31 V03.R06.M00: 11200BA8
      +000000 11200BA8  11201750 11200CBC 000D0002 00000000  02020240 00000003 02020240 0000000B  |...&.............. ....... ....|
      +000020 11200BC8  02020240 0000000D 02020240 0000000F  02020240 00000021 00000000 11200C00  |... ....... ....... ............|
      +000040 11200BE8  00000000 11200CA8 00000000 11200E18  00000000 11200C00 00000000 11200C08  |.......y........................|
      +000060 11200C08  00000000 00000000 31010001 00000000  00000000 00000000 31000001 00000000  |................................|
⋮
```

Figure 134. Language Environment dump from example Enterprise PL/I routine (Part 2 of 2)

To understand the dump information and debug this routine, use the following steps:

1. Notice the title of the dump: `PLIDUMP called from error ON-unit`. This was the title specified when PLIDUMP was invoked, and it indicates that the ERROR condition was raised and PLIDUMP was called from within the ERROR ON-unit.
2. Locate the messages in the Condition Information section of the dump.

   There are two messages. The current condition message indicates that a prior condition was promoted to the ERROR condition. The promotion of a condition occurs when the original condition is left unhandled (no Enterprise PL/I ON-units are assigned to gain control). The original condition message is `CEE3209S  The system detected a fixed-point divide exception`. The original condition usually indicates the actual problem. For more information about this message, see *z/OS Language Environment Run-Time Messages*.
3. In the traceback section, note the sequence of calls in the call chain. SAMPLE called SUB1 at statement 19, and SUB1 raised an exception at statement 27, PU offset X'1C6'.
4. Find the statement in the listing for SUB1 that raised the ZERODIVIDE condition. If SUB1 was compiled with GOSTMT and SOURCE, find statement 27 in the source listing.

   Since the object listing was generated in this example, you can also locate the actual assembler instruction causing the exception at offset X'1C6' in the object listing for this routine, shown in Figure 133 on page 343. Either method shows that *divisor* was loaded into register 2 (r2) and used as the divisor in a divide operation.
5. You can see from the declaration of SUB1 that *divisor* is a parameter passed from SAMPLE. Because of linkage conventions, you can infer that register 1 in the SAMPLE save area points to a parameter list that was passed to SUB1. *divisor* is the first parameter in the list.
6. In the SAMPLE DSA, the R1 value is X'11A3B450'. This is the address of the parameter list, which is located in static storage.
7. Find the parameter list in the stack frame; the address of the first parameter is X'11A3B484' and the value of the first parameter is X'00000000'. Thus, the exception occurred when SAMPLE passed a 0 value used as a divisor in subroutine SUB1.

Chapter 9. Debugging under CICS

This chapter provides information for debugging under the Customer Information Control System (CICS). The following sections explain how to access debugging information under CICS, and describe features unique to debugging under CICS.

Use the following list as a quick reference for debugging information:
- Language Environment run-time messages (CESE transient data queue)
- Language Environment traceback (CESE transient data queue)
- Language Environment dump output (CESE transient data queue)
- CICS Transaction Dump (CICS DFHDMPA or DFHDMPB data set)
- Language Environment abend and reason codes (system console)
- Language Environment return codes to CICS (system console)

If the EXEC CICS HANDLE ABEND command is active and the application, or CICS, initiates an abend or application interrupt, then Language Environment does not produce any run-time messages, tracebacks, or dumps.

If EXEC CICS ABEND NODUMP is issued, then no Language Environment dumps or CICS transaction dumps are produced.

Accessing debugging information

The following sections list the debugging information available to CICS users, and describe where you can find this information.

Under CICS, the Language Environment run-time messages, Language Environment traceback, and Language Environment dump output are written to the CESE transient data queue. The transaction identifier, terminal identifier, date, and time precede the data in the queue. For detailed information about the format of records written to the transient data queue, see *z/OS Language Environment Programming Guide*.

The CESE transient data queue is defined in the CICS destination control table (DCT). The CICS macro DFHDCT is used to define entries in the DCT. See *CICS Resource Definition Guide* for a detailed explanation of how to define a transient data queue in the DCT. If you are not sure how to define the CESE transient data queue, see your system programmer.

Locating Language Environment run-time messages

Under CICS, Language Environment run-time messages are written to the CESE transient data queue. A sample Language Environment message that appears when an application abends due to an unhandled condition from an EXEC CICS command is:

```
P039UTV9 19910916145313 CEE3250C The System or User ABEND AEI0 was issued.
P039UTV9 19910916145313          From program unit UT9CVERI at entry point UT9CVERIT
                                 +0000011E at P039UTV9 19910916145313
                                 at offset address 0006051E.
```

Locating the Language Environment traceback

Under CICS, the Language Environment traceback is written to the CESE transient data queue. Because Language Environment invokes your application routine, the Language Environment routines that invoked your routine appear in the traceback. Figure 135 on page 348 shows an example Language Environment traceback

© Copyright IBM Corp. 1991, 2009

written to the CESE transient data queue. Data unnecessary for this example has been replaced by ellipses.

```
CEE3211S The system detected a decimal-divide exception (System Completion Code=0CB).
          From compile unit DIVZERO2 at entry point DIVZERO2 at compile unit offset +0000039A
          at entry offset +0000039A at address
          262E139A.
 CEE3DMP V1 R9.0: Condition processing resulted in the unhandled condition. 01/16/07 6:07:22 PM  Page:1
 Task Number: 0860   Transaction ID: DIVZ

 CEE3845I CEEDUMP Processing started.

 Information for enclave DIVZERO2

   Information for thread 8000000000000000

   Traceback:
     DSA   Entry       E  Offset  Statement   Load Mod             Program Unit      Service  Status
     1     CEEHDSP     +000049D6                                  CEEHDSP           D1908    Call
     2     IGZCDSP     -007BDDF6                                  IGZCDSP                    Call
     3     DIVZERO2    +0000039A                                  DIVZERO2                   Exception
     4     IGZCEV5     +0000066A                                  IGZCEV5                    Call
     5     CEECRINV    +00000480                                  CEECRINV          D1908    Call
     6     CEECRINI    +00000AF6                                  CEECRINI          D1908    Call

     DSA   DSA Addr   E  Addr    PU Addr    PU Offset  Comp Date  Compile Attributes
     1     2610CDB0   266BDB08   266BDB08   +000049D6  20061215   CEL
     2     26108B90   26E72398   26E72398   -007BDDF6  20061213   LIBRARY
     3     26109BA8   262E1000   262E1000   +0000039A  ********   COBOL
     4     261089B8   25DDE000   25DDE000   +0000066A  20061213   LIBRARY
     5     26108810   266B6DE0   266B6DE0   +00000480  20061215   CEL
     6     26108790   266B60B8   266B60B8   +00000AF6  20061214   CEL

   Condition Information for Active Routines
     Condition Information for DIVZERO2 (DSA address 26109BA8)
       CIB Address: 2610D6D0
       Current Condition:
         CEE3211S The system detected a decimal-divide exception (System Completion Code=0CB).
       Location:
         Program Unit: DIVZERO2 Entry: DIVZERO2 Statement:  Offset: +0000039A
       Machine State:
         ILC..... 0006    Interruption Code..... 000B
         PSW..... 079D0000 A62E13A0
         GPR0..... 00000000  GPR1..... 262E11E1  GPR2..... 000617FC  GPR3..... A62E1366
         GPR4..... 262E1054  GPR5..... 00000000  GPR6..... 26105778  GPR7..... 25DDEFFF
         GPR8..... 261031B8  GPR9..... 26109DB0  GPR10.... 262E1088  GPR11.... 262E1262
         GPR12.... 262E1080  GPR13.... 26109BA8  GPR14.... A62E1374  GPR15.... A6E72398

     Storage dump near condition, beginning at location: 262E138A
       +000000 262E138A  92409169 D2CC916A 9169D201 D180A155  FD10D180 A157F300 9090D180 96F09090 =>
       |k j.K.j.j.K.J.....J...3...J.o0..|
     GPREG STORAGE:
       Storage around GPR0 (00000000)
         +0000 00000000    Inaccessible storage.
         +0020 00000020    Inaccessible storage.
         +0040 00000040    Inaccessible storage.
.
.
.
```

Figure 135. Language Environment traceback written to the transient data queue

Locating the Language Environment dump

Under CICS, the Language Environment dump output is written to the CESE transient data queue. For active routines, the Language Environment dump contains the traceback, condition information, variables, storage, and control block information for the thread, enclave, and process levels. Use the Language Environment dump with the CICS transaction dump to locate problems when operating under CICS.

For a sample Language Environment dump, see “Understanding the Language Environment dump” on page 43.

Using CICS transaction dump

The CICS transaction dump is generated to the DFHDMPA or DFHDMPB data set. The offline CICS dump utility routine converts the transaction dump into formatted, understandable output.

The CICS transaction dump contains information for the storage areas and resources associated with the current transaction. This information includes the Communication Area (COMMAREA), Transaction Work Area (TWA), Exec Interface Block (EIB), and any storage obtained by the CICS EXEC commands. This information does not appear in the Language Environment dump. It can be helpful to use the CICS transaction dump with the Language Environment dump to locate problems when operating under CICS.

When the location of an error is uncertain, it can be helpful to insert EXEC CICS DUMP statements in and around the code suspected of causing the problem. This generates CICS transaction dumps close to the error for debugging reference.

For information about interpreting CICS dumps, see *CICS Problem Determination Guide*

Using CICS register and program status word contents

When a routine interrupt occurs (code = ASRA) and a CICS dump is generated, CICS formats the contents of the program status word (PSW) and the registers at the time of the interrupt. This information is also contained in the CICS trace table entry marked `SSRP * EXEC* – ABEND DETECTED`. For the format of the information contained in this trace entry, see *CICS Data Areas*, KERRD - KERNEL ERROR DATA.

The address of the interrupt can be found from the second word of the PSW, giving the address of the instruction following the point of interrupt. The address of the entry point of the function can be subtracted from this address. The offset compared to this listing gives the statement that causes the interrupt.

For C routines, you can find the address of the entry point in register 3.

If register 15 is corrupted, the contents of the first load module of the active enclave appear in the program storage section of the CICS transaction dump.

Using Language Environment abend and reason codes

An application can end with an abend in two ways:

- User-specified abend (that is, an abend requested by the assembler user exit or the ABTERMENC run-time option).
- Language Environment-detected unrecoverable error (in which case there is no Language Environment condition handling).

When Language Environment detects an unrecoverable error under CICS, Language Environment terminates the transaction with an EXEC CICS abend. The abend code has a number between 4000 and 4095. A write-to-operator (WTO) is performed to write a CEE1000S message to the system console. This message contains the abend code and its associated reason code. The WTO is performed only for unrecoverable errors detected by Language Environment. No WTO occurs for user-requested abends.

Although this type of abend is performed only for unrecoverable error conditions, an abend code of 4000–4095 does not necessarily indicate an internal error within Language Environment. For example, an application routine can write a variable outside its storage and corrupt the Language Environment control blocks.

Possible causes of a 4000–4095 abend are corrupted Language Environment control blocks and internal Language Environment errors. For more information about abend codes 4000–4095, see *z/OS Language Environment Run-Time Messages*. Following is a sample Language Environment abend and reason code. Abend codes appear in decimal, and reason codes appear in hexadecimal.

```
12.34.27 JOB05585  IEF450I XCEPII03 GO CEPII03 - ABEND=S000 U4094 REASON=0000002C
```

Using Language Environment return codes to CICS

When the Language Environment condition handler encounters a severe condition that is specific to CICS, the condition handler generates a CICS-specific return code. This return code is written to the system console.

Possible causes of a Language Environment return code to CICS are:

- Incorrect region size
- Incorrect DCT
- Incorrect CSD definitions

For a list of the reason codes written only to CICS, see *z/OS Language Environment Run-Time Messages*. Following is a sample of a return code that was returned to CICS

```
 +DFHAP1200I
LE03CC01 A CICS request to Language Environment has failed.  Reason
code '0012030'.
```

Activating Language Environment feature trace records under CICS

Activating Language Environment feature trace records under CICS will allow users to monitor and determine the activity of a transaction. By activating the feature trace records, Level 2 trace points are added insideLanguage Environment at these significant points:

- Event Handle
- Set anchor
- Gives R13 and parameters before call

These trace points are useful for any support personnel that needs to know what happpened inside Language Environment from a CICS call.

The function will be enabled by the existing CICS transactions. A user must enable the AP domain level 2 in order to include the Language Environment trace points. For more information on activating the CICS trace, see *CICS Diagnosis Reference*.

Every time CICS calls Language Environment, the feature trace is activated under the Extended Run-Time Library Interface (ERTLI). The trace can bee seen in CICS transaction dumps. Feature trace entries are formatted in a similar way to CICS trace items. There are three formats: ABBREV, SHORT & FULL. The ABBREV version just formats the heading line for each trace point and is laid out in a similar way to CICS trace entries. For example,

```
00036 1 AP 1940 APLI  ENTRY START_PROGRAM         NAMETEST,CEDF,FULLAPI,EXEC,NO,0678FABC,00000000 , 00000000,1,NO          =000334=
00036 1 AP 1948 APLI  EVENT CALL-TO-LE/370        Thread_Initialization NAMETEST                                           =000339=
00036 1 AP 1949 APLI  EVENT RETURN-FROM-LE/370    Thread_Initialization OK NAMETEST                                        =000340=
00036 1 AP 1948 APLI  EVENT CALL-TO-LE/370        Rununit_Initialization NAMETEST                                          =000343=
00036 1 FT 1014 Lang.Env. CEEZCREN EVENT CEEEVNT-ID(PRCINIT)   R13(06C00E10), 00000000                                     =000344=
00036 1 FT 1013 Lang.Env. CEEZCREN EVENT CEEEVNT-ID(OPTP)      R13(06C00E10), 06C049B0, 07500F28, 06C0403C, 06C010B4       =000345=
00036 1 FT 1101 Lang.Env. CEECRINI EVENT SET_ANCHOR            R13(06C009B8), 06C06180, 00000002                        =000346=
00036 1 FT 1018 Lang.Env. CEEZINV  EVENT CEEEVNT-ID(ENCINIT)   R13(06C06D80), 00000000, 06C0403C, 00000000, 06C041B4, 00000 =000347=
00036 1 FT 1008 Lang.Env. CEECRINV EVENT CEEEVNT-ID(MAININV)   R13(06C06D80), 87500020, 00000001, 00000000, 00140050, 87500 =000348=
00036 1 AP 1948 APLI  EVENT CALL-TO-LE/370        Rununit_End_Invocation NAMETEST                                          =000386=
00036 1 AP 1949 APLI  EVENT RETURN-FROM-LE/370    Rununit_End_Invocation OK NAMETEST                                       =000387=
00036 1 AP 1948 APLI  EVENT CALL-TO-LE/370        Rununit_Termination NAMETEST                                             =000388=
00036 1 FT 1012 Lang.Env. CEEZDSEX EVENT CEEEVNT-ID(ENCTERM)   R13(06C06D80), 06C0403C, 00000000                          =000389=
00036 1 FT 1102 Lang.Env. CEECRTRM EVENT SET_ANCHOR            R13(06C009B8), 00000000                                  =000390=
00036 1 AP 1949 APLI  EVENT RETURN-FROM-LE/370    Rununit_Termination OK NAMETEST                                          =000391=
00036 1 AP 1948 APLI  EVENT CALL-TO-LE/370        Thread_Termination                                                       =000392=
00036 1 FT 1009 Lang.Env. CEEZDSPR EVENT CEEEVNT-ID(PRCTERM)   R13(06C00A80), 00000000                                     =000393=
00036 1 AP 1949 APLI  EVENT RETURN-FROM-LE/370    Thread_Termination OK                                                    =000394=
00036 1 AP 1941 APLI  EXIT  START_PROGRAM/OK      ....,NO,NAMETEST                                                         =000395=
```

Figure 136. CICS trace output in the ABBREV format.

The Domain Name field is replaced with a ″Feature″ short name (for example, Lang.Env.) and module name (for example, CEE.....) which are coded into the ″Feature Trace″ initialization (short name) and header formatting call (module name). See the following macro example.

The FULL version includes the heading from the ABBREV version and then dumps each captured block in Hex and Character formats. For example:

```
AP 1948 APLI EVENT CALL-TO-LE/370 - Rununit_Initialization    Program_name(NAMETEST)

              TASK-00036 KE_NUM-0026 TCB-006FA1D0 RET-868218FE TIME-05:58:55.2643333923 INTERVAL-00.0000020781    =000343=
                1-0000  0000001E                                                        *....                          *
                2-0000  06878DE0 00140148 0005848C 0014014C  00045A4C 00140130 0014001C 067F3CE8  *.g.\......d....<..!<.........".Y*
                  0020  0678FAD8 06878F37 867F3DD0                                      *...Q.g..f".}                  *
                3-0000  D5C1D4C5 E3C5E2E3                                              *NAMETEST                      *
                4-0000  00000030 20000000 07500000 00001B00  87500020 00000000 06C03800 00000000  *.........&......g&.......{......*
                  0020  00140050 00000000 00000000 0678FABC                            *...&............              *

FT Lang.Env.  1014 CEEZCREN EVENT - CEEEVNT-ID(PRCINIT)   R13(06C00E10), PARMS(00000000)

              TASK-00036 KE_NUM-0026 TCB-006FA1D0 RET-06F092A0 TIME-05:58:55.2643970329 INTERVAL-00.0000636406    =000344=
                  0000  0000C9C2 D4404040 40404040 40404040  40404040 40404040 40404040 40404040  *..IBM                         *
                  0020  D3819587 A4818785 40C595A5 89999695  948595A3 40404040 40404040 4040F0F0  *Language Environment          00*
                  0040  F0F0F0F0 F0F0F0F1 C3C5C5C3 E3C6D4E3  D3819587 4BC595A5 4B000000          *00000001CEECTFMTLang.Env....    *
                1-0000  06C00E10 00000011 00000000                                      *.{.........                   *

FT Lang.Env.  1013 CEEZCREN EVENT - CEEEVNT-ID(OPTP)      R13(06C00E10), PARMS(06C049B0, 07500F28, 06C0403C, 06C010B4)

              TASK-00036 KE_NUM-0026 TCB-006FA1D0 RET-06F0A23A TIME-05:58:55.2644148454 INTERVAL-00.0000178125    =000345=
                  0000  0000C9C2 D4404040 40404040 40404040  40404040 40404040 40404040 40404040  *..IBM                         *
                  0020  D3819587 A4818785 40C595A5 89999695  948595A3 40404040 40404040 4040F0F0  *Language Environment          00*
                  0040  F0F0F0F0 F0F0F0F1 C3C5C5C3 E3C6D4E3  D3819587 4BC595A5 4B000000          *00000001CEECTFMTLang.Env....    *
                1-0000  06C00E10 00000004 06C049B0 07500F28  06C0403C 06C010B4                *.{.......{...&...{ ..{..       *

FT Lang.Env.  1101 CEECRINI EVENT - SET_ANCHOR R13(06C009B8), PARMS(06C06180, 00000002)

              TASK-00036 KE_NUM-0026 TCB-006FA1D0 RET-06F02F90 TIME-05:58:55.2644493767 INTERVAL-00.0000345312    =000346=
                  0000  0000C9C2 D4404040 40404040 40404040  40404040 40404040 40404040 40404040  *..IBM                         *
                  0020  D3819587 A4818785 40C595A5 89999695  948595A3 40404040 40404040 4040F0F0  *Language Environment          00*
                  0040  F0F0F0F0 F0F0F0F1 C3C5C5C3 E3C6D4E3  D3819587 4BC595A5 4B0092B4          *00000001CEECTFMTLang.Env..k.    *
                1-0000  06C009B8 06C06180 00000002                                      *.{...{/.....                  *

FT Lang.Env.  1018 CEEZINV  EVENT - CEEEVNT-ID(ENCINIT)   R13(06C06D80), PARMS(00000000, 06C0403C, 00000000, 06C041B4, 00000000,
                                    01000000, 00000000, 00000000)

              TASK-00036 KE_NUM-0026 TCB-006FA1D0 RET-06F0C9B4 TIME-05:58:55.2644710798 INTERVAL-00.0000217031    =000347=
                  0000  000AC9C2 D4404040 40404040 40404040  40404040 40404040 40404040 40404040  *..IBM                         *
                  0020  D3819587 A4818785 40C595A5 89999695  948595A3 40404040 40404040 4040F0F0  *Language Environment          00*
                  0040  F0F0F0F0 F0F0F0F1 C3C5C5C3 E3C6D4E3  D3819587 4BC595A5 4B0072B4          *00000001CEECTFMTLang.Env....    *
                1-0000  06C06D80 00000012 00000000 06C0403C  00000000 06C041B4 00000000 01000000  *.{_.........{ ......{.........*
                  0020  00000000 00000000                                                *........                      *
                2-0000  D8C3C5E2 C9000000 00000000 00000000  D8C3C5E2 D6000000 00000000 00000000  *QCESI...........QCESO...........*
                  0020  D8C3C5E2 C5000000 00000000 00000000                              *QCESE...........              *

FT Lang.Env.  1008 CEECRINV EVENT - CEEEVNT-ID(MAININV)   R13(06C06D80), PARMS(87500020, 00000001, 00000000, 00140050, 87500020)

              TASK-00036 KE_NUM-0026 TCB-006FA1D0 RET-06F038D2 TIME-05:58:55.2645123298 INTERVAL-00.0000412500    =000348=
                  0000  0000C9C2 D4404040 40404040 40404040  40404040 40404040 40404040 40404040  *..IBM                         *
                  0020  D3819587 A4818785 40C595A5 89999695  948595A3 40404040 40404040 4040F0F0  *Language Environment          00*
                  0040  F0F0F0F0 F0F0F0F1 C3C5C5C3 E3C6D4E3  D3819587 4BC595A5 4B000000          *00000001CEECTFMTLang.Env....    *
                1-0000  06C06D80 0000000E 87500020 00000001  00000000 00140050 87500020          *.{_.....g&.............&g&..    *

AP 1948 APLI EVENT CALL-TO-LE/370 - Rununit_End_Invocation    Program_name(NAMETEST)

              TASK-00036 KE_NUM-0026 TCB-006FA1D0 RET-868218FE TIME-05:58:55.2670554079 INTERVAL-00.0000107187    =000386=
                1-0000  00000021                                                        *....                          *
                2-0000  06878DEC 00140148 0005848C 0014014C  00045A4C 00140130 0014001C 067F3CE8  *.g........d....<..!<.........".Y*
                  0020  0678FAD8 80140390                                              *...Q....                      *
                3-0000  D5C1D4C5 E3C5E2E3                                              *NAMETEST                      *
                4-0000  40000000 00000000 D5C1D4C5 0000036C  D3F3F2F1 00000005 00000000 00000000  * .......NAME...%L321............*
                  0020  00000000 001402FC 00000000 00000000  00000000 00000000 00000000 00000000  *..............................*
```

Figure 137. CICS trace output in the FULL format.

The first block is used for the feature trace information. It contains the name of the off-line formatting module and the short name used in the formatted heading line. The other 6 blocks are available for user data.

The SHORT version is a cross between the ABBREV and FULL versions.

For more information about the CICS trace, see *CICS Diagnosis Reference*.

Ensuring transaction rollback

If your application does not run to normal completion and there is no CICS transaction abend, take steps to ensure that transaction rollback (the backing out of any updates made by the malfunctioning application) takes place.

There are two ways to ensure that a transaction rollback occurs when an unhandled condition of severity 2 or greater is detected:

- Use the ABTERMENC run-time option with the ABEND suboption (ABTERMENC(ABEND))
- Use an assembler user exit that requests an abend for unhandled conditions of severity 2 or greater

The IBM-supplied assembler user exit for CICS (CEECXITA), available in the Language Environment SCEESAMP sample library, ensures that a transaction abend and rollback occur for all unhandled conditions of severity 2 or greater. For more information about the assembler user exit, see "Invoking the assembler user exit" on page 23 and *z/OS Language Environment Programming Guide*.

Finding data when Language Environment returns a nonzero return code

Language Environment does not write any messages to the CESE transient data queue. Following is the output generated when Language Environment returns a nonzero reason code to CICS and the location where the output appears:

Table 23. Finding data when Language Environment returns a nonzero return code

Output Message	Location	Issued By
DFHAC2206 14:43:54 LE03CC01 Transaction UTV2 has failed with abend AEC7. Resource backout was successful.	User's terminal	CICS
DFHAP1200I LE03CC01 A CICS request to the Language Environment has failed. Reason code '0012030'.	System console	CICS
DFHAC2236 06/05/91 14:43:48 LE03CC01 Transaction UTV2 abend AEC7 in routine UT2CVERI term P021 backout successful.	Transient data queue CSMT	CICS

Finding data when Language Environment abends internally

Language Environment does not write any messages to the CESE transient data queue. Following is the output generated when Language Environment abends internally and the location where the output appears:

Table 24. Finding data when Language Environment abends internally

Output Message	Location	Issued By
DFHAC2206 14:35:24 LE03CC01 Transaction UTV8 has failed with abend 4095. Resource backout was successful.	User's terminal	CICS
CEE1000S LE INTERNAL abend. ABCODE = 00000FFF REASON = 00001234	System console	Language Environment

Table 24. Finding data when Language Environment abends internally (continued)

Output Message	Location	Issued By
DFHAC2236 06/05/91 14:35:24 LE03CC01 Transaction UTV8 abend 4095 in routine UT8CVERI term P021 backout successful.	Transient data queue CSMT	CICS

Finding data when Language Environment abends from an EXEC CICS command

This section shows the output generated when an application abends from an EXEC CICS command and the location where the output appears.

This error assumes the use of Language Environment run-time option TERMTHDACT(MSG).

Table 25. Finding data when Language Environment abends from an EXEC CICS command

Output Message	Location	Issued By
DFHAC2206 14:35:34 LE03CC01 Transaction UTV8 has failed with abend AEI. Resource backout was successful.	User's terminal	CICS
No message.	System console	CICS
DFHAC2236 06/05/91 14:35:17 LE03CC01 Transaction UTV9 abend AEI0 in routine UT9CVERI term P021 backout successful.	Transient data queue CSMT	CICS
P021UTV9 091156 143516 CEE3250C The System or User Abend AEI0 was issued.	Transient data queue CESE	Language Environment

Displaying and modifying run-time options with the CLER transaction

The CICS transaction (CLER) allows you to display all the current Language Environment run-time options for a region, and to also have the capability to modify a subset of these options.

The CLER transaction can be used to:

- Display the current run-time options in effect for the region.
- Modify the following subset of the region run-time options:
  - ALL31(ON|OFF)
  - CBLPSHPOP(ON|OFF)
  - CHECK(ON|OFF)
  - INFOMSGFILTER(ON|OFF)
  - RPTOPTS(ON|OFF)
  - RPTSTG(ON|OFF)
  - TERMTHDACT(QUIET|MSG|TRACE|DUMP|UAONLY|UATRACE|UADUMP|UAIMM)
  - TRAP(ON|OFF)
- Write the current region run-time options to the CESE queue for printing.

The CLER transaction is conversational; it presents the user with commands for the terminal display. The run-time options that can be modified with this transaction are only in effect for the duration of the running region.

The CLER transaction must be defined in the CICS CSD (CICS System Definition file). The following definitions are required, and are in the Language Environment CEECCSD job in the SCEESAMP data set:

```
DEFINE PROGRAM(CEL4RTO) GROUP(CEE) LANGUAGE(ASSEMBLER) EXECKEY(CICS)
DEFINE MAPSET(CELCLEM) GROUP(CEE)
DEFINE MAPSET(CELCLRH) GROUP(CEE)
DEFINE TRANS(CLER) PROG(CEL4RTO) GROUP(CEE)
```

Use the CEECCSD job to activate these definitions, or you must define them dynamically with the CICS CEDA transaction.

Note: If the run-time option ALL31 is modified to OFF, the stack is forced to BELOW. When the stack is modified to BELOW, it will remain below for the duration of the region, even if you set ALL31 back to ON. A warning message, asking if you want to continue, is presented on the panel if the run-time option ALL31 is set to OFF or CBLPSHPOP, RPTOPTS, and RPTSTG are set to ON.

To send the run-time option report to the CESE queue for output display or printing, press `PF10` on the panel which displays the run-time option report.

For detailed information on the use of CLER, select `PF1` from the main menu that is displayed when the CLER transaction is invoked.

Part 3. Debugging Language Environment AMODE 64 applications

This part provides specific information for debugging applications written to make use of the memory address space above the 2 GB bar.

© Copyright IBM Corp. 1991, 2009

Chapter 10. Preparing your AMODE 64 application for debugging

This chapter describes options and features that you can use to prepare your AMODE 64 application for debugging. The following topics are covered:

- Compiler options for C, C++
- Language Environment run-time options
- Use of storage in routines
- Options for modifying exception handling
- Assembler user exits
- Enclave termination behavior
- Language Environment feedback codes and condition tokens

Setting compiler options

The following sections discuss language-specific compiler options important to debugging routines in Language Environment. These sections cover only the compiler options that are important to debugging. For a complete list of compiler options, see the appropriate HLL publications.

The use of some compiler options (such as DEBUG) can affect the performance of your routine. You must set these options before you compile. In some cases, you might need to remove the option and recompile your routine before delivering your application.

XL C and XL C++ compiler options for AMODE 64 applications

When compiling an application using the LP64 compiler option, you cannot use the TEST compiler option. You must instead use the DEBUG(FORMAT(DWARF)) compiler option.

When the GONUMBER compiler option is used with LP64, it will produce executables with additional debug information. This is used by Language Environment to produce statement numbers in the Language Environment dump (CEEDUMP). Statement numbers in the CEEDUMP are also produced if the DEBUG compiler option or the `c89 -g` option is used.

For a detailed explanation of the debugging options for XL C/C++ and Inter-procedural Analysis (IPA), see *z/OS XL C/C++ User's Guide* and *z/OS XL C/C++ Programming Guide*.

Using Language Environment run-time options

There are several run-time options that affect debugging in Language Environment. The TEST run-time option, for example, can be used with a debugging tool to specify the level of control in effect for the debugging tool when the routine being initialized is started. The DYNDUMP, HEAPCHK, TERMTHDACT, TRACE, and TRAP options affect exception handling.

The following Language Environment run-time options affect debugging:

CEEDUMP Specifies options to control the processing of the Language Environment dump report.

© Copyright IBM Corp. 1991, 2009

DYNDUMP	Provides a way to obtain IPCS readable dumps of user applications that would ordinarily be lost due to the absence of a SYSMDUMP, SYSUDUMP, or SYSABEND DD statement
HEAPCHK	Determines whether additional heap check tests are performed.
INFOMSGFILTER	Filters user specified informational messages from stderr. **Note:** Affects only those messages generated by Language Environment and any routine that calls `__le_msg_get_and_write()`. Other routines that write to stderr, such as `__le_msg_write()`, do not have a filtering option.
PROFILE	Controls the use of an optional profiler tool, which collects performance data for the running application. When this option is in effect, the profiler is loaded and the debugger cannot be loaded. If the TEST option is in effect when PROFILE is specified, the profiler tool will not be loaded.
RPTOPTS	Causes a report to be produced which contains the run-time options in effect. See “Determining run-time options in effect” below.
RPTSTG	Generates a report of the storage used by an enclave. See “Controlling storage allocation” on page 361.
STORAGE	Specifies that Language Environment initializes all heap and stack storage to a user-specified value.
TERMTHDACT	Controls response when an enclave terminates due to an unhandled condition of severity 2 or greater.
TEST	Specifies the conditions under which a debugging tool assumes control.
TRACE	Activates Language Environment run-time library tracing and controls the size of the trace table, the type of trace, and whether the trace table should be dumped unconditionally upon termination of the application.
TRAP	When TRAP is set to ON, Language Environment traps routine interrupts and abends, and optionally prints trace information or invokes a user-written exception handling routine. With TRAP set to OFF, the operating system handles all interrupts and abends. You should generally set TRAP to ON, or your run-time results can be unpredictable.

For a more detailed discussion of these run-time options, see *z/OS Language Environment Programming Reference*.

Determining run-time options in effect

The run-time options in effect at the time the routine is run can affect routine behavior. Use RPTOPTS(ON) to generate an options report in the Language Environment message file when your routine terminates. The options report lists run-time options, and indicates where they were set.

Figure 138 on page 361 shows a sample options report.

```
Options Report for Enclave main Fri Dec 19 19:21:04 2008
  Language Environment V01 R11.00
  LAST WHERE SET                OPTION
  ------------------------------------------------------------------------------
  Installation default            ENVAR("")
  PARMLIB(CEEPRMPV)               ENVAR("AA1="Report 1")
  Installation default            FILETAG(NOAUTOCVT,NOAUTOTAG)
  PARMLIB(CEEPRMPV)               HEAPCHK(OFF,1,0,0,0,1024,0,1024,0)
  Installation default            HEAPPOOLS(OFF,8,10,32,10,128,10,
                                  256,10,1024,10,2048,10,0,10,0,10,
                                  0,10,0,10,0,10,0,10)
  Installation default            HEAPPOOLS64(OFF,8,4000,32,2000,128,700,
                                  256,350,1024,100,2048,50,3072,50,4096,50,
                                  8192,25,16384,10,32768,5,65536,5)
  PARMLIB(CEEPRMPV)               HEAP64(6M,1M,KEEP,32768,32768,KEEP,
                                  4096,4096,FREE)
  Installation default            INFOMSGFILTER(OFF,,,,)
  Installation default            IOHEAP64(1M,1M,FREE,12288,8192,FREE,
                                  4096,4096,FREE)
  Invocation command              LIBHEAP64(1M,1M,FREE,32763,8192,FREE,
                                  8192,4096,FREE)
  Installation default            NATLANG(ENU)
  Invocation command              POSIX(ON)
  Installation default            PROFILE(OFF,"")
  DD:CEEOPTS                      RPTOPTS(ON)
  SETCEE command                  RPTSTG(ON)
  Installation default            STACK64(1M,1M,128M)
  Installation default            STORAGE(NONE,NONE,NONE,)
  Installation default            TERMTHDACT(TRACE,,96)
  Installation default            NOTEST(ALL,"*","PROMPT","INSPPREF")
  Installation default            THREADSTACK64(OFF,1M,1M,128M)
  Installation default            TRACE(OFF,4096,DUMP,LE=0)
  Installation default            TRAP(ON,SPIE)
```

Figure 138. 64–bit options report

Controlling storage allocation

The following run-time options control storage allocation:

- HEAP64
- HEAPPOOLS
- HEAPPOOLS64
- IOHEAP64
- LIBHEAP64
- STACK64
- THREADSTACK64

z/OS Language Environment Programming Guide for 64-bit Virtual Addressing Mode provides useful tips to assist with the tuning process. Appropriate tuning is necessary to avoid performance problems.

To generate a report of the storage a routine (or more specifically, an enclave) used during its run, specify the RPTSTG(ON) run-time option. The storage report, generated during enclave termination provides statistics that can help you understand how space is being consumed as the enclave runs. If storage management tuning is desired, the statistics can help you set the corresponding storage-related run-time options for future runs.

Figure 139 on page 362 shows a sample storage report.

```
Storage Report for Enclave main Fri Dec  19 16:52:36 2008
Language Environment V01 R11.00

    STACK64 statistics:
      Initial size:                                          1M
      Increment size:                                        1M
      Maximum used by all concurrent threads:                1M
      Largest used by any thread:                            1M
      Number of increments allocated:                        0
    THREADSTACK64 statistics:
      Initial size:                                          1M
      Increment size:                                        1M
      Maximum used by all concurrent threads:                0M
      Largest used by any thread:                            0M
      Number of increments allocated:                        0
    64bit User HEAP statistics:
      Initial size:                                          1M
      Increment size:                                        1M
      Total heap storage used:                           983808
      Suggested initial size:                                1M
      Successful Get Heap requests:                         11
      Successful Free Heap requests:                         0
      Number of segments allocated:                          0
      Number of segments freed:                              0
    31bit User HEAP statistics:
      Initial size:                                      32768
      Increment size:                                    32768
      Total heap storage used (sugg. initial size):     243352
      Successful Get Heap requests:                         58
      Successful Free Heap requests:                         0
      Number of segments allocated:                          9
      Number of segments freed:                              0
    24bit User HEAP statistics:
      Initial size:                                       4096
      Increment size:                                     4096
      Total heap storage used (sugg. initial size):          0
      Successful Get Heap requests:                          0
      Successful Free Heap requests:                         0
      Number of segments allocated:                          0
      Number of segments freed:                              0
    64bit Library HEAP statistics:
      Initial size:                                          1M
      Increment size:                                        1M
      Total heap storage used:                         3795584
      Suggested initial size:                                4M
      Successful Get Heap requests:                        384
      Successful Free Heap requests:                       337
      Number of segments allocated:                          2
      Number of segments freed:                              0
    31bit Library HEAP statistics:
      Initial size:                                      16384
      Increment size:                                     8192
      Total heap storage used (sugg. initial size):          0
      Successful Get Heap requests:                          0
      Successful Free Heap requests:                         0
      Number of segments allocated:                          0
      Number of segments freed:                              0
```

Figure 139. 64–bit storage report (Part 1 of 4)

```
 24bit Library HEAP statistics:
   Initial size:                                          8192
   Increment size:                                        4096
   Total heap storage used (sugg. initial size):             0
   Successful Get Heap requests:                             0
   Successful Free Heap requests:                            0
   Number of segments allocated:                             0
   Number of segments freed:                                 0
64bit I/O HEAP statistics:
   Initial size:                                            1M
   Increment size:                                          1M
   Total heap storage used:                                  0
   Suggested initial size:                                  1M
   Successful Get Heap requests:                             0
   Successful Free Heap requests:                            0
   Number of segments allocated:                             0
   Number of segments freed:                                 0
 31bit I/O HEAP statistics:
   Initial size:                                         12288
   Increment size:                                        8192
   Total heap storage used (sugg. initial size):          9616
   Successful Get Heap requests:                            27
   Successful Free Heap requests:                           19
   Number of segments allocated:                             1
   Number of segments freed:                                 0
 24bit I/O HEAP statistics:
   Initial size:                                          4096
   Increment size:                                        4096
   Total heap storage used (sugg. initial size):          3032
   Successful Get Heap requests:                            14
   Successful Free Heap requests:                            6
   Number of segments allocated:                             1
   Number of segments freed:                                 0
 HEAPPOOLS Statistics:
   Pool  1     size:     8 Get Requests:               0
   Pool  2     size:    32 Get Requests:               1
     Successful Get Heap requests:    17-   24                   1
   Pool  3     size:   128 Get Requests:               0
   Pool  4     size:   256 Get Requests:               0
   Pool  5.1   size:  1024 Get Requests:             225
   Pool  5.2   size:  1024 Get Requests:               0
   Pool  5.3   size:  1024 Get Requests:               0
     Successful Get Heap requests:   273-  280                 225
   Pool  6     size:  2048 Get Requests:               0
   Requests greater than the largest cell size:                0
 HEAPPOOLS Summary:
   Specified  Element  Extent   Cells Per  Extents    Maximum      Cells In
   Cell Size  Size     Percent  Extent     Allocated  Cells Used   Use
   ------------------------------------------------------------------------
        8        16     10         409          0          0           0
       32        40     10         163          1          1           1
      128       136     10          48          0          0           0
      256       264     10          24          0          0           0
     1024      1032     10           4         57        225         225
     1024      1032     10           4          0          0           0
     1024      1032     10           4          0          0           0
     2048      2056     10           4          0          0           0
   ------------------------------------------------------------------------
   Suggested Percentages for current Cell Sizes:
     HEAPP(ON,8,1,32,1,128,1,256,1,(1024,3),90,2048,1,0)
   Suggested Cell Sizes:
     HEAPP(ON,24,,280,,2048,,0)
```

Figure 139. 64–bit storage report (Part 2 of 4)

```
HEAPPOOLS64 Statistics:
  Pool  1     size:     8 Get Requests:                2
    Successful Get Heap requests:     1-    8                     2
  Pool  2     size:    32 Get Requests:              240
    Successful Get Heap requests:     9-   16                    12
    Successful Get Heap requests:    17-   24                   227
    Successful Get Heap requests:    25-   32                     1
    Successful Get Heap requests:    33-   40                     4
    Successful Get Heap requests:    41-   48                     1
    Successful Get Heap requests:    49-   56                     1
    Successful Get Heap requests:    57-   64                     4
    Successful Get Heap requests:    65-   72                     3
    Successful Get Heap requests:    73-   80                     7
    Successful Get Heap requests:    81-   88                     2
    Successful Get Heap requests:    89-   96                    88
    Successful Get Heap requests:   105-  112                     3
    Successful Get Heap requests:   113-  120                     8
    Successful Get Heap requests:   121-  128                     4
  Pool  4     size:   256 Get Requests:               53
    Successful Get Heap requests:   129-  136                     2
    Successful Get Heap requests:   137-  144                     2
    Successful Get Heap requests:   145-  152                     2
    Successful Get Heap requests:   153-  160                     8
    Successful Get Heap requests:   161-  168                     1
    Successful Get Heap requests:   169-  176                     2
    Successful Get Heap requests:   177-  184                     3
    Successful Get Heap requests:   185-  192                     6
    Successful Get Heap requests:   193-  200                     5
    Successful Get Heap requests:   201-  208                     5
    Successful Get Heap requests:   209-  216                     2
    Successful Get Heap requests:   217-  224                     1
    Successful Get Heap requests:   225-  232                     5
    Successful Get Heap requests:   233-  240                     6
    Successful Get Heap requests:   249-  256                     3
  Pool  5.1   size:  1024 Get Requests:                2
  Pool  5.2   size:  1024 Get Requests:                2
  Pool  5.3   size:  1024 Get Requests:                0
    Successful Get Heap requests:   281-  288                     2
    Successful Get Heap requests:   521-  528                     1
    Successful Get Heap requests:   713-  720                     1
  Pool  6     size:  2048 Get Requests:                2
    Successful Get Heap requests:  1505- 1512                     1
    Successful Get Heap requests:  1641- 1648                     1
  Pool  7     size:  3072 Get Requests:                2
    Successful Get Heap requests:  2073- 2080                     1
    Successful Get Heap requests:  2105- 2112                     1
  Pool  8     size:  4096 Get Requests:                1
    Successful Get Heap requests:  3681- 3688                     1
  Pool  9     size:  8192 Get Requests:                0
  Pool 10     size: 16384 Get Requests:                0
  Pool 11     size: 32768 Get Requests:                0
  Pool 12     size: 65536 Get Requests:                0
  Requests greater than the largest cell size:                 0
```

Figure 139. 64–bit storage report (Part 3 of 4)

```
    HEAPPOOLS64 Summary:
      Specified  Element    Cells Per   Extents    Maximum       Cells In
      Cell Size  Size       Extent      Allocated  Cells Used    Use
      ------------------------------------------------------------------
            8         32         4000           1           1           0
           32         48         2000           1         226         225
          128        144          700           1          83          77
          256        272          350           1           1           0
         1024       1040           34           1           2           2
         1024       1040           34           1           2           0
         1024       1040           34           0           0           0
         2048       2064           50           1           2           2
         3072       3088           50           1           2           2
         4096       4112           50           1           1           0
         8192       8208           25           0           0           0
        16384      16400           10           0           0           0
        32768      32784            5           0           0           0
        65536      65552            5           0           0           0
      ------------------------------------------------------------------
      Suggested Cell Sizes:
        HP64(ON,
             40,,80,,96,,128,,168,,224,,
             288,,528,,720,,1648,,2112,,3688,)
    Largest number of threads concurrently active:                 6
End of Storage Report
```

Figure 139. 64–bit storage report (Part 4 of 4)

Storage statistics for AMODE 64 applications

The statistics for initial and incremental allocations of storage types that have a corresponding run-time option differ from the run-time option settings when their values have been rounded up by the implementation, or when allocations larger than the amounts specified were required during execution. See the descriptions of the run-time options in *z/OS Language Environment Programming Reference* for information about rounding.

Stack storage statistics for AMODE 64 applications

Language Environment stack storage is managed at the thread level—each thread has its own stack-type resources.

STACK64 and THREADSTACK64 statistics:

- Initial size—the actual size of the initial stack area assigned to each thread. If a pthread-attributes-table is provided on the invocation of pthread-create, the stack size specified in the pthread-attributes-table takes precedence over the stack run-time options.
- Increment size—the size of each incremental stack area made available, as determined by the increment portion of the corresponding run-time option.
- Maximum used by all concurrent threads—the maximum amount allocated in total at any one time by all concurrently executing threads.
- Largest used by any thread—the largest amount allocated ever by any single thread.
- Number of increments allocated—the number of incremental segments allocated by all threads.

Determining the applicable threads: If the application is not a multithreading application, the STACK64 statistics are for the one and only thread that executed, and the THREADSTACK64 statistics are all zero.

If the application is a multithreading application, and THREADSTACK64 was not suppressed, the STACK64 statistics are for the initial thread (IPT), and the THREADSTACK64 statistics are for the other threads. However, if THREADSTACK64 was suppressed, the STACK64 statistics are for all of the threads, initial and other.

Allocating stack storage: The allocation of the stack for each thread, including the initial processing thread (IPT), is part of a storage request to the system when the thread is first created. Other storage, not part of the stack, is also acquired at this time. These storage allocations are not shown in the storage report. The size of the stack portion of this storage is the stack maximum size plus a one megabyte (1M) guard area. After allocation, the guard area follows the stack initial size and runs through the end of the stack maximum size plus the 1M guard area. Increments to the stack for each thread do not result in additional storage requests to the system. They result in the movement of the beginning of the guard area no further than the maximum size of the stack. The stack initial, increment, and maximum sizes are controlled through the STACK64 and THREADSTACK64 run-time options.

Heap storage statistics

Language Environment heap storage is managed at the enclave level. Each enclave has its own heap type resources, which are shared by the threads that execute within the enclave. The heap resources have 64-bit, 31-bit, and 24-bit addressable areas, each of which can be tuned separately.

HEAP64, LIBHEAP64, and IOHEAP64 statistics:

- Initial size—the default initial allocation, as specified by the corresponding run-time option.
- Increment size—the minimum incremental allocation, as specified by the corresponding run-time option.
- Total heap storage used—the largest total amount used by the enclave at any one time.
- Successful Get Heap requests—the number of get heap requests.
- Successful Free Heap requests—the number of free heap requests.
- Number of segments allocated—the number of incremental segments allocated.
- Number of segments freed—the number of incremental segments individually freed.

The number of Free Heap requests could be less than the number of Get Heap requests if the pieces of heap storage acquired by individual Get Heap requests were not explicitly freed, but were freed implicitly during enclave termination. The number of incremental segments individually freed could be less than the number allocated if the segments were not explicitly freed, but were freed implicitly during enclave termination. The initial segment is included in *Number of segments allocated* for each 31-bit and 24-bit addressable heap resource, and for the 64-bit addressable IOHEAP64 resource. A disposition of KEEP always causes 0 to be reported for the *Number of segments freed*. These statistics, in all cases, specify totals for the entire enclave.

Heap pools storage statistics

The HEAPPOOLS and HEAPPOOLS64 run-time options for C/C++ applications only controls usage of the heap pools storage algorithm at the enclave level. The heap pools algorithm allows for the definition of one to twelve heap pools, each consisting of a number of storage cells of a specified length. For further details regarding heap pools storage statistics in the storage report, see “Language Environment storage report with heap pools statistics” on page 516.

Modifying exception handling behavior

Setting the exception handling behavior of your routine affects the response that occurs when the routine encounters an error.

You can modify exception handling behavior in the following ways:

- Application program interfaces (API)
- User-written exception handlers
- POSIX functions (used to specifically set signal actions and signal masks)

Language Environment application program interfaces (API)

You can use the following APIs to modify exception handling:

__cabend()	Terminates an enclave using an abend.
__le_cib_get()	Returns a pointer to a condition information block (CIB) associated with a given condition token. The CIB contains detailed information about the condition.
__set_exception_handler()	Activates a routine to handle an exception.
__reset_exception_handler()	Removes handling of an exception by any routine.

Language Environment run-time options

These Language Environment run-time options can affect your routine’s exception handling behavior:

TERMTHDACT Sets the level of information that is produced when a condition of severity 2 or greater remains unhandled within the enclave. The possible parameter settings for different levels of information are:

- QUIET for no information
- MSG for message only
- TRACE for message and a traceback
- DUMP for message, traceback, and Language Environment dump
- UAONLY for message and a system dump of the user address space
- UATRACE for message, Language Environment dump with traceback information only, and a system dump of the user address space
- UADUMP for message, traceback, Language Environment dump, and system dump
- UAIMM for a system dump of the user address space of the original abend or program interrupt prior to the Language Environment condition manager processing the condition.

TRAP(ON) Fully enables the Language Environment exception handler. This causes the Language Environment exception handler to intercept error conditions and routine interrupts.

When TRAP(ON, NOSPIE) is specified, Language Environment handles all program interrupts and abends through an ESTAE. Use this feature when you do not want Language Environment to issue an ESPIE macro.

During normal operation, you should use TRAP(ON) when running your applications.

TRAP(OFF) Disables the Language Environment condition handler from handling abends and program checks/interrupts. ESPIE is not issued with TRAP(OFF).

Specify TRAP(OFF) when you do not want Language Environment to issue an ESPIE.

When TRAP(OFF), TRAP(OFF,SPIE), or TRAP(OFF,NOSPIE) is specified and either a program interrupt or abend occurs, the user exit for termination is ignored.

TRAP(OFF) can cause several unexpected side effects. It is not supported in AMODE 64 production execution.

For further information, see the TRAP run-time option in *z/OS Language Environment Programming Reference*.

Customizing exception handlers

User-written exception handlers permit you to customize exception handling for certain conditions. You can register a user-written exception handler for the current stack frame by using the `__set_exception_handler()` API.

For more information about user-written exception handlers and the Language Environment condition manager, see *z/OS XL C/C++ Programming Guide*.

Using condition information

If a condition that might require attention occurs while an application is running, Language Environment builds a condition token. The condition token contains 16 bytes (128 bits) of information about the condition that Language Environment or your routines can use to respond appropriately. Each condition is associated with a single Language Environment run-time message.

You can use this condition information in two ways:

- To specify the feedback code parameter when calling Language Environment services (see “Using the feedback code parameter”).
- To code a symbolic feedback code in a user-written exception handler (see “Using the symbolic feedback code” on page 370).

Using the feedback code parameter

The feedback code is an optional parameter of the Language Environment APIs. For C/C++ applications, this parameter is optional. For more information about **feedback codes** and condition tokens, see *z/OS Language Environment Programming Guide for 64-bit Virtual Addressing Mode*.

When you provide the feedback code (**fc**) parameter, the API in which the condition occurs sets the feedback code to a specific value called a condition token.

The condition token does not apply to asynchronous signals. For a discussion of the distinctions between synchronous signals and asynchronous signals with POSIX(ON), see *z/OS Language Environment Programming Guide for 64-bit Virtual Addressing Mode* .

When you do not provide the **fc** parameter, any nonzero condition is signaled and processed by Language Environment exception handling routines. If you have registered a user-written exception handler, Language Environment passes control to the handler, which determines the next action to take. If the condition remains unhandled, Language Environment writes a message to stderr. The message is the translation of the condition token into English (or another supported national language).

Language Environment provides APIs that can be used to convert condition tokens to routine variables, messages, or signaled conditions. The following table lists these Language Environment APIs and their functions.

__le_msg_write()	Writes a message string to stderr
__le_msg_get_and_write()	Takes a message associated with a condition and writes it to stderr
__le_msg_get()	Retrieves, formats, and stores message data for a condition
__le_msg_add_insert()	Creates a message insert

For more information on these APIs, see *z/OS XL C/C++ Programming Guide*.

There are two types of condition tokens. Case 1 condition tokens contain condition information, including the Language Environment message number. All Language Environment APIs and most application routines use case 1 condition tokens. Case 2 condition tokens contain condition information and a user-specified class and cause code. Application routines, user-written exception handlers, assembler user exits, and some operating systems can use case 2 condition tokens.

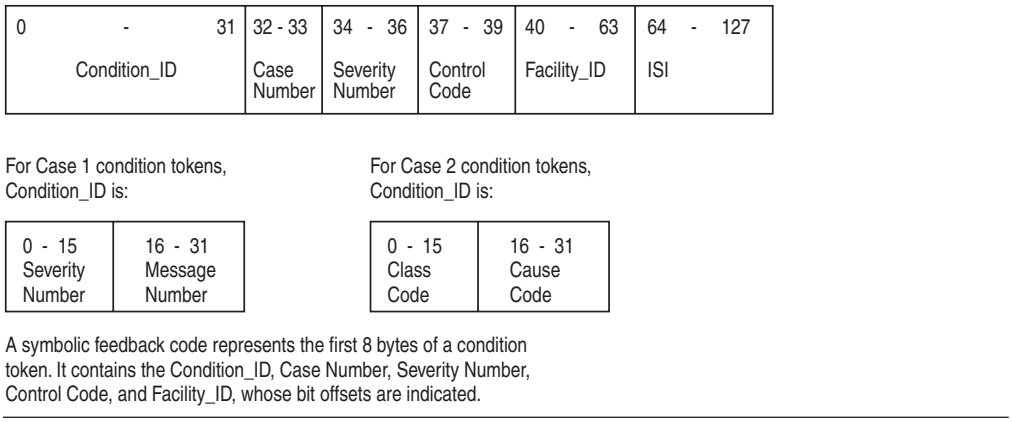


Figure 140. Language Environment condition token

For example, in the condition token: X'0003032D 59C3C5C5 00000000 00000000'

- X'0003' is severity.
- X'032D' is message number 813.
- X'59' are hexadecimal flags for case, severity, and control.
- X'C3C5C5' is the CEE facility ID.
- X'00000000 00000000' is the instance specific information (ISI). (In this case, no ISI was provided.)

If a Language Environment traceback or dump is generated while a condition token is being processed or when a condition exists, Language Environment writes the run-time message to the condition section of the traceback or dump. If a condition is detected when a Language Environment API is invoked without a feedback code, the condition token is passed to the Language Environment condition manager. If a condition is severity 0 or 1, Language Environment resumes without issuing a message. For conditions of severity 2 or greater, Language Environment issues a message and terminates. For a list of Language Environment run-time messages and corrective information, see *z/OS Language Environment Run-Time Messages*.

If a second condition is raised while Language Environment is attempting to handle a condition, the message `CEE0374C CONDITION = <message no.>` is displayed using a write-to-operator (WTO). The message number in the CEE0374C message indicates the original condition that was being handled when the second condition was raised. This can happen when a critical error is signaled (for example, when internal control blocks are damaged).

If the output for this error message appears several times in sequence, the conditions appear in order of occurrence. Correcting the earliest condition can cause your application to run successfully.

Using the symbolic feedback code

The symbolic feedback code represents the first 8 bytes of a 16-byte condition token. You can think of the symbolic feedback code as the nickname for a condition. As such, the symbolic feedback code can be used in user-written exception handlers to screen for a given condition, even if it occurs at different locations in an application.

For more details on symbolic feedback codes, see *z/OS Language Environment Programming Guide for 64-bit Virtual Addressing Mode*.

Chapter 11. Classifying AMODE 64 application errors

This chapter describes errors that commonly occur in Language Environment AMODE 64 applications. It also explains how to use run-time messages and abend codes to obtain information about errors in your application.

Identifying problems in routines

The following sections describe how you can identify errors in Language Environment routines. Included are common error symptoms and solutions.

Language Environment module names

You can identify Language Environment-supplied module elements by any of the following three-character prefixes:

- CEE (Language Environment)
- CEL (Language Environment)
- EDC (C/C++)

Module elements or text files with other prefixes are not part of the Language Environment product for AMODE 64 applications.

Common errors in routines

These common errors have simple solutions:

- If you receive abend U4093, reason X'224' (548 decimal), then make sure you use MEMLIMIT to allow access to above the 2 GB bar. For more information, see *z/OS MVS Programming: Extended Addressability Guide*.
- If you do not have enough virtual storage, increase your region size or decrease your storage usage (stack size) by using the storage-related run-time options and callable services. (See “Controlling storage allocation” on page 361 for information about using storage in routines.)
- If you do not have enough disk space, increase your disk allocation.
- If executable files are not available, check your executable library to ensure that they are defined. For example, check your STEPLIB or JOBLIB definitions.

If your error is not caused by any of the items listed above, examine your routine or routines for changes since the last successful run. If there have been changes, review these changes for errors that might be causing the problem. One way to isolate the problem is to branch around or comment out recent changes and rerun the routine. If the run is successful, the error can be narrowed to the scope of the changes.

Changes in optimization levels, addressing modes, and input/output file formats can also cause unanticipated problems in your routine.

In most cases, generated condition tokens or run-time messages point to the nature of the error. The run-time messages offer the most efficient corrective action. To help you analyze errors and determine the most useful method to fix the problem, Table 26 on page 372 lists common error symptoms, possible causes, and programmer responses.

© Copyright IBM Corp. 1991, 2009

Table 26. Common error symptoms, possible causes, and programmer responses

Error Symptom	Possible Cause	Programmer Response
Numbered run-time message appears	Condition raised in routine	For any messages you receive, read the Programmer Response. For information about message structure, see “Interpreting run-time messages” below.
User abend code < 4000	a) A non-Language Environment abend occurred b) The assembler user exit requested an abend for an unhandled condition of severity ≥2	See the Language Environment abend codes in *z/OS Language Environment Run-Time Messages*. Check for a subsystem-generated abend or a user-specified abend.
User abend code ≥ 4000	a) Language Environment detected an error and could not proceed b) An unhandled software-raised condition occurred c) The assembler user exit requested an abend for an unhandled condition of severity 4	For any abends you receive, read the appropriate explanation listed in the abend codes section of *z/OS Language Environment Run-Time Messages*.
System abend with TRAP(OFF)	Cause depends on type of malfunction	Respond appropriately. See the messages and codes book of the operating system.
System abend with TRAP(ON)	System-detected error	See the messages and codes book of the operating system.
No response (wait/loop)	Application logic failure	Check routine logic.
Unexpected message (message received was not from most recent service)	Condition caused by something related to current service	Generate a traceback using `cdump()` or `ctrace()`.
Incorrect output	Incorrect file definitions, storage overlay, incorrect routine mask setting, references to uninitialized variables, data input errors, or application routine logic error	Correct the appropriate parameters.
No output	Incorrect ddname or file definitions	Correct the appropriate parameters.
Nonzero return code from enclave	The return code was issued by the application routine	Check the application for the meaning of the return code.

Interpreting run-time messages

The first step in debugging your routine is to look up any run-time messages. Run-time messages are written to the C stderr stream.

Run-time messages provide users with additional information about a condition, and possible solutions for any errors that occurred. They can be issued by Language Environment common routines or language-specific run-time routines and contain a message prefix, message number, severity code, and descriptive text.

In the following example Language Environment message:

```
CEE3206S The system detected a specification exception (System Completion Code=0C6).
```

- The message prefix is CEE.
- The message number is 3206.
- The severity code is S.

- The message text is “The system detected a specification exception (System Completion Code=0C6)”.

Language Environment messages can appear even though you made no explicit calls to Language Environment services. C/C++ run-time library routines commonly use the Language Environment services. This is why you can see Language Environment messages even when the application routine does not directly call common run-time services.

Message prefix

The message prefix indicates the Language Environment component that generated the message. The message prefix is the first three characters of the message number and is also the facility ID in the condition token. See the following table for more information about Language Environment run-time messages.

Message Prefix	Language Environment Component
CEE	Common run time
EDC	C/C++ run time

The messages for the various components can be found in *z/OS Language Environment Run-Time Messages*.

Message number

The message number is the 4-digit number following the message prefix. Leading zeros are inserted if the message number is less than four digits. It identifies the condition raised and references additional condition and programmer response information.

Severity code

The severity code is the letter following the message number and indicates the level of attention called for by the condition. Messages with severity “I” are informational messages and do not usually require any corrective action. In general, if more than one run-time message appears, the first noninformational message indicates the problem. For a complete list of severity codes, severity values, condition information, and default actions, see *z/OS Language Environment Programming Guide for 64-bit Virtual Addressing Mode*.

Message text

The message text provides a brief explanation of the condition.

Understanding abend codes

Under Language Environment, abnormal terminations generate abend codes. There are two types of abend codes: 1) user abends (Language Environment and user-specified) and 2) system abends. User abends follow the format of U*dddd*, where *dddd* is a decimal user abend code. System abends follow the format of S*hhh*, where *hhh* is a hexadecimal abend code. Language Environment abend codes are usually in the range of 4000 to 4095. However, some subsystem abend codes can also fall in this range. User-specified abends use the range of 0 to 3999.

Example abend codes are:

```
User (Language Environment) abend code:U4041
User-specified abend code:U0005
System abend code:S80A
```

The Language Environment API __cabend() terminates your application with an abend. You can set the clean_up parameter value to determine how the abend is processed and how Language Environment handles the raised condition. For more information about __cabend() and clean_up, see *z/OS XL C/C++ Run-Time Library Reference*.

User abends

If you receive a Language Environment abend code, see *z/OS Language Environment Run-Time Messages* for a list of abend codes, error descriptions, and programmer responses.

System abends

If you receive a system abend code, look up the code and the corresponding information in the publications for the system you are using.

When a system abend occurs, the operating system can generate a system dump. System dumps are written to ddname SYSMDUMP, SYSABEND, or SYSUDUMP. If the DYNDUMP run-time option is used in combination with the TERMTHDACT run-time option, the system dump can be written without the ddname specified. System dumps show the memory state at the time of the condition. See "Generating a system dump" on page 394 for more information about system dumps.

Chapter 12. Using Language Environment AMODE 64 debugging facilities

This chapter describes methods of debugging AMODE 64 routines in Language Environment. Currently, most problems in Language Environment and member language routines can be determined through the use of a debugging tool or through information provided in the Language Environment dump.

Debugging tools

You can use **dbx** to debug Language Environment applications. *z/OS UNIX System Services Command Reference* has information on **dbx** subcommands, while *z/OS UNIX System Services Programming Tools* contains usage information.

Language Environment dumps

The following sections provide information about using the Language Environment dump service, and describe the contents of the Language Environment dump.

Generating a Language Environment dump with TERMTHDACT

The TERMTHDACT run-time option produces a dump during program checks or abnormal terminations. You must use TERMTHDACT(DUMP) in conjunction with TRAP(ON) to generate a Language Environment dump.

You can use TERMTHDACT to produce a traceback, Language Environment dump, or user address space dump when a thread ends abnormally because of an unhandled condition of severity 2 or greater. If this is the last thread in the process, the enclave goes away. A thread terminating in a non-POSIX environment is analogous to an enclave terminating. For information on enclave termination, see *z/OS Language Environment Programming Guide for 64-bit Virtual Addressing Mode* .

The TERMTHDACT suboptions QUIET, MSG, TRACE, DUMP, UAONLY, UATRACE, UADUMP, and UAIMM control the level of information available. Following are the suboptions, the levels of information produced, and the destination of each.

Table 27. TERMTHDACT suboptions, level of information, and destinations

Suboption	Level of Information	Destination
QUIET	No information	No destination.
MSG	Message	Stderr
TRACE	Message and Language Environment dump containing only a traceback	Message goes to stderr. Traceback goes to CEEDUMP file.
DUMP	Message and complete Language Environment dump	Message goes to stderr. Language Environment dump goes to CEEDUMP file.

© Copyright IBM Corp. 1991, 2009

Table 27. TERMTHDACT suboptions, level of information, and destinations (continued)

Suboption	Level of Information	Destination
UAONLY	SYSMDUMP, SYSABEND dump, or SYSUDUMP depending on the DD card used in the JCL in z/OS. You will get a system dump of your user address space if the appropriate DD statement is used. **Note:** A Language Environment dump is not generated.	Language Environment generates a U4039 abend which allows a system dump of the user address space to be generated. For z/OS, the system dump is written to the ddname specified.
UATRACE	Message, Language Environment dump containing only a traceback, and a system dump of the user address space	Message goes to stderr. Traceback goes to CEEDUMP file. Language Environment generates a U4039 abend which allows a system dump of the user address space to be generated. For z/OS, the system dump is written to the ddname specified.
UADUMP	Message, Language Environment dump, and SYSMDUMP, SYSABEND dump, or SYSUDUMP depending on the DD card used in the JCL in z/OS.	Message goes to stderr. Language Environment dump goes to CEEDUMP file. Language Environment generates a U4039 abend which allows a system dump of the user address space to be generated. For z/OS, the system dump is written to the ddname specified.
UAIMM	Language Environment generates a system dump of the original abend/program interrupt of the user address space. You will get a system dump of your user address space if the appropriate DD statement is used. After the dump is taken by the operating system, Language Environment condition manager continues processing.	Message goes to stderr. User address space dump goes to ddname specified for z/OS.

The TRACE and UATRACE suboptions of TERMTHDACT use these dump options:
- CONDITION
- ENCLAVE(ALL)
- FILES
- FNAME(CEEDUMP)
- GENOPTS
- NOBLOCKS
- NOENTRY
- NOSTORAGE
- STACKFRAME(ALL)
- THREAD(ALL)
- TRACEBACK
- VARIABLES

The DUMP and UADUMP suboptions of TERMTHDACT use these dump options:
- BLOCKS
- CONDITION
- ENCLAVE(ALL)
- FILES

- FNAME(CEEDUMP)
- GENOPTS
- NOENTRY
- STACKFRAME(ALL)
- STORAGE
- THREAD(CURRENT)
- TRACEBACK
- VARIABLES

Considerations for setting TERMTHDACT options

- **z/OS UNIX Considerations**
  - The TERMTHDACT option applies when a thread terminates abnormally. Abnormal termination of a single thread causes termination of the entire enclave. If an unhandled condition of severity 2 or higher percolates beyond the first routine's stack frame, the enclave terminates abnormally.
  - If an enclave terminates due to a POSIX default signal action, then TERMTHDACT applies to conditions that result from software signals, program checks, or abends.
  - If running under a shell and Language Environment generates a system dump, then a core dump is generated to a file based on the kernel environment variable, _BPXK_MDUMP.
- **Preinitialized Environments for Authorized Programs Considerations**
  - The TERMTHDACT suboptions TRACE, DUMP, UADUMP, UATRACE are overridden to UAONLY.
  - For UAONLY, a U4039 abend is generated and an SVC dump of the U4039 abend with the title:

    ```
    COMPON=CEL,COMPID=568819801,ISSUER=CELAFRR ,MODULE=CELAEICT+????,
    ABEND=U4039,REASON=00000000
    ```

    is taken.
  - For UAIMM, an SVC dump of the original abend/program interrupt with a title like:

    ```
    COMPON=CEL,COMPID=568819801,ISSUER=CELAFRR ,MODULE=CELAEICT+????,
    ABEND=S00C9,REASON=00000009
    ```

    (where the ABEND and REASON values are those of the original abend/program interrupt) is taken.

For more information about the TERMTHDACT run-time option, see *z/OS Language Environment Programming Reference*.

Generating a Language Environment dump with language-specific functions

C/C++ routines can use the functions `cdump()`, `csnap()`, and `ctrace()` to produce a Language Environment dump. For more information on these functions, see "Generating a Language Environment dump of a C/C++ routine" on page 488.

Understanding the Language Environment dump

The Language Environment dump service generates output of data and storage from the Language Environment run-time environment on an enclave basis. This output contains the information needed to debug most basic routine errors.

Figure 143 on page 381 illustrates a dump for enclave main. The example shows full use of the TERMTHDACT dump options. Ellipses are used to summarize some

sections of the dump and information regarding unhandled conditions may not be present at all. Sections of the dump are numbered to correspond with the descriptions given in “Sections of the Language Environment dump” on page 389.

The CEE3DMP was generated by the C program CELQSAMP shown in Figure 141 on page 379. CELQSAMP uses the DLL CELQDLL shown in Figure 142 on page 381.

```
#pragma options(SERVICE("1.8"),NOOPT,GONUM)
#pragma runopts(TERMTHDACT(UADUMP),POSIX(ON))
#pragma runopts(TRACE(ON,1M,NODUMP,LE=1),HEAPCHK(ON))
#pragma runopts(RPTSTG(ON))
#define _OPEN_THREADS
#include <pthread.h>
#include <stdio.h>
#include <stdlib.h>
#include <dll.h>

typedef void* FUNC(void *);

pthread_mutex_t      mut;
pthread_t            thread[2];
int                  threads_joined = 0;
char *               t1 = "Thread 1";
char *               t2 = "Thread 2";
/*********************************************************************/
/*  thread_func: Invoked via pthread_create.                         */
/*********************************************************************/
void *thread_func(void *parm)
{
  printf(">>> Thread_func: %s locking mutex\n",parm);
  pthread_mutex_lock(&mut);
  pthread_mutex_unlock(&mut);
  printf(">>> Thread_func: %s exitting\n",parm);
  pthread_exit(NULL);
}
/*********************************************************************/
/*  Start of Main function.                                          */
/*********************************************************************/
main()
{
  dllhandle *          handle;
  FUNC *               fp;
  FILE*                fp1;
  FILE*                fp2;

  printf("Load DLL...\n");
  handle = dllload("CELQDLL");
  if (handle == NULL) {
    perror("Could not load DLL CELQDLL");
    exit(106);
  }

  printf("Query DLL...\n");
  fp = (FUNC *)dllqueryfn(handle,"div_zero");
  if (fp == NULL) {
    perror("Could not find thread_func");
    exit(107);
  }

  printf("Init MUTEX...\n");
  if (pthread_mutex_init(&mut, NULL) == -1) {
    perror("Init of mut failed");
    exit(101);
  }
```

Figure 141. The C program CELQSAMP (Part 1 of 2)

```
  printf("Lock Mutex Lock...\n");
  if (pthread_mutex_lock(&mut) == -1) {
    perror("Lock of mut failed");
    exit(102);
  }

  printf("Create 1st thread...\n");
  if (pthread_create(&thread[0],NULL,thread_func,(void *)t1) == -1) {
    perror("Could not create thread #1");
    exit(103);
  }

  printf("Create 2nd thread...\n");
  if (pthread_create(&thread[1],NULL,thread_func,(void *)t2) == -1) {
    perror("Could not create thread #2");
    exit(104);
  }
  printf("Write to some files...\n");
  fp1 = fopen("myfile.data", "w");
  if (!fp1) {
    perror("Could not open myfile.data for write");
    exit(109);
  }

  fprintf(fp1, "record 1\n");
  fprintf(fp1, "record 2\n");
  fprintf(fp1, "record 3\n");

  fp2 = fopen("memory.data", "wb,type=memory");
  if (!fp2) {
    perror("Could not open memory.data for write");
    exit(112);
  }

  fprintf(fp2, "some data");
  fprintf(fp2, "some more data");
  fprintf(fp2, "even more data");

  printf("Call div_zero...\n");
  fp(NULL);

  printf("Error -- Should not get here\n");
  exit(110);
}
```

Figure 141. The C program CELQSAMP (Part 2 of 2)

```
/* DLL containing div_zero */
#pragma options(SERVICE("1.8"),NOOPT,GONUM)
#pragma export(div_zero)
#include <stdio.h>
#include <stdlib.h>
char wsa_array[11] = { 'C','E','L','Q','D','L','L',' ','W','S','A'};
/*********************************************************************/
/*  div_zero: Cause divide by zero exception                         */
/*********************************************************************/
void *div_zero(void *parm)
{
  int                  i = 0;

  printf("Divide by zero...\n");
  i = 1/i;
  printf("Error -- Should not get here. i=%d\n",i);
  exit(110);
}
```

Figure 142. The C DLL CELQDLL

For easy reference, the sections of the following dump are numbered to correspond with the descriptions in “Sections of the Language Environment dump” on page 389.

```
[1] CEE3DMP V1 R9.0: Condition processing resulted in the unhandled condition.         Wed Jan 17 21:19:59 2007            Page:    1
    ASID: 0028   Job ID: JOB00051   Job name: CELQSAMP   Step name: STEP1      PID: 67108872   Parent PID: 1   User name: IBMUSER

[2] CEE3845I CEEDUMP Processing started.

[3] Information for enclave main

[4]   Information for thread 253E019000000000

[5]   Traceback:
        DSA   Entry       E  Offset  Statement   Load Mod             Program Unit                  Service  Status
        1     CEEHDSP     +00000000              CELQLIB              CEEHDSP                       D1908    Call
        2     CEEOSIGJ    +0000094E              CELQLIB              CEEOSIGJ                      D1908    Call
        3     CELQHROD    +0000024E              CELQLIB              CELQHROD                      D1908    Call
        4     CEEOSIGG    +1B032E48              CELQLIB              CEEOSIGG                      D1908    Call
        5     CELQHROD    +0000024E              CELQLIB              CELQHROD                      D1908    Call
        6     div_zero    +0000004E  15          CELQDLL              CELQDLL                       1.4.f    Exception
        7     main        +00000468  98          CELQSAMP             CELQSAMP                      1.2.d    Call
        8     CELQINIT    +0000134C              CELQLIB              CELQINIT                      D1908    Call

        DSA   DSA Addr          E  Addr             PU Addr          PU Offset   Comp Date Compile Attributes
        1     00000001082FAAC0  00000000251B6060    00000000251B6060  00000000    20061215  CEL       POSIX  XPLINK  EBCDIC  HFP
        2     00000001082FD3E0  0000000002504AAB0   0000000002504AAB0  0000094E    20070109  CEL       POSIX  XPLINK  EBCDIC  HFP
        3     00000001082FDDE0  00000000251C9480    00000000251C9480  0000024E    20061215  CEL       POSIX  XPLINK  EBCDIC  HFP
        4     00000001082FE020  00000000253D11F8    00000000253D11F8  1B032E48    20061215  CEL       POSIX  XPLINK  EBCDIC  HFP
        5     00000001082FEE40  00000000251C9480    00000000251C9480  0000024E    20061215  CEL       POSIX  XPLINK  EBCDIC  HFP
        6     00000001082FF080  0000000002575B5A0    0000000000000000  ********    20070117  C/C++     POSIX  XPLINK  EBCDIC  IEEE
        7     00000001082FF180  000000000250000D8    0000000000000000  ********    20070117  C/C++     POSIX  XPLINK  EBCDIC  IEEE
        8     00000001082FF280  0000000025005010    0000000025005010  0000134C    20061215  CEL       POSIX  XPLINK  EBCDIC  HFP

        Fully Qualified Names
        DSA   Entry       Program Unit                                        Load Module
        6     div_zero    PLPSC://'POSIX.CRTL.C(CELQDLL)'                     CELQDLL
        7     main        PLPSC://'POSIX.CRTL.C(CELQSAMP)'                    CELQSAMP
```

Figure 143. Example dump using CEE3DMP (Part 1 of 9)

```
[6]   Condition Information for Active Routines
        Condition Information for PLPSC://'POSIX.CRTL.C(CELQDLL)' (DSA address 00000001082FF080)
          CIB Address: 00000001082FBE00
          Current Condition:
            CEE0198S The termination of a thread was signaled due to an unhandled condition.
          Original Condition:
            CEE3209S The system detected a fixed-point divide exception (System Completion Code=0C9).
          Location:
            Program Unit: PLPSC://'POSIX.CRTL.C(CELQDLL)'
            Entry:        div_zero Statement: 15 Offset: +0000004E
          Machine State:
            ILC..... 0002    Interruption Code..... 0009
            PSW..... 0785240180000000 000000002575B5F0
            GPR0..... 0000000000000000  GPR1..... 0000000100009DF0  GPR2..... 00000001082FF278  GPR3..... 0000000000000012
            GPR4..... 00000001082FF080  GPR5..... 00000000000000C0  GPR6..... 0000000000000000  GPR7..... 0000000000000001
            GPR8..... 000000002575B5AC  GPR9..... 000000002575B638  GPR10.... 00000000250014B0  GPR11.... 0000000108FC5E70
            GPR12.... 0000000100005340  GPR13.... 0000000000006F58  GPR14.... 0000000025250098  GPR15.... 000000000000001F

          Storage dump near condition, beginning at location(000000002575B5DE)
            +0000 000000002575B5DE  0700E300 48C00014 A7690001 8E600020  |..T.....x....-..|
            +0010 000000002575B5EE  1D60B904 00075000 48C0E320 48C00014  |.-....&...T.....|
          GPREG STORAGE:
            Storage around GPR0 (0000000000000000)
              +0000 0000000000000000  Inaccessible storage.
              +0010 0000000000000010  Inaccessible storage.
              +0020 0000000000000020  Inaccessible storage.
              +0030 0000000000000030  Inaccessible storage.
              +0040 0000000000000040  Inaccessible storage.
              +0050 0000000000000050  Inaccessible storage.
            Storage around GPR1 (0000000100009DF0)
              -0020 0000000100009DD0  00000000 00000000 00000000 00000000  |................|
              -0010 0000000100009DE0 - +FFFFFF 0000000100009DEF             same as above
⋮
            Storage around GPR15(000000000000001F)
              -001F 0000000000000000  Inaccessible storage.
              -000F 0000000000000010  Inaccessible storage.
              +0001 0000000000000020  Inaccessible storage.
              +0011 0000000000000030  Inaccessible storage.
              +0021 0000000000000040  Inaccessible storage.
              +0031 0000000000000050  Inaccessible storage.

[7]   Parameters, Registers, and Variables for Active Routines:
        div_zero (DSA address 00000001082FF080):
          DOWNSTACK DSA
          Saved Registers:
            GPR0..... ****************  GPR1..... ****************  GPR2..... ****************  GPR3..... ****************
            GPR4..... 00000001082FF080  GPR5..... BBBBBBBBBBBBBBBB  GPR6..... 00000000251C9480  GPR7..... 0000000000000001
            GPR8..... 000000002575B5AC  GPR9..... 000000002575B638  GPR10.... 00000000250014B0  GPR11.... 0000000108FC5E70
            GPR12.... 4040404040404040  GPR13.... 4040404040404040  GPR14.... 4040404040404040  GPR15.... 4040404040404040
        GPREG STORAGE:
          Storage around GPR0  is invalid.
          Storage around GPR1  is invalid.
          Storage around GPR2  is invalid.
          Storage around GPR3  is invalid.
          Storage around GPR4 (00000001082FF080)
            +0800 00000001082FF880  00000001 082FF180 00000001 083710A0  |......1.........|
            +0810 00000001082FF890  00000000 2575B5A0 00000000 25000542  |................|
            +0820 00000001082FF8A0  00000000 250000E4 00000000 25000658  |.......U........|
            +0830 00000001082FF8B0  00000000 250014B0 00000001 08FC5E70  |............¸.|
            +0840 00000001082FF8C0  00000001 00005340 00000000 00006F58  |....... ......?.|
            +0850 00000001082FF8D0  00000000 25250098 00000000 0000001F  |.......q........|
⋮
          Storage around GPR15(4040404040404040)
            -0020 4040404040404020  Inaccessible storage.
            -0010 4040404040404030  Inaccessible storage.
            +0000 4040404040404040  Inaccessible storage.
            +0010 4040404040404050  Inaccessible storage.
            +0020 4040404040404060  Inaccessible storage.
            +0030 4040404040404070  Inaccessible storage.
         main (DSA address 00000001082FF180):
          DOWNSTACK DSA
          Saved Registers:
            GPR0..... ****************  GPR1..... ****************  GPR2..... ****************  GPR3..... ****************
            GPR4..... 00000001082FF180  GPR5..... 00000001083710A0  GPR6..... 000000002575B5A0  GPR7..... 0000000025000542
            GPR8..... 00000000250000E4  GPR9..... 0000000025000658  GPR10.... ****************  GPR11.... ****************
            GPR12.... ****************  GPR13.... ****************  GPR14.... ****************  GPR15.... ****************
```

Figure 143. Example dump using CEE3DMP (Part 2 of 9)

```
       GPREG STORAGE:
         Storage around GPR0  is invalid.
         Storage around GPR1  is invalid.
⋮
       CELQINIT (DSA address 00000001082FF280):
         DOWNSTACK DSA
         Saved Registers:
           GPR0..... ****************  GPR1..... ****************  GPR2..... ****************  GPR3..... ****************
           GPR4..... 00000001082FF280  GPR5..... 0000000108300070  GPR6..... 00000000250000D8  GPR7..... 000000002500635E
           GPR8..... 00000000000006FF0  GPR9..... 00000000025002E98  GPR10.... ****************  GPR11.... ****************
           GPR12.... ****************  GPR13.... ****************  GPR14.... ****************  GPR15.... ****************
       GPREG STORAGE:
         Storage around GPR0  is invalid.
         Storage around GPR1  is invalid.
⋮
[8]  Control Blocks for Active Routines:
       DSA for CEEHDSP: 00000001082FB2C0
         +000000  R4..... 00000001082FD3E0           R5..... 000000000251BABA0           R6..... 000000000251B6060
         +000018  R7..... 000000002504B400           R8..... 00000001089135B0           R9..... 0000000000000005
         +000030  R10..... 00000001082FE3DF          R11..... 00000001082FE0C0          R12..... 00000001089135B0
         +000048  R13..... 00000001082FE680          R14..... 000000002504B300          R15..... 000000002530A300
         +000060  reserved. 0000000000000000         reserved. 0000000000000000         HPTRAN... 0000000000000000
         +000078  reserved. 0000000000000000
       DSA for CEEOSIGJ: 00000001082FDBE0
         +000000  R4..... 00000001082FDDE0           R5..... 000000002504C3EC           R6..... 000000002504AAB0
         +000018  R7..... 00000000251C96D0           R8..... 0000000025754AD8           R9..... 0000000025754BD0
         +000030  R10..... 0000000025754A30          R11..... 0000000000000020          R12..... 0000000100007B18
         +000048  R13..... 00000001082FE680          R14..... 00000000253D6504          R15..... 0000000000000003
         +000060  reserved. 082FE3C400000001         reserved. 082FDDB000000001         HPTRAN... 082FDDF000000001
         +000078  reserved. 082FE13C00000001
       DSA for CELQHROD: 00000001082FE5E0
         +000000  R4..... E3D9C1D5E3D9C1D5           R5..... CCCCCCCCCCCCCCCC           R6..... 00000000251C9480
         +000018  R7..... 0000000000000000           R8..... 0000000000000008           R9..... 000000000119B648
         +000030  R10..... 00000001082FF01F          R11..... 0000000119B00050          R12..... 0000000100007B18
         +000048  R13..... 00000001082FF6E0          R14..... 00000000253D3012          R15..... 00000000007FF050
         +000060  reserved. 0000000100007B18         reserved. 00000001082FF6E0         HPTRAN... 00000001082FE708
         +000078  reserved. 000000000284F9CA
       DSA for CELQHROD: 00000001082FE708
         +000000  EYE..... 64INTRPT  TRTYPE... 00000010  reserved. 40404040  reserved. 4040404040404040
         +000018  reserved. 4040404040404040          reserved. 4040404040404040          reserved. 4040404040404040
         +000030  TRANEP... 00000000251C9480          TR_R0.... 4040404040404040          TR_R1.... 4040404040404040
         +000048  TR_R2.... 4040404040404040          TR_R3.... 4040404040404040          TR_R4.... 00000001082FE020
         +000060  TR_R5.... 4040404040404040          TR_R6.... 4040404040404040          TR_R7.... 0000000000000003
         +000078  TR_R8.... 00000001082FEBD0          TR_R9.... 00000001082FEBD8          TR_R10... 00000001082FECB0
         +000090  TR_R11... 000000007F754910          TR_R12... 00000001082FEBD0          TR_R13... 00000001082FEBD8
         +0000A8  TR_R14... 00000001082FE7D8          TR_R15... 4040404040404040          reserved. 0000000000000000
         +0000C0  ROND_DSA. 00000001082FDDE0          ROND_R13. 00000000257549A0          ROND_R14. 00000000253D6504
       DSA for CEEOSIGG: 00000001082FE820
         +000000  R4..... 00000001082FEE40           R5..... 00000000253D4114           R6..... 00000000253D11F8
         +000018  R7..... 00000000251C96D0           R8..... 0000000025754190           R9..... 0000000025754198
         +000030  R10..... 0000000025754110          R11..... 0000000000000020          R12..... 0000000100007B18
         +000048  R13..... 00000001082FF6E0          R14..... 00000000251CCBF8          R15..... 0000000000000001
         +000060  reserved. 00000001082FEC28         reserved. 00000001082FEAA4         HPTRAN... 00000001082FEB30
         +000078  reserved. 00000001082FEB38
       DSA for CELQHROD: 00000001082FF640
         +000000  R4..... E3D9C1D5E3D9C1D5           R5..... CCCCCCCCCCCCCCCC           R6..... 00000000251C9480
         +000018  R7..... 0000000000000000           R8..... 000000002575B5AC           R9..... 000000002575B638
         +000030  R10..... 00000000250014B0          R11..... 0000000108FC5E70          R12..... 0000000100005340
         +000048  R13..... 0000000000006F58          R14..... 0000000025250098          R15..... 000000000000001F
         +000060  reserved. 00000001082FF080         reserved. 00000000000000C0         HPTRAN... 00000001082FF768
         +000078  reserved. 000000002575B5DE
       DSA for CELQHROD: 00000001082FF768
         +000000  EYE..... 64INTRPT  TRTYPE... 00000010  reserved. 00000000  reserved. 3C10000000000000
         +000018  reserved. 3410000000000000          reserved. 0000008000000000          reserved. 0000000000000048
         +000030  TRANEP... 00000000251C9480          TR_R0.... 00000001082FF180          TR_R1.... 00000000000000C0
         +000048  TR_R2.... 0000000025573FF0          TR_R3.... 000000002500052E          TR_R4.... 00000001082FF080
         +000060  TR_R5.... 0000000025000658          TR_R6.... 00000000250014B0          TR_R7.... 0000000000000001
         +000078  TR_R8.... 0000000100005340          TR_R9.... 0000000000006F58          TR_R10... 0000000025250098
         +000090  TR_R11... 000000000000001F          TR_R12... 000024D000000001          TR_R13... 1990036000000001
         +0000A8  TR_R14... 199013C800000001          TR_R15... 19901F3800000001          reserved. 0000000100009DF0
         +0000C0  ROND_DSA. 00000001082FEE40          ROND_R13. 0000000025754040          ROND_R14. 00000000251CCBF8
       DSA for div_zero: 00000001082FF880
         +000000  R4..... 00000001082FF180           R5..... 00000001083710A0           R6..... 000000002575B5A0
         +000018  R7..... 0000000025000542           R8..... 00000000250000E4           R9..... 0000000025000658
         +000030  R10..... 00000000250014B0          R11..... 0000000108FC5E70          R12..... 0000000100005340
         +000048  R13..... 0000000000006F58          R14..... 0000000025250098          R15..... 000000000000001F
         +000060  reserved. 00000001082FF918         reserved. 000000007F7547D8         HPTRAN... 0000000000000000
         +000078  reserved. 0000000000000000
```

Figure 143. Example dump using CEE3DMP (Part 3 of 9)

```
        CIB for div_zero(00000001082FBE00)
          +0000 00000001082FBE00  C3C9C240 00000000 00000000 00000000  |CIB ............|
          +0010 00000001082FBE10  00000000 00000000 01900004 00000000  |................|
          +0020 00000001082FBE20  00000000 00000000 000300C6 59C3C5C5  |...........F.CEE|
          +0030 00000001082FBE30  00000000 00000000 00000001 082FBF90  |................|
          +0040 00000001082FBE40  00030C89 59C3C5C5 00000000 00000004  |...i.CEE........|
          +0050 00000001082FBE50  00000004 00000000 00000001 082FF180  |.............1..|
          +0060 00000001082FBE60  00000000 251BB1D0 00000000 00000000  |................|
          +0070 00000001082FBE70  00000001 082FF080 00000000 2575B5F0  |......0........0|
          +0080 00000001082FBE80  00000001 00007000 00000003 00000000  |................|
          +0090 00000001082FBE90  00000001 082FF080 01010000 00000000  |......0.........|
          +00A0 00000001082FBEA0  00000000 00000000 00000000 00000000  |................|
          +00B0 00000001082FBEB0 - +0000FF 00000001082FBEFF             same as above
          +0100 00000001082FBF00  48220400 00000000 940C9000 00000009  |........m.......|
          +0110 00000001082FBF10  00000000 00000000 00000000 250008C0  |................|
          +0120 00000001082FBF20  00000001 082FF080 00000001 082FF080  |......0.......0.|
          +0130 00000001082FBF30  00000000 2575B5EE 00000000 00000000  |................|
          +0140 00000001082FBF40  00000000 00000000 00000067 00000000  |................|
          +0150 00000001082FBF50  00000001 082FF180 00000003 00000008  |......1.........|
          +0160 00000001082FBF60  00000014 00000004 00000000 00000000  |................|
          +0170 00000001082FBF70  00000000 00000000 00000008 00000000  |................|
          +0180 00000001082FBF80  00000001 00007220 00000000 00000000  |................|
        DSA for main: 00000001082FF980
          +000000  R4....... 00000001082FF280           R5....... 0000000108300070           R6....... 00000000250000D8
          +000018  R7....... 000000002500635E           R8....... 0000000000006FF0           R9....... 0000000025002E98
          +000030  R10...... 00000000250014B0           R11...... 0000000108FC5E70           R12...... 0000000100005340
          +000048  R13...... 0000000000006F58           R14...... 0000000025250098           R15...... 000000000000001F
          +000060  reserved. 0000000000000000           reserved. 0000000000000000           HPTRAN... 0000000000000000
          +000078  reserved. 0000000000000000
        DSA for CELQINIT: 00000001082FFA80
          +000000  R4....... 00000001082FF760           R5....... 0000000000000000           R6....... 0000000025005010
          +000018  R7....... 00000000250064F8           R8....... 0000000000000000           R9....... 0000000000000000
          +000030  R10...... 0000000000000000           R11...... 0000000000000000           R12...... 0000000000000000
          +000048  R13...... 0000000000000000           R14...... 0000000000000000           R15...... 0000000000000000
          +000060  reserved. 0000000000000000           reserved. 0000000000000000           HPTRAN... 0000000000000000
          +000078  reserved. 0000000000000000
[9]     Storage for Active Routines:
          DSA frame(00000001082FAAC0)
          +0800 00000001082FB2C0  00000001 082FD3E0 00000000 251BABA0  |......L.........|
          +0810 00000001082FB2D0  00000000 251B6060 00000000 2504B400  |......-.........|
          +0820 00000001082FB2E0  00000001 089135B0 00000000 00000005  |.....j..........|
          +0830 00000001082FB2F0  00000001 082FE3DF 00000001 082FE0C0  |......T.........|
          +0840 00000001082FB300  00000001 089135B0 00000001 082FE680  |.....j........W.|
          +0850 00000001082FB310  00000000 2504B300 00000000 2530A300  |.............t..|
          +0860 00000001082FB320  00000000 00000000 00000000 00000000  |................|
          +0870 00000001082FB330 - +00087F 00000001082FB33F             same as above
:
          +2540 00000001082FD000  00000000 00000000 00000000 00000000  |................|
          +2550 00000001082FD010 - +00311F 00000001082FDBDF             same as above

        DSA frame(00000001082FD3E0)
          +0800 00000001082FDBE0  00000001 082FDDE0 00000000 2504C3EC  |.............C.|
          +0810 00000001082FDBF0  00000000 2504AAB0 00000000 251C96D0  |.............o.|
          +0820 00000001082FDC00  00000000 25754AD8 00000000 25754BD0  |.......Q........|
          +0830 00000001082FDC10  00000000 25754A30 00000000 00000020  |................|
:
          +1180 00000001082FE560 - +0011EF 00000001082FE5CF             same as above
          +11F0 00000001082FE5D0  00000000 00000000 00000001 082FEBD8  |...............Q|

        DSA frame(00000001082FDDE0)
          +0800 00000001082FE5E0  E3D9C1D5 E3D9C1D5 CCCCCCCC CCCCCCCC  |TRANTRAN........|

        DSA frame(00000001082FE020)
          +0800 00000001082FE820  00000001 082FEE40 00000000 253D4114  |....... ........|
          +0810 00000001082FE830  00000000 253D11F8 00000000 251C96D0  |.......8......o.|
          +0820 00000001082FE840  00000000 25754190 00000000 25754198  |..............q.|
:
          +1600 00000001082FF620  00000000 00000000 00000000 00000013  |................|
          +1610 00000001082FF630  00000000 252B27D0 00000000 252B2810  |................|

        DSA frame(00000001082FEE40)
          +0800 00000001082FF640  E3D9C1D5 E3D9C1D5 CCCCCCCC CCCCCCCC  |TRANTRAN........|

        DSA frame(00000001082FF080)
          +0800 00000001082FF880  00000001 082FF180 00000001 083710A0  |......1.........|
          +0810 00000001082FF890  00000000 2575B5A0 00000000 25000542  |................|
          +0820 00000001082FF8A0  00000000 250000E4 00000000 25000658  |.......U........|
          +0830 00000001082FF8B0  00000000 250014B0 00000001 08FC5E70  |.............;.|
          +0840 00000001082FF8C0  00000001 00005340 00000000 00006F58  |....... ......?.|
          +0850 00000001082FF8D0  00000000 25250098 00000000 0000001F  |.......q........|
:
          +08E0 00000001082FF960  34100000 00000000 00000080 00000000  |................|
          +08F0 00000001082FF970  00000000 00000048 00000000 00000000  |................|
```

Figure 143. Example dump using CEE3DMP (Part 4 of 9)

```
        DSA frame(00000001082FF180)
          +0800 00000001082FF980  00000001 082FF280 00000001 08300070  |......2.........|
          +0810 00000001082FF990  00000000 250000D8 00000000 2500635E  |.......Q.......;|
          +0820 00000001082FF9A0  00000000 00006FF0 00000000 25002E98  |......?0.......q|
          +0830 00000001082FF9B0  00000000 250014B0 00000001 08FC5E70  |..............;.|
⋮
          +08E0 00000001082FFA60  00000001 08300070 00000000 00000000  |................|
          +08F0 00000001082FFA70  00000000 00000000 00000000 00000000  |................|

        DSA frame(00000001082FF280)
          +0800 00000001082FFA80  00000001 082FF760 00000000 00000000  |......7-........|
          +0810 00000001082FFA90  00000000 25005010 00000000 250064F8  |......&........8|
          +0820 00000001082FFAA0  00000000 00000000 00000000 00000000  |................|
          +0830 00000001082FFAB0 - +00087F 00000001082FFAFF             same as above
⋮
          +0C00 00000001082FFE80  00000000 00000000 00000000 00000000  |................|
          +0C10 00000001082FFE90 - +000CDF 00000001082FFF5F             same as above

[4]     Information for thread 253E10A000000001


[5]     Traceback:
          DSA   Entry       E  Offset  Statement   Load Mod             Program Unit                   Service  Status
          1     CEEOPML2    +00000000              CELQLIB              CEEOPML2                       D1908    Call
          2     thread_func +0000005A  24          CELQSAMP             CELQSAMP                       1.2.d    Call
          3     CELQPCMM    +00000DEA              CELQLIB              CELQPCMM                       D1908    Call

          DSA  DSA Addr          E  Addr           PU Addr           PU Offset  Comp Date Compile Attributes
          1    000000001111FEF60  0000000025290D80  0000000025290D80  00000000   20061215  CEL     POSIX  XPLINK  EBCDIC  HFP
          2    00000001111FF2C0  00000000250005A8  0000000000000000  ********   20070117  C/C++   POSIX  XPLINK  EBCDIC  IEEE
          3    00000001111FF3C0  0000000002526E6D0  0000000002526E6D0  00000DEA   20061214  CEL     POSIX  XPLINK  EBCDIC  HFP

          Fully Qualified Names
          DSA   Entry       Program Unit                                        Load Module
          2     thread_func PLPSC://'POSIX.CRTL.C(CELQSAMP)'                    CELQSAMP

        GPR0..... 0000000000000001  GPR1..... 00000000257669A0  GPR2..... 0000000108910290  GPR3..... 00000000257669A0
        GPR4..... 000000001111FEF60  GPR5..... 0000000025292620  GPR6..... 0000000000000000  GPR7..... 0000000025292004
        GPR8..... 00000000DA899660  GPR9..... 00000001114013C8  GPR10.... 0000000100003CA0  GPR11.... 0000000108358750
        GPR12.... 00000001114013C8  GPR13.... 0000000002576F000  GPR14.... 00000001114013C8  GPR15.... 00000001807D17D8
          GPREG STORAGE:
            Storage around GPR0 (0000000000000001)
              -0001 0000000000000000  Inaccessible storage.
              +000F 0000000000000010  Inaccessible storage.
⋮
[8]     Control Blocks for Active Routines:
          DSA for CEEOPML2: 00000001111FF760
            +000000  R4....... 00000001111FFB60           R5....... 0000000002576F000           R6....... 0000000025290D80
            +000018  R7....... 0000000025000604           R8....... 00000002250005B4           R9....... 0000000025000658
            +000030  R10...... 00000001083001B8           R11...... 00000001111FFEE8           R12...... 000000007F64A75C
            +000048  R13...... 0000000002576F000           R14...... 0000000111401F38           R15...... 0000000120000000
            +000060  reserved. 0000000000000000           reserved. 0000000000000000           HPTRAN... 0000000000000000
            +000078  reserved. 0000000000000000
          DSA for thread_func: 00000001111FFAC0
            +000000  R4....... 00000001111FF3C0           R5....... 0000000108300070           R6....... 00000000250005A8
            +000018  R7....... 0000000002526F4BC           R8....... 0000000111401FA0           R9....... 0000000002576F0D0
            +000030  R10...... 0000000000000080           R11...... 0000000000000000           R12...... 0000000000000000
            +000048  R13...... 0001004000000001           R14...... 00000000251D9FD4           R15...... 0000000002505CF48
            +000060  reserved. 0000000108FE8C30           reserved. 0000000000000000           HPTRAN... 000000007F6C58C8
            +000078  reserved. 0000000000000000
          DSA for CELQPCMM: 00000001111FFBC0
            +000000  R4....... 00000001111FF760           R5....... 0000000000000000           R6....... 0000000002526E6D0
            +000018  R7....... 0000000002526FC8C           R8....... 0000000111401FA0           R9....... 0000000002576F0D0
            +000030  R10...... 0000000000000080           R11...... 00000001111FFEE8           R12...... 000000007F64A75C
            +000048  R13...... 0000000002576F000           R14...... 0000000111401F38           R15...... 0000000120000000
            +000060  reserved. 0000000000000000           reserved. 0000000000000000           HPTRAN... 0000000000000000
            +000078  reserved. 0000000000000000
```

Figure 143. Example dump using CEE3DMP (Part 5 of 9)

```
 [9]   Storage for Active Routines:
        DSA frame(00000001111FEF60)
          +0800 00000001111FF760  00000001 111FFB60 00000000 2576F000  |.......-......0.|
          +0810 00000001111FF770  00000000 25290D80 00000000 25000604  |................|
          +0820 00000001111FF780  00000000 250005B4 00000000 25000658  |................|
          +0830 00000001111FF790  00000001 083001B8 00000001 111FFEE8  |............... Y|
⋮
[10]  Control Blocks Associated with the Thread:
       CAA(00000001114013C8)
          +0000 00000001114013C8  00000000 00000000 00000000 00000000  |................|
          +0010 00000001114013D8 - +0002AF 0000000111401677             same as above
          +02B0 0000000111401678  00008000 00000000 00000000 00000000  |................|
⋮
 [11]  Enclave Control Blocks:
       EDB(0000000100005340)
          +0000 0000000100005340  C3C5C5C5 C4C24040 00000000 00000000  |CEEEDB  ........|
          +0010 0000000100005350  00000000 00000000 00000000 00000000  |................|
          +0020 0000000100005360 - +0000FF 000000010000543F             same as above
          +0100 0000000100005440  97000100 00000000 00000001 000068F8  |p..............8|
⋮
          +01A0 00000001000054E0  00000000 00000000 00000000 00000000  |................|
          +01B0 00000001000054F0 - +0001FF 000000010000553F             same as above
       MEML(00000001000068F8)
          +0000 00000001000068F8  00000000 00000000 00000000 00000000  |................|
          +0010 0000000100006908  FFFFFFFF FFFFFFFF 00000000 00000000  |................|
          +0020 0000000100006918  00000000 00000000 00000000 00000000  |................|
          +0030 0000000100006928  FFFFFFFF FFFFFFFF 00000000 00000000  |................|
          +0040 0000000100006938  00000000 00000000 00000000 00000000  |................|
⋮
          +0190 0000000100006A88  FFFFFFFF FFFFFFFF 00000000 00000000  |................|
          +01A0 0000000100006A98  00000000 00000000 00000000 00000000  |................|
       Mutex and Condition Variable Blocks (MCVB+MHT+CHT)(00000001089100B8)
          +0000 00000001089100B8  00000000 00011E78 00000001 08910100  |............... j..|
          +0010 00000001089100C8  000007F0 00007F00 00000000 00000000  |...0..".........|
          +0020 00000001089100D8  00000001 08FC7470 00000001 08910900  |............... j..|
          +0030 00000001089100E8  000001F0 00001F00 00000000 00000000  |...0............|
          +0040 00000001089100F8  00000001 08FC74B0 00000000 00000000  |................|
          +0050 0000000108910108  00000000 00000000 00000000 00000000  |................|
          +0060 0000000108910118 - +00014F 0000000108910207             same as above
⋮
          +04B0 0000000108910568 - +00097F 0000000108910A37             same as above
          +0980 0000000108910A38  00000001 08FC74F0 00000000 00000000  |.......0........|
          +0990 0000000108910A48  00000000 00000000 00000000 00000000  |................|
          +09A0 0000000108910A58 - +000A2F 0000000108910AE7             same as above
          +0A30 0000000108910AE8  00000001 08FC73F0 00000000 00000000  |.......0........|
          +0A40 0000000108910AF8  00000001 08FC7430 00000000 00000000  |................|
       Thread Synchronization Enclave Latch Table (EPALT)(0000000108910B00)
          +0000 0000000108910B00  00000000 00000000 00000000 00000000  |................|
          +0010 0000000108910B10 - +00015F 0000000108910C5F             same as above
          +0160 0000000108910C60  00000000 00000000 DA8ADF60 00000000  |...........-....|
          +0170 0000000108910C70  00000000 257520A0 00000001 08911118  |............ j..|
          +0180 0000000108910C80  00000000 00000000 00000000 00000000  |................|
          +0190 0000000108910C90 - +00022F 0000000108910D2F             same as above
⋮
          +0B00 0000000108911600 - +000C6F 000000010891176F             same as above
          +0C70 0000000108911770  00000000 2538B4E0 00000000 00000000  |................|
          +0C80 0000000108911780  00000000 00000000 00000000 00000000  |................|
          +0C90 0000000108911790 - +0013FF 0000000108911EFF             same as above

       DLL Information:
       WSA Addr          Module Addr          Thread ID         Use Count  Name
       0000000108300050                                        00000001   main
       0000000108371090  0000000002575B000     253E019000000000  00000001   CELQDLL
       0000000108390510  0000000025777000     253E019000000000  00000002   CDAEQED
       0000000108396110  00000000257F5000     253E019000000000  00000001   CDAEQDPI
       00000001083A0430  00000000258C4000     253E019000000000  00000001   CELQDSNF

       HEAPCHK Option Control Block (HCOP)(00000001089234D0)
          +0000 00000001089234D0  C8C3D6D7 00000048 00000001 00000000  |HCOP............|
          +0010 00000001089234E0  00000000 0000000A 0000000A 00000000  |................|
          +0020 00000001089234F0  00000001 08FC0090 00000001 08923518  |.............k..|
          +0030 0000000108923500  00000001 08A00050 00000000 00000000  |.......&........|
          +0040 0000000108923510  00000000 00000000 C8C3C6E3 00004000  |........HCFT.. .|
```

Figure 143. Example dump using CEE3DMP (Part 6 of 9)

```
      HEAPCHK Element Table (HCEL) for Heapid 0000000100100138 :
Header(0000000108FC0090)
  +0000 0000000108FC0090  C8C3C5D3 00000000 00000000 00000000  |HCEL............|
  +0010 0000000108FC00A0  00000000 00000000 00000001 00100138  |................|
  +0020 0000000108FC00B0  000001F4 0000000F 00000010 00000000  |...4............|
                          Address           Seg Address        Length

Table(0000000108FC00C0)
  +0000 0000000108FC00C0  00000001 08300040 00000001 08300000  00000000 00000180 00000001 08FC3F50
  +0020 0000000108FC00E0  00000001 083001C0 00000001 08300000  00000000 00019660 00000001 08FC5B30
  +0040 0000000108FC0100  00000001 08319820 00000001 08300000  00000000 00025B40 00000001 08FC5C90
  +0060 0000000108FC0120  00000001 0833F360 00000001 08300000  00000000 00019340 00000001 08FC5EB0
  +0080 0000000108FC0140  00000001 083586A0 00000001 08300000  00000000 000189E0 00000001 08FC6010
  +00A0 0000000108FC0160  00000001 08371080 00000001 08300000  00000000 00000060 00000001 08FC7050
  +00C0 0000000108FC0180  00000001 083710E0 00000001 08300000  00000000 0001F420 00000001 08FC7530
  +00E0 0000000108FC01A0  00000001 08390500 00000001 08300000  00000000 00005C00 00000001 08FEC4F0
  +0100 0000000108FC01C0  00000001 08396100 00000001 08300000  00000000 0000A320 00000001 08FEE1D0
  +0120 0000000108FC01E0  00000001 083A0420 00000001 08300000  00000000 00000180 00000001 08FEE4F0
  +0140 0000000108FC0200  00000001 083A05A0 00000001 08300000  00000000 00017400 00000001 08FEE6F0
  +0160 0000000108FC0220  00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000
  +0180 0000000108FC0240  00000001 083B79A0 00000001 08300000  00000000 00017720 00000001 08FEEA50
  +01A0 0000000108FC0260  00000001 19D00040 00000001 19D00000  00000000 00032360 00000001 08FEEC10
  +01C0 0000000108FC0280  00000001 19D323A0 00000001 19D00000  00000000 000280C0 00000001 08FEEDB0
  +01E0 0000000108FC02A0  00000001 19D5A460 00000001 19D00000  00000000 000321A0 00000001 08FEEF70

Language Environment Trace Table:

      Most recent trace entry is at displacement: 000680

      Displacement                    Trace Entry in Hexadecimal                                  Trace Entry in EBCDIC
      ------------ ------------------------------------------------------------------------  --------------------------------
        +000000    Time 21.19.55.717535    Date 2007.01.17    Thread ID... 253E019000000000
        +000010    Member ID.... 01    Flags..... 000000    Entry Type..... 00001000
        +000018    40404040 40404040 40404040 40404040  40404040 40404040 40404040 40404040  |                                |
        +000038    40404040 40404040 40404040 40404040  40404040 40404040 40404040 40404040  |                                |
        +000058    40404040 40404040 40404040 40404040  40404040 40404040 40404040 40404040  |                                |
        +000078    40404040 40404040                                                         |                                |

        +000080    Time 21.19.55.717715    Date 2007.01.17    Thread ID... 253E019000000000
        +000090    Member ID.... 01    Flags..... 000000    Entry Type..... 00001010
        +000098    C3C5C5D7 C2D24040 00000070 00000000  00000000 257669A0 00001660 00000000  |CEEPBK  ...................-....|
        +0000B8    00000001 11400000 00000000 000024D0  00000001 11400360 00000001 114013C8  |..... ............... .-..... .H|
        +0000D8    00000001 11401F38 00000001 11402010  00000001 08300060 00000000 25000658  |..... ....... .........-........|
        +0000F8    24000000 00000000                                                         |........                        |

        +000100    Time 21.19.55.717821    Date 2007.01.17    Thread ID... 253E019000000000
        +000110    Member ID.... 01    Flags..... 000000    Entry Type..... 00001011
        +000118    253E10A0 00000001 00000000 7F7547D8  00000000 257669A0 00001660 00000000  |............"..Q...........-....|
        +000138    00000001 11400000 00000000 000024D0  00000001 11400360 00000001 114013C8  |..... ............... .-..... .H|
        +000158    00000001 11401F38 00000001 11402010  00000001 08300060 00000000 25000658  |..... ....... .........-........|
        +000178    24000000 00000000                                                         |........                        |

        +000180    Time 21.19.55.717823    Date 2007.01.17    Thread ID... 253E019000000000
        +000190    Member ID.... 01    Flags..... 000000    Entry Type..... 000010F0
        +000198    00000000 00000000 00000000 00000000  00000000 257669A0 00001660 00000000  |............................-....|
        +0001B8    00000001 11400000 00000000 000024D0  00000001 11400360 00000001 114013C8  |..... ............... .-..... .H|
        +0001D8    00000001 11401F38 00000001 11402010  00000001 08300060 00000000 25000658  |..... ....... .........-........|
        +0001F8    24000000 00000000                                                         |........                        |

        +000200    Time 21.19.55.717845    Date 2007.01.17    Thread ID... 253E019000000000
        +000210    Member ID.... 01    Flags..... 000000    Entry Type..... 00001000
        +000218    40404040 40404040 40404040 40404040  40404040 40404040 40404040 40404040  |                                |
        +000238    40404040 40404040 40404040 40404040  40404040 40404040 40404040 40404040  |                                |
        +000258    40404040 40404040 40404040 40404040  40404040 40404040 40404040 40404040  |                                |
        +000278    40404040 40404040                                                         |                                |


        +000280    Time 21.19.55.717974    Date 2007.01.17    Thread ID... 253E019000000000
        +000290    Member ID.... 01    Flags..... 000000    Entry Type..... 00001010
        +000298    C3C5C5D7 C2D24040 00000070 00000000  00000000 257689A0 00001660 00000000  |CEEPBK  ..............i....-....|
        +0002B8    00000001 19900000 00000000 000024D0  00000001 19900360 00000001 199013C8  |.......................-.......H|
        +0002D8    00000001 19901F38 00000001 19902010  00000001 08300060 00000000 25000664  |.......................-........|
        +0002F8    24000000 00000000                                                         |........                        |
```

Figure 143. Example dump using CEE3DMP (Part 7 of 9)

```
+000300    Time 21.19.55.718015    Date 2007.01.17    Thread ID... 253E019000000000
+000310    Member ID.... 01    Flags..... 000000    Entry Type..... 00001011
+000318    253E1FB0 00000002 00000000 7F7547D8  00000000 257689A0 00001660 00000000  |............"..Q......i....-....|
+000338    00000001 19900000 00000000 000024D0  00000001 19900360 00000001 199013C8  |......................-.......H|
+000358    00000001 19901F38 00000001 19902010  00000001 08300060 00000000 25000664  |......................-........|
+000378    24000000 00000000                                                        |........                        |

+000380    Time 21.19.55.718016    Date 2007.01.17    Thread ID... 253E019000000000
+000390    Member ID.... 01    Flags..... 000000    Entry Type..... 000010F0
+000398    00000000 00000000 00000000 00000000  00000000 257689A0 00001660 00000000  |......................i....-....|
+0003B8    00000001 19900000 00000000 000024D0  00000001 19900360 00000001 199013C8  |......................-.......H|
+0003D8    00000001 19901F38 00000001 19902010  00000001 08300060 00000000 25000664  |......................-........|
+0003F8    24000000 00000000                                                        |........                        |

+000400    Time 21.19.55.719149    Date 2007.01.17    Thread ID... 253E1FB000000002
+000410    Member ID.... 01    Flags..... 000000    Entry Type..... 00001910
+000418    253E1FB0 00000002 00000001 19901FA0  00000001 19901F38 80000000 00000000  |................................|
+000438    00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
+000458    00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
+000478    00000000 00000000                                                        |........                        |

+000480    Time 21.19.55.719199    Date 2007.01.17    Thread ID... 253E1FB000000002
+000490    Member ID.... 01    Flags..... 000000    Entry Type..... 00001930
+000498    253E1FB0 00000002 00000001 19901FA0  00000001 19901F38 80000000 00000000  |................................|
+0004B8    00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
+0004D8    00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
+0004F8    00000000 00000000                                                        |........                        |

+000500    Time 21.19.55.719713    Date 2007.01.17    Thread ID... 253E10A000000001
+000510    Member ID.... 01    Flags..... 000000    Entry Type..... 00001910
+000518    253E10A0 00000001 00000001 11401FA0  00000001 11401F38 80000000 00000000  |.............. ....... ..........|
+000538    00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
+000558    00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
+000578    00000000 00000000                                                        |........                        |

+000580    Time 21.19.55.719742    Date 2007.01.17    Thread ID... 253E10A000000001
+000590    Member ID.... 01    Flags..... 000000    Entry Type..... 00001930
+000598    253E10A0 00000001 00000001 11401FA0  00000001 11401F38 80000000 00000000  |.............. ....... ..........|
+0005B8    00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
+0005D8    00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
+0005F8    00000000 00000000                                                        |........                        |

+000600    Time 21.19.55.719935    Date 2007.01.17    Thread ID... 253E019000000000
+000610    Member ID.... 01    Flags..... 000000    Entry Type..... 00000700
+000618    00000000 00000000 00000000 00000000  00000000 00000000 00000001 00005340  |................................ |
+000638    00000008 00400579 00000000 00000001  00000001 082FE020 00000000 253D3012  |..... ..........................|
+000658    001F2000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
+000678    00000000 00000000                                                        |........                        |

+000680    Time 21.19.55.719939    Date 2007.01.17    Thread ID... 253E019000000000
+000690    Member ID.... 01    Flags..... 000000    Entry Type..... 00000701
+000698    00000001 80000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
+0006B8    00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
+0006D8    00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000  |................................|
+0006F8    00000000 00000000                                                        |........                        |

  Heap Storage Diagnostics
    All storage has been freed.
⋮
```

Figure 143. Example dump using CEE3DMP (Part 8 of 9)

```
[12]  Run-Time Options Report:

       LAST WHERE SET                OPTION
       ------------------------------------------------------------------------------
       DD:CEEOPTS                      CEEDUMP(0,SYSOUT=*,FREE=END,SPIN=UNALLOC)
       Installation default            DYNDUMP(*USERID,NODYNAMIC,TDUMP)
       Installation default            ENVAR("")
       Installation default            FILETAG(NOAUTOCVT,NOAUTOTAG)
       DD:CEEOPTS                      HEAPCHK(ON,1,0,10,10)
       DD:CEEOPTS                      HEAPPOOLS(ON,8,10,32,10,128,10,256,10,1024,10,2048,10,0,10,0,10,0,10,0,10,0,10,0,10,0,10)
       DD:CEEOPTS                      HEAPPOOLS64(ON,8,4000,32,2000,128,700,256,350,1024,100,2048,50,3072,50,4096,50,8192,25,
                                         16384,10,32768,5,65536,5)
       Installation default            HEAP64(1M,1M,KEEP,32768,32768,KEEP,4096,4096,FREE)
       Installation default            INFOMSGFILTER(OFF,,,,)
       Installation default            IOHEAP64(1M,1M,FREE,12288,8192,FREE,4096,4096,FREE)
       Installation default            LIBHEAP64(1M,1M,FREE,16384,8192,FREE,8192,4096,FREE)
       Installation default            NATLANG(ENU)
       Programmer default              POSIX(ON)
       Installation default            PROFILE(OFF,"")
       DD:CEEOPTS                      RPTOPTS(ON)
       DD:CEEOPTS                      RPTSTG(ON)
       Installation default            STACK64(1M,1M,128M)
       Installation default            STORAGE(NONE,NONE,NONE,)
       Programmer default              TERMTHDACT(UADUMP,,96)
       Installation default          NOTEST(ALL,"*","PROMPT","INSPPREF")
       Installation default            THREADSTACK64(OFF,1M,1M,128M)
       DD:CEEOPTS                      TRACE(ON,1048576,NODUMP,LE=8)
       Installation default            TRAP(ON,SPIE)
 [13]  Process Control Blocks:

        PCB(0000000100003CA0)
          +0000 0000000100003CA0  C3C5C5D7 C3C24040 00000000 00000000  |CEEPCB  ........|
          +0010 0000000100003CB0  00000000 00000000 00000000 00000000  |................|
          +0020 0000000100003CC0 - +0000FF 0000000100003D9F             same as above
          +0100 0000000100003DA0  03030208 00000000 00000000 00000000  |................|
          +0110 0000000100003DB0  00000001 00004048 00000000 00000000  |...... .........|
          +0120 0000000100003DC0  00000000 00000000 00000000 00000000  |................|
          +0130 0000000100003DD0  00000000 00000000 00000001 00003A10  |................|
          +0140 0000000100003DE0  7FC00000 00000000 00000000 00000000  |".............. |
          +0150 0000000100003DF0  00000000 00000000 00000000 00000000  |................|
          +0160 0000000100003E00  00000000 252A3F48 00000000 00000000  |................|
          +0170 0000000100003E10  00000000 00000000 00000000 00000000  |................|
          +0180 0000000100003E20 - +0001BF 0000000100003E5F             same as above
        MEML(0000000100004048)
          +0000 0000000100004048  00000000 00000000 00000000 00000000  |................|
          +0010 0000000100004058 - +00005F 00000001000040A7             same as above
          +0060 00000001000040A8  00000001 00008688 00000000 00000000  |......fh........|
          +0070 00000001000040B8  00000000 00000000 00000000 00000000  |................|
          +0080 00000001000040C8 - +0001AF 00000001000041F7             same as above
        Thread Synchronization Process Latch Table (PPALT)(0000000108911F00)
          +0000 0000000108911F00  DA8ADF60 00000000 00000000 257520A0  |...-............|
          +0010 0000000108911F10  00000001 08911050 00000000 00000000  |.....j.&........|
          +0020 0000000108911F20  00000000 00000000 00000000 00000000  |................|
          +0030 0000000108911F30 - +00009F 0000000108911F9F             same as above
          +00A0 0000000108911FA0  DA8ADF60 00000000 00000000 257520A0  |...-............|
          +00B0 0000000108911FB0  00000001 08911500 00000000 00000000  |.....j..........|
          +00C0 0000000108911FC0  00000000 00000000 00000000 00000000  |................|
          +00D0 0000000108911FD0 - +0013FF 00000001089132FF             same as above
[14]CEE3846I CEEDUMP Processing completed.
```

Figure 143. Example dump using CEE3DMP (Part 9 of 9)

Sections of the Language Environment dump

The sections of the dump listed here appear independently of the Language Environment-conforming languages used.

[1] Page Heading

The page heading section appears on the top of each page of the dump and contains:

- CEE3DMP identifier
- Title

  For dumps generated as a result of an unhandled condition, the title is “Condition processing resulted in the Unhandled condition.”

- Product abbreviation of Language Environment
- Version number
- Release number
- Date
- Time
- Page number

For CEEDUMPs produced under a batch environment, the following items are displayed:

- ASID

  Describes the address space ID.
- Job ID

  Describes the JES Job ID.
- Job name

  Describes the job name.
- Step name:

  Describes the job's step name in which the CEEDUMP was produced.
- UserID:

  Describes the TSO userid who issued the job.

For jobs running with POSIX(ON), the following additional items are displayed:

- PID

  Displays the associated process ID.
- Parent PID

  Displays the associated parent PID.

For CEEDUMPs produced under the z/OS UNIX shell, the following items are displayed:

- ASID

  Describes the address space ID.
- PID

  Displays the associated process ID.
- Parent PID

  Displays the associated parent PID.
- User name

  Contains the userid associated to the CEEDUMP.

[2] CEE3845I CEEDUMP Processing started.

Message CEE3845I identifies the start of the Language Environment dump processing. Similarly, message CEE3846I identifies the end of the dump processing, Message number CEE3845I can be used to locate the start of the next CEEDUMP report when scanning forward in a data set that contains several CEEDUMP reports.

[3] Enclave Information

These sections show information that is specific to an enclave.

[3] Enclave Identifier

This statement names the enclave for which information in the dump is provided.

[4] - [10] Thread Information

These sections show information that is specific to a thread. When multiple threads are dumped, these sections will appear for each thread.

[4] Information for thread

This section shows the system identifier for the thread. Each thread has a unique identifier.

[5] Traceback

For all active routines in a particular thread, the traceback section shows routine information in three parts. The first part contains:

- DSA number

  A number assigned to the information for this active routine by dump processing. The number is used to associate information from the first part of the traceback with information in the second and third parts of the traceback.
- Entry

  For C/C++ routines, this is the function name. If a function name or entry point was not specified for a particular routine, then the string '** NoName **' will appear.
- Entry point offset
- Statement number

  Refers to the line number in the source code (program unit) in which a call was made or an exception took place. The statement number appears only if your routine was compiled with the options required to generate statement numbers. These options are described under "XL C and XL C++ compiler options for AMODE 64 applications" on page 359.
- Load module

  The load module name displayed can be a partitioned data set member or an UNIX executable file. The load module name is also displayed in the third part of the traceback (see below for details).
- Program unit

  The primary entry point of the external procedure. For C routines, this is the compile unit name. For Language Environment-conforming assemblers, this is the ENTNAME = value on the CELQPRLG macro.

  If your routine was compiled with the compile options to generate statement numbers then the program unit name displayed under this column will appear as follows:

  – If your compiled routine is in a partitioned data set then only the member will be output.
  – If your compiled routine is in a sequential data set then only the last qualifier will be shown.
  – If your compiled routine is in an UNIX filename then only what fits of the filename will be displayed in a line.

  Look for the complete name of the program unit in the Fully Qualified Names section of the traceback, if your routine was compiled using compile options to generate statement numbers.
- Service level

The latest service level applied to the compile unit (for example, for IBM products, it would be the PTF number).

- Status

  Routine status can be call or exception.

The second part contains:

- DSA number

  A number assigned to the information for this active routine by dump processing. The number is used to associate information from the first part of the traceback with information in the second and third parts of the traceback.
- Stack frame (DSA) address
- Entry point address
- Program unit address
- Program unit offset

  The offset of the last instruction to run in the routine. If the offset is a negative number, zero, or a very large positive number, the routine associated with the offset probably did not allocate a save area or the routine could have been called using SVC-assisted linkage. Adding the program unit address to the offset gives you the location of the current instruction in the routine. This offset is from the starting address of the routine.
- Compile Date
- Attributes

  The attributes of the compile unit including whether character data is being treated as EBCDIC or ASCII and whether floating point data is being treated as IEEE or hexadecimal.

The third part, which is also referred to as 'Fully Qualified Names' section, contains the following:

- DSA number
- Entry
- Program unit

  Similar to the Program Unit column in part 1 except that the server name and the complete program unit (PU) name will be displayed. A PU name will appear here only if it was compiled using compile options to produce statement numbers.
- Load Module

  The complete pathname of a load module name residing in an UNIX filename will be displayed here if available. The load module's full pathname will be displayed if the PATH environment variable is set such that the pathname of the load module's directory appears before the current directory (.). For load modules found in data sets, the same output shown in the traceback part 1 will also be displayed here.

[6] Condition Information for Active Routines

This section displays the following information for all conditions currently active on the call chain:

- Statement showing failing routine and stack frame address of routine
- Condition information block (CIB) address
- Current condition, in the form of a Language Environment message for the condition raised or a Language Environment abend code, if the condition was caused by an abend

- Location

  For the failing routine, this is the program unit, entry routine, statement number, and offset.
- Machine state, which shows:
  - Instruction length counter (ILC)
  - Interruption code
  - *Program status word (PSW)*
  - Contents of GPRs 0–15. Contents of floating point content register (FPC) and floating point registers FPR 0-15.
  - Storage dump near condition (2 hex-bytes of storage near the PSW)
  - Storage pointed to by General Purpose Registers

  These values are the current values at the time the condition was raised.

[7] Parameters, Registers, and Variables for Active Routines

For each active routine, this section shows:

- Routine name and stack frame address
- Saved registers

  This lists the contents of GPRs 0–15 at the time the routine received control. The saved registers are those saved by the DSA-owning routine on entry. Register 7 is the return address back to the caller of the DSA-owning routine. Register 6 may be the entry point of the DSA-owning routine. (This is not true when the Branch Relative and Save instruction is used to implement the call. The non-volatile floating-point registers that are saved in the stack frame. The registers are only displayed if the program owning the stack frame saved them. Dashes are displayed in the registers when the register values are not saved.
- Storage pointed to by the saved registers

  Treating the saved contents of each register as an address, 32 bytes before and 64 bytes after the address shown.

[8] Control Blocks for Active Routines

For each active routine controlled by the STACKFRAME option, this section lists contents of related control blocks. The Language Environment-conforming language determines which language-specific control blocks appear. The possible control blocks are:

- Stack frame
- Condition information block
- Language-specific control blocks

[9] Storage for Active Routines

This displays local storage for each active routine. The storage is dumped in hexadecimal, with EBCDIC translations on the right side of the page. There can be other information, depending on the language used. For C/C++ routines, this is the stack frame storage.

[10] Control Blocks Associated with the Thread

This section lists the contents of the Language Environment common anchor area (CAA), thread synchronization queue element (SQEL) and dummy stack frame. Other language-specific control blocks can appear in this section.

[11] Enclave Control Blocks

This section lists the contents of the Language Environment enclave data block (EDB) and enclave member list (MEML). The information presented may vary depending on which run-time options are set.

- If the POSIX run-time option is set to ON, this section lists the contents of the mutex and condition variable control blocks, the enclave level latch table, and the thread synchronization trace block and trace table.
- If DLLs have been loaded, this section shows information for each DLL including the DLL name, load address, use count, writeable static area (WSA) address, and the thread id of the thread that loaded the DLL.
- If the HEAPCHK run-time option is set to ON, this section shows the contents of the HEAPCHK options control block (HCOP) and the HEAPCHK element tables (HCEL). A HEAPCHK element table contains the location and length of all allocated storage elements for a heap in the order that they were allocated.
- When the *call-level* suboption of the HEAPHCK run-time option is set, any unfreed storage, which would indicate a storage leak, would be displayed in this area. The traceback could then be used to identify the program which did not free the storage.
- If the TRACE run-time option is set to ON, this section shows the contents of the Language Environment trace table.

Other language-specific control blocks can appear in this section.

[12] Run-Time Options Report

This section lists the Language Environment run-time options in effect when the routine was executed.

[13] Process Control Blocks

This section lists the contents for the Language Environment process control block (PCB), process member list (MEML), and if the POSIX run-time option is set to ON, the process level latch table. Other language-specific control blocks can appear in this section.

[14] CEE3846I CEEDUMP Processing completed.

Message CEE3846I identifies the end of the Language Environment dump processing. Similarly, message CEE3845I identifies the start of the dump processing, Message number CEE3846I can be used to locate the end of the previous CEEDUMP report when scanning backward in a data set that contains several CEEDUMP reports.

Generating a system dump

A system dump contains the storage information needed to diagnose errors. You can use Language Environment to generate a system dump through any of the following methods:

DYNDUMP(*hlq*,DYNAMIC,TDUMP)
: You can use the DYNDUMP run-time option to obtain IPCS readable dumps of user applications that would ordinarily be lost due to the absence of a SYSMDUMP, SYSUDUMP, or SYSABEND DD statement.

TERMTHDACT(UAONLY, UATRACE, or UADUMP)
You can use these run-time options, with TRAP(ON), to generate a system dump if an unhandled condition of severity 2 or greater occurs. For further details regarding the level of dump information produced by each of the TERMTHDACT suboptions, see “Generating a Language Environment dump with TERMTHDACT” on page 375.

TRAP(ON,NOSPIE) TERMTHDACT(UAIMM)
TRAP(ON,NOSPIE) TERMTHDACT(UAIMM) generates a system dump of the user address space of the original abend or program interrupt prior to the Language Environment condition manager processing the condition.

Abend Codes in Initialization Assembler User Exit
Abend codes listed in the initialization assembler user exit are passed to the operating system. The operating system can then generate a system dump.

__cabend()
You can use the `__cabend()` API to cause the operating system to handle an abend.

See system or subsystem documentation for detailed system dump information.

The method for generating a system dump varies for each of the Language Environment run-time environments. The following sections describe the recommended steps needed to generate a system dump in batch and z/OS UNIX shell run-time environments. Other methods may exist, but these are the recommended steps for generating a system dump.

For details on setting Language Environment run-time options, see *z/OS Language Environment Programming Guide*.

Steps for generating a system dump in a batch run-time environment

Perform the following steps to generate a system dump in a batch run-time environment:

1. Specify run-time options TERMTHDACT(UAONLY, UADUMP, UATRACE, or UAIMM), and TRAP(ON). If you specify the suboption UAIMM then you must set TRAP(ON,NOSPIE). The TERMTHDACT suboption determines the level of detail of the Language Environment formatted dump. For further details on the TERMTHDACT suboptions, see “Generating a Language Environment dump with TERMTHDACT” on page 375.
2. Decide whether to include a SYSMDUMP DD card or use the DYNDUMP run-time option.
   - Include a SYSMDUMP DD card with the desired data set name and DCB information:

     `LRECL=4160, BLKSIZE=4160, and RECFM=FBS.`
   - Specify the DYNDUMP run-time option with the following information:

     `DYNDUMP (hlq,DYNAMIC,TDUMP)`
3. Rerun the program.

When you are done, you have a generated system dump in a batch run-time environment.

Steps for generating a system dump in a z/OS UNIX shell

Perform the following steps to generate a system dump from a z/OS UNIX shell:

- Using _BPXK_MDUMP
  1. Specify where to write the system dump
     - To write the system dump to a z/OS data set, issue the command:

       ```
       export _BPXK_MDUMP=filename
       ```

       where *filename* is a fully qualified data set name with DCB information: LRECL=4160, BLKSIZE=4160, and RECFM=FBS.

       Example:

       ```
       export _BPXK_MDUMP=hlq.mydump
       ```
     - To write the system dump to an HFS file, issue the command:

       ```
       export _BPXK_MDUMP=filename
       ```

       where *filename* is a fully qualified HFS filename.

       Example:

       ```
       export _BPXK_MDUMP=/tmp/mydump.dmp
       ```
  2. Specify Language Environment run-time options:

     ```
     export _CEE_RUNOPTS="termthdact(suboption)"
     ```

     where *suboption* = UAONLY, UADUMP, UATRACE, or UAIMM. If UAIMM is set, TRAP(ON,NOSPIE) must also be set. The TERMTHDACT suboption determines the level of detail of the Language Environment formatted dump. For further details regarding the TERMTHDACT suboptions, see “Generating a Language Environment dump with TERMTHDACT” on page 375.
  3. Rerun the program.

  When you are done, the system dump is written to the data set name or HFS file name specified.

  For additional BPXK_MDUMP information see *z/OS UNIX System Services Command Reference*.
- Using DYNDUMP
  1. Specify Language Environment run-time options:

     ```
     export _CEE_RUNOPTS="termthdact(suboption),DYNDUMP(hlq,DYNAMIC,TDUMP)"
     ```

     where:
     - *suboption* = UAONLY, UADUMP, UATRACE, or UAIMM. If UAIMM is set, TRAP(ON,NOSPIE) must also be set. The TERMTHDACT suboption determines the level of detail of the Language Environment formatted dump. For further details regarding the TERMTHDACT suboptions, see “Generating a Language Environment dump with TERMTHDACT” on page 375.
     - *hlq* is the high level qualifier for the dump data set to be created.
  2. Rerun the program.

  When you are done, the system dump is written to the name generated by the DYNDUMP run-time option.

  For additional DYNDUMP information see *z/OS Language Environment Programming Reference*.

Note: You can also specify the signal SIGDUMP on the kill command to generate a system dump of the user address space. For more information regarding the SIGDUMP signal, see *z/OS UNIX System Services Command Reference*.

Formatting and analyzing system dumps

You can use the Interactive Problem Control System (IPCS) to format and analyze system dumps. Language Environment provides an IPCS Verbexit LEDATA that can be used to format Language Environment control blocks.

For more information on using IPCS, see *z/OS MVS IPCS User's Guide*.

Preparing to use the Language Environment support for IPCS

Guidelines: Use the following guidelines before you use IPCS to format Language Environment control blocks:

- Ensure that your IPCS job can find the CEEIPCSP member.

  IPCS provides an exit control table with imbed statements to enable other products to supply exit control information. The IPCS default table, BLSCECT, normally in the SYS1.PARMLIB library, has the following entry for Language Environment:

  ```
  IMBED MEMBER(CEEIPCSP) ENVIRONMENT(IPCS)
  ```

  The Language Environment-supplied CEEIPCSP member, installed in the SYS1.PARMLIB library, contains the Language Environment-specific entries for the IPCS exit control table.
- Provide an IPCSPARM DD statement to specify the libraries containing the IPCS control tables.

  Example:

  ```
  //IPCSPARM  DD  DSN=SYS1.PARMLIB,DISP=SHR
  ```
- Ensure that your IPCS job can find the Language Environment-supplied ANALYZE exit routines installed in the SYS1.MIGLIB library.
- To aid in debugging system or address space hang situations, Language Environment mutexes, latches and condition variables can be displayed if the CEEIPSCP member you are using is updated to identify the Language Environment ANALYZE exit, by including the following statement:

  ```
  EXIT EP(CEEEANLZ) ANALYZE
  ```

Language Environment IPCS Verbexit – LEDATA

Use the LEDATA Verbexit to format data for Language Environment. This Verbexit provides information about the following topics:

- A summary of Language Environment at the time of the dump
- Run-time Options
- Storage Management Control Blocks
- Condition Management Control Blocks
- Message Handler Control Blocks
- C/C++ Control Blocks

Format

Syntax

VERBEXIT LEDATA ['parameter[,parameter]...']

- Report Type Parameters:
  - [**AUTH**]
  - [**NTHREADS**(*value*)]
  - [**SUM**]
  - [**HEAP** | **STACK** | **SM**]
  - [**HPT**(*number*) [**HPTTCB** (*address*)] [**HPTCELL**(*address*)] [**HPTLOC**(*location*)]]
  - [**CM**]
  - [**MH**]
  - [**CEEDUMP**]
  - [**COMP**(*(value)*)]
  - [**PTBL(value)**]
  - [**ALL**]
- Data Selection Parameters:
  - [**DETAIL** | **EXCEPTION**]
- Control Block Selection Parameters:
  - [**CAA**(*caa-address*)]
  - [**DSA**(*dsa-address*)]
  - [**TCB**(*tcb-address*)]
  - [**ASID**(*address-space-id*)]
  - [**LAA**(*laa-address*)]

Parameters

Report type parameters

Use these parameters to select the type of report. If you omit these parameters, the default is SUMMARY.

Address space report types: Use these parameters to select a report that shows the Language Environment activity for an address space. Only one of these reports may be specified.

NTHREADS(value)
Requests a report that shows the traceback for the TCBs in the address space. *value* is the number of TCBs for which the traceback will be displayed. If *value* is specified as asterisk (*), all TCBs will be displayed. The LAA, CAA, or TCB parameter can be used to limit the display to only TCBs that are part of the same enclave.

AUTH
Requests a report on all Preinitialized Environments for Authorized Programs control blocks for the address space. NTHREADS is ignored when AUTH is specified.

PTBL(value)
Requests that PreInit tables be formatted according to the following values:,

CURRENT
If current is specified, the PreInit table associated with the current or specified TCB is displayed.

address
If an address is specified, the PreInit table at that address is specified.

***** All active and dormant PreInit tables within the current address space are displayed; this option is time-consuming.

ACTIVE
The PreInit tables for all TCBs in the address space are displayed.

Thread specific report types: Use these parameters to select reports that show Language Environment activity for a specific TCB. These report types are ignored if AUTH or NTHREADS is specified. You can specify as many of these reports as you wish.

SUMmary
Requests a summary of the Language Environment at the time of the dump. The following information is included:
- TCB address
- Address Space Identifier
- Language Environment Release
- Active members
- Formatted CAA, PCB, RCB, EDB, LAA and LCA
- Run-time Options in effect

HEAP | STACK | SM

HEAP
Requests a report on Storage Management control blocks pertaining to HEAP storage, as well as a detailed report on heap segments. The detailed report includes information about the free storage tree in the heap segment, and information about each allocated storage element. It also specifies a heappools report with information useful to find potential damaged cells.

Note: Language Environment does not provide support for alternative Vendor Heap Manager (VHM) data.

STACK
Requests a report on Storage Management control blocks pertaining to STACK storage.

SM
Requests a report on Storage Management control blocks. This is the same as specifying both HEAP and STACK.

HPT(*number***) [HPTTCB (***address***)] [HPTCELL(***address***)] [HPTLOC(***location***)]**

HPT(*number***)**
Requests that the heappools trace, if available, be formatted. If the value is 0 or *, the trace for every heappools poolid is formatted. If the value is a single number (1-12), the trace for the specific heappools poolid is formatted. If only the HPT keyword is specified with no value, the trace behaves similar to when the value is *. If no filter is specified, all of the entries are formatted for the specific poolid.

HPTTCB (*address***)**
Filters the heappool trace table, if available, printing only those entries for a given TCB address (*address*).

HPTCELL(*address***)**
Filters the heappool trace table, if available, printing only those entries for a given cell address (*address*).

HPTLOC(*value*)
Filters the heappool trace table, if available, printing only those entries for a given virtual storage location (*location*). The following values are valid:

- 31: Display entries located in virtual storage below the bar.
- 64: Display entries located in virtual storage above the bar.
- ALL: Display entries located in virtual storage below or above the bar.

Notes:

1. Filter options without specifying HPT implies HPT(*).
2. User can specify multiple options together, like HPTTCB and HPTCELL. All pieces of information must match the trace entry for it to be formatted. If location and cell contradict each other, such as HPTLOC(31) and HPTCELL(64bit addr), an error will be displayed.

CM
Requests a report on Condition Management control blocks.

MH
Requests a report on Message Handler control blocks.

CEEdump
Requests a CEEDUMP-like report. Currently this includes the traceback, the Language Environment trace, and thread synchronization control blocks at process, enclave and thread levels.

ALL
Requests all above reports, as well as C/C++ reports.

COMP(value)
Requests component control blocks to be formatted according to the following values:

C Requests a report on C/C++ Run-Time control blocks.

CIO
Requests a report on C/C++ I/O control blocks.

COBOL
Requests a report on COBOL-specific control blocks.

ALL
Requests a report on all the previous control blocks.

If the value specified in COMP is not one of the values (C, CIO, COBOL, or ALL), a message is displayed and it continues executing as if COMP(ALL) was specified.

Note: The ALL parameter for LEDATA also generates a report that includes all the component control blocks.

Data selection parameters

Data selection parameters limit the scope of the data in the report. If no data selection parameter is selected, the default is DETAIL.

DETail
Requests formatting all control blocks for the selected components. Only significant fields in each control block are formatted.

Note: For the Heap and Storage Management Reports, the DETAIL parameter will provide a detailed heap segment report for each heap segment in the dump. The detailed heap segment report includes information on the free storage tree in the heap segments, and all allocated storage elements. This report will also identify problems detected in the heap management data structures. For more information about the Heap Reports, see "Understanding the HEAP LEDATA output" on page 418.

EXCeption
Requests validating all control blocks for the selected components. Output is only produced naming the control block and its address for the first control block in a chain that is invalid. Validation consists of control block header verification at the very least.

Note: For the Summary, CEEDUMP, C/C++ reports, the EXCEPTION parameter has not been implemented. For these reports, DETAIL output is always produced.

Control block selection parameters

Use these parameters to select the control blocks used as the starting points for formatting.

CAA(caa-address)
specifies the address of the CAA. If not specified, the CAA address is obtained from the LAA.

DSA(dsa-address)
specifies the address of the DSA. If not specified, the DSA address may be obtained from the TCB or the IPCS symbol REGGEN.

TCB(tcb-address)
specifies the address of the TCB. If not specified, the TCB address may be obtained from the CAA or the CVT.

LAA(laa-address)
specifies the address of the LAA. If not specified, the LAA address may be obtained from the TCB or the PSA.

ASID(address-space-id)
specifies the hexadecimal address space id. If not specified, the IPCS default address space id is used. This parameter is not needed when the dump only has one address space.

Usage Note: Only hexadecimal characters can be specified as addresses provided in LEDATA parameters. Special characters cause the formatter to fail. Therefore, in order to specify a 64 bit address as a parameter, it must be in the form like 123456789 instead of 1_23456789.

Understanding the Language Environment IPCS Verbexit LEDATA output

The Language Environment IPCS Verbexit LEDATA generates formatted output of the Language Environment run-time environment control blocks from a system dump. Figure 144 on page 403 illustrates the output produced when the LEDATA Verbexit is invoked with the ALL parameter. The system dump being formatted was obtained by specifying the TERMTHDACT(UADUMP) run-time option when running the program CELQSAMP in Figure 141 on page 379. "Sections of the Language

Environment LEDATA Verbexit formatted output" on page 412 describes the information contained in the formatted output. Ellipses are used to summarize some sections of the dump.

For easy reference, the sections of the following dump are numbered to correspond with the descriptions in "Sections of the Language Environment LEDATA Verbexit formatted output" on page 412.

```
 ALL
********************************************************************************
                  64 BIT LANGUAGE ENVIRONMENT DATA
********************************************************************************

 Language Environment Product 04 V01 R09.00

[1]  Information for enclave main

[2]    Information for thread 253E019000000000
       TCB Address: 007FF050
       CAA Address: 00000001_00007B18
       PCB Address: 00000001_00003CA0

[3]    Registers and PSW:
       GPR0..... 0000000084000000  GPR1..... 0000000084000FC7  GPR2..... 00000001082FBE00  GPR3..... 3C10000000000000
       GPR4..... 00000001082FA900  GPR5..... 00000000253C45F8  GPR6..... 00000000253C4500  GPR7..... 00000000251B9B1A
       GPR8..... 00000001082FBE00  GPR9..... 00000000253C459A  GPR10.... 00000001082FBABF  GPR11.... 00000001082FBE00
       GPR12.... 00000001082FBB08  GPR13.... 00000001082FE680  GPR14.... 0000000100005DC8  GPR15.... 0000000000000000
       PSW..... 07851401 80000000 00000000 253C459A

[4]    Traceback:
         DSA      Entry       E  Offset  Statement   Load Mod            Program Unit                  Service  Status
         1        CEEHSDMP    +0000009A              CELQLIB             CEEHSDMP                      D1908    Call
         2        CEEHDSP     +00003AB8              CELQLIB             CEEHDSP                       D1908    Call
         3        CEEOSIGJ    +0000094E              CELQLIB             CEEOSIGJ                      D1908    Call
         4        CELQHROD    +0000024E              CELQLIB             CELQHROD                      D1908    Call
         5        CEEOSIGG    +00000000              CELQLIB             CEEOSIGG                      D1908    Call
         6        CELQHROD    +0000024E              CELQLIB             CELQHROD                      D1908    Call
         7        div_zero    +00000040              CELQDLL                                           1.4.f    Exception
         8        main        +00000468              CELQSAMP                                          1.2.d    Call
         9        CELQINIT    +0000134C              CELQLIB             CELQINIT                      D1908    Call

         DSA      DSA Addr           E Addr             PU Addr            PU Offset   Comp Date  Compile Attributes
         1        00000001_082FA900  00000000_253C4500  00000000_253C4500  +0000009A0  20061215   CEL       POSIX XPLINK EBCDIC  HFP
         2        00000001_082FAAC0  00000000_251B6060  00000000_251B6060  +00003AB80  20061215   CEL       POSIX XPLINK EBCDIC  HFP
         3        00000001_082FD3E0  00000000_2504AAB0  00000000_2504AAB0  +0000094E0  20070109   CEL       POSIX XPLINK EBCDIC  HFP
         4        00000001_082FDDE0  00000000_251C9480  00000000_251C9480  +0000024E0  20061215   CEL       POSIX XPLINK EBCDIC  HFP
         5        00000001_082FE020  00000000_253D11F8  00000000_253D11F8  +000000000  20061215   CEL       POSIX XPLINK EBCDIC  HFP
         6        00000001_082FEE40  00000000_251C9480  00000000_251C9480  +0000024E0  20061215   CEL       POSIX XPLINK EBCDIC  HFP
         7        00000001_082FF080  00000000_2575B5A0  00000000_00000000  +2575B5E00  20070116   C/C++     POSIX XPLINK EBCDIC  IEEE
         8        00000001_082FF180  00000000_250000D8  00000000_00000000  +250005400  20070116   C/C++     POSIX XPLINK EBCDIC  IEEE
         9        00000001_082FF280  00000000_25005010  00000000_25005010  +0000134C0  20061215   CEL       POSIX XPLINK EBCDIC  HFP

  [5]    Control Blocks Associated with the Thread:
         Thread Synchronization Queue Element (SQEL): 00000000_257520A0
           +000000 00000000_257520A0  00000000 00000000 00000000 00000000 |................|
           +000010 00000000_257520B0  00000000 00000000 00000001 08358750 |..............g&|
           +000020 00000000_257520C0  00000000 00000000 00000000 00000000 |................|
           +000030 00000000_257520D0  00000000 00000000 00000001 00007B18 |..............#.|
           +000040 00000000_257520E0  00000000 00000000 00000000 00000000 |................|
           +000050 00000000_257520F0 - +000000 00000000_2575210F            same as above

  [6]    Enclave Control Blocks:

        Mutex and Condition Variable Blocks (MCVB+MHT+CHT): 00000001_089100B8
           +000000 00000001_089100B8  00000000 00011E78 00000001 08910100 |............j..|
           +000010 00000001_089100C8  000007F0 00007F00 00000000 00000000 |...0.."........|
           +000020 00000001_089100D8  00000001 08FC7490 00000001 08910900 |............j..|
           +000030 00000001_089100E8  000001F0 00001F00 00000000 00000000 |...0............|
           +000040 00000001_089100F8  00000001 08FC74D0 00000000 00000000 |................|
           +000050 00000001_08910108  00000000 00000000 00000000 00000000 |................|
           +000060 00000001_08910118 - +000000 00000001_08910207            same as above
           +000150 00000001_08910208  00000001 08358A20 00000000 00000000 |................|
           +000160 00000001_08910218  00000001 08358900 00000000 00000000 |......i.........|
           +000170 00000001_08910228  00000001 08358990 00000000 00000000 |......i.........|
           +000180 00000001_08910238  00000000 00000000 00000000 00000000 |................|
           +000190 00000001_08910248 - +000000 00000001_08910297            same as above
           +0001E0 00000001_08910298  00000001 08358750 00000000 00000000 |......g&........|
           +0001F0 00000001_089102A8  00000000 00000000 00000000 00000000 |................|
           +000200 00000001_089102B8 - +000000 00000001_08910307            same as above
           +000250 00000001_08910308  00000001 0831AB10 00000000 00000000 |................|
           +000260 00000001_08910318  00000001 0831ABD0 00000000 00000000 |................|
           +000270 00000001_08910328  00000001 0831A990 00000000 00000000 |......z.........|
           +000280 00000001_08910338  00000001 0831AA50 00000000 00000000 |.......&........|
```

Figure 144. Example of formatted output from LEDATA Verbexit (Part 1 of 10)

```
  +000290 00000001_08910348  00000001 0831A810 00000000 00000000 |......y.........|
  +0002A0 00000001_08910358  00000001 0831A8D0 00000000 00000000 |......y.........|
  +0002B0 00000001_08910368  00000001 0831A690 00000000 00000000 |......w.........|
  +0002C0 00000001_08910378  00000001 0831A750 00000000 00000000 |......x&........|
  +0002D0 00000001_08910388  00000001 0831A510 00000000 00000000 |......v.........|
  +0002E0 00000001_08910398  00000001 0831A5D0 00000000 00000000 |......v.........|
  +0002F0 00000001_089103A8  00000000 00000000 00000000 00000000 |................|
  +000300 00000001_089103B8  00000001 0831A450 00000000 00000000 |......u&........|
  +000310 00000001_089103C8  00000000 00000000 00000000 00000000 |................|
  +000320 00000001_089103D8 - +000000 00000001_089104C7            same as above
  +000410 00000001_089104C8  00000001 08358870 00000000 00000000 |......h.........|
  +000420 00000001_089104D8  00000000 00000000 00000000 00000000 |................|
  +000430 00000001_089104E8  00000001 0831AC30 00000000 00000000 |................|
  +000440 00000001_089104F8  00000001 083587E0 00000000 00000000 |......g.........|
  +000450 00000001_08910508  00000000 00000000 00000000 00000000 |................|
  +000460 00000001_08910518 - +000000 00000001_08910A37            same as above
  +000980 00000001_08910A38  00000001 08FC7510 00000000 00000000 |................|
  +000990 00000001_08910A48  00000000 00000000 00000000 00000000 |................|
  +0009A0 00000001_08910A58 - +000000 00000001_08910AC7            same as above
  +000A10 00000001_08910AC8  00000001 08FC7410 00000000 00000000 |................|
  +000A20 00000001_08910AD8  00000001 08FC7450 00000000 00000000 |.......&........|
  +000A30 00000001_08910AE8  00000000 00000000 00000000 00000000 |................|
  +000A40 00000001_08910AF8 - +000000 00000001_08910B07            same as above

Thread Synchronization Enclave Latch Table (EPALT): 00000001_08910B00
  +000000 00000001_08910B00  00000000 00000000 00000000 00000000 |................|
  +000010 00000001_08910B10 - +000000 00000001_089115DF            same as above
  +000AE0 00000001_089115E0  00000000 2524F9C0 00000000 00000000 |......9.........|
  +000AF0 00000001_089115F0  00000000 00000000 00000000 00000000 |................|
  +000B00 00000001_08911600 - +000000 00000001_0891176F            same as above
  +000C70 00000001_08911770  00000000 2538B4E0 00000000 00000000 |................|
  +000C80 00000001_08911780  00000000 00000000 00000000 00000000 |................|
  +000C90 00000001_08911790 - +000000 00000001_08911EFF            same as above

HEAPCHK Option Control Block (HCOP): 00000001_089234D0
  +000000 00000001_089234D0  C8C3D6D7 00000048 00000001 00000000 |HCOP............|
  +000010 00000001_089234E0  00000000 0000000A 0000000A 00000000 |................|
  +000020 00000001_089234F0  00000001 08FC0090 00000001 08923518 |.............k..|
  +000030 00000001_08923500  00000001 08A00050 00000000 00000000 |.......&........|
  +000040 00000001_08923510  00000000 00000000 C8C3C6E3 00004000 |........HCFT.. .|
 HEAPCHK Element Table (HCEL) for Heapid 00000001 :

Header: 00000001_08FC0090
  +000000 00000001_08FC0090  C8C3C5D3 00000000 00000000 00000000 |HCEL............|
  +000010 00000001_08FC00A0  00000000 00000000 00000001 00100138 |................|
  +000020 00000001_08FC00B0  000001F4 0000000C 0000000D 00000000 |...4............|

Address           Seg Addr           Length
Table: 00000001_08FC00C0
  +000000  00000001_08300040 00000001_08300000  00000000 00000180 00000001 08FC3F50 |....... .......&|
  +000020  00000001_083001C0 00000001_08300000  00000000 00019660 00000001 08FC5B30 |.....o-.....$.|
  +000040  00000001_08319820 00000001_08300000  00000000 00025B40 00000001 08FC5C90 |......q.....$ .....*.|
  +000060  00000001_0833F360 00000001_08300000  00000000 00019340 00000001 08FC5EB0 |.....3-.....l .....;.|
  +000080  00000001_083586A0 00000001_08300000  00000000 000189E0 00000001 08FC6010 |......f.....i.....-.|
  +0000A0  00000001_08371080 00000001_08300000  00000000 00000060 00000001 08FC7050 |.....-.....&|
  +0000C0  00000001_083710E0 00000001_08300000  00000000 0001F420 00000001 08FE9790 |.....4.....p.|
  +0000E0  00000001_08390500 00000001_08300000  00000000 00005C00 00000001 08FEC530 |.....*.....E.|
  +000100  00000001_08396100 00000001_08300000  00000000 0000A320 00000001 08FEE210 |....../.....t.....S.|
  +000120  00000001_083A0420 00000001_08300000  00000000 00000180 00000001 08FEE530 |.....V.|
  +000140  00000001_083A05A0 00000001_08300000  00000000 00017400 00000001 08FEE730 |.....X.|
  +000160  00000000_00000000 00000000_00000000  00000000 00000000 00000000 00000000 |................|
  +000180  00000001_083B79A0 00000001_08300000  00000000 00017720 00000001 08FEEA90 |................|

[7]    Language Environment Trace Table:
         Most recent trace entry is at displacement: 005A80
             Displacement                    Trace Entry in Hexadecimal                                  Trace Entry in EBCDIC
           ------------ ------------------------------------------------------------------------  --------------------------------
             +000000    Time 21.22.38.487562    Date 2007.01.16    Thread ID... 253E019000000000
             +000010    Member ID.... 03    Flags..... 000000    Entry Type..... 00000005
             +000018    94818995 40404040 40404040 40404040  40404040 40404040 40404040 40404040  |main                            |
             +000038    60606E4D F0F0F6C6 5D409799 8995A386  4D5D4040 40404040 40404040 40404040  |-->(006F) printf()              |
             +000058    40404040 40404040 40404040 40404040  40404040 40404040 40404040 40404040  |                                |
             +000078    40404040 40404040                                                         |                                |
```

Figure 144. Example of formatted output from LEDATA Verbexit (Part 2 of 10)

```
                +000080    Time 21.22.38.497576    Date 2007.01.16    Thread ID... 253E019000000000
                +000090    Member ID.... 03    Flags..... 000000    Entry Type..... 00000006
                +000098    4C60604D F0F0F6C6 5D40D9F1 7EF0F0F0  F0F0F0F0 F1F0F0F0 F0F9C4C6 F040D9F2  |<--(006F) R1=0000000100009DF0 R2|
                +0000B8    7EF0F0F0 F0F0F0F0 F0F2F5F5 F7F4F6C4  F040D9F3 7EF0F0F0 F0F0F0F0 F0F0F0F0  |=00000000255746D0 R3=00000000000|
                +0000D8    F0F0F0F0 C340C5D9 D9D5D67E F0F0F0F0  F0F0F0F0 40C5D9D9 D5D6F27E F0F0F0F0  |0000C ERRNO=00000000 ERRNO2=0000|
                +0000F8    F0F0F0F0 00000000                                                          |0000....                        |

                +000100    Time 21.22.38.497582    Date 2007.01.16    Thread ID... 253E019000000000
                +000110    Member ID.... 03    Flags..... 000000    Entry Type..... 00000005
                +000118    94818995 40404040 40404040 40404040  40404040 40404040 40404040 40404040  |main                            |
                +000138    60606E4D F0F1F7F0 5D408493 93939681  844D5D40 40404040 40404040 40404040  |-->(0170) dllload()              |
                +000158    40404040 40404040 40404040 40404040  40404040 40404040 40404040 40404040  |                                |
                +000178    40404040 40404040                                                          |                                |

                +000180    Time 21.22.38.526042    Date 2007.01.16    Thread ID... 253E019000000000
                +000190    Member ID.... 03    Flags..... 000000    Entry Type..... 00000006
                +000198    4C60604D F0F1F7F0 5D40D9F1 7EF0F0F0  F0F0F0F0 F1F0F8F2 C6C6F4F6 F040D9F2  |<--(0170) R1=00000001082FF460 R2|
                +0001B8    7EF0F0F0 F0F0F0F0 F0F2F5F5 F7F4F6C4  F040D9F3 7EF0F0F0 F0F0F0F0 F1F0F8C6  |=00000000255746D0 R3=0000000108F|
                +0001D8    C3F5C5F3 F040C5D9 D9D5D67E F0F0F0F0  F0F0F0F0 40C5D9D9 D5D6F27E F0F0F0F0  |C5E30 ERRNO=00000000 ERRNO2=0000|
                +0001F8    F0F0F0F0 00000000                                                          |0000....                        |

                +000200    Time 21.22.38.526049    Date 2007.01.16    Thread ID... 253E019000000000
                +000210    Member ID.... 03    Flags..... 000000    Entry Type..... 00000005
                +000218    94818995 40404040 40404040 40404040  40404040 40404040 40404040 40404040  |main                            |
                +000238    60606E4D F0F0F6C6 5D409799 8995A386  4D5D4040 40404040 40404040 40404040  |-->(006F) printf()              |
                +000258    40404040 40404040 40404040 40404040  40404040 40404040 40404040 40404040  |                                |
                +000278    40404040 40404040                                                          |                                |

                +000280    Time 21.22.38.526081    Date 2007.01.16    Thread ID... 253E019000000000
                +000290    Member ID.... 03    Flags..... 000000    Entry Type..... 00000006
                +000298    4C60604D F0F0F6C6 5D40D9F1 7EF0F0F0  F0F0F0F0 F1F0F0F0 F0F9C4C6 F040D9F2  |<--(006F) R1=0000000100009DF0 R2|
                +0002B8    7EF0F0F0 F0F0F0F0 F0F2F5F5 F7F4F6C4  F040D9F3 7EF0F0F0 F0F0F0F0 F0F0F0F0  |=00000000255746D0 R3=00000000000|
                +0002D8    F0F0F0F0 C440C5D9 D9D5D67E F0F0F0F0  F0F0F0F0 40C5D9D9 D5D6F27E F0F0F0F0  |0000D ERRNO=00000000 ERRNO2=0000|
                +0002F8    F0F0F0F0 00000000                                                          |0000....                        |

                +000300    Time 21.22.38.526083    Date 2007.01.16    Thread ID... 253E019000000000
                +000310    Member ID.... 03    Flags..... 000000    Entry Type..... 00000005
                +000318    94818995 40404040 40404040 40404040  40404040 40404040 40404040 40404040  |main                            |
                +000338    60606E4D F0F1F6C4 5D408493 9398A485  99A88695 4D5D4040 40404040 40404040  |-->(016D) dllqueryfn()           |
                +000358    40404040 40404040 40404040 40404040  40404040 40404040 40404040 40404040  |                                |
                +000378    40404040 40404040                                                          |                                |
⋮
                +005900    Time 21.22.38.942077    Date 2007.01.16    Thread ID... 253E019000000000
                +005910    Member ID.... 03    Flags..... 000000    Entry Type..... 00000005
                +005918    6D979696 936D8699 85856D81 93936D96  866D9695 856D8481 A3817CC1 C6F1F26D  |_pool_free_all_of_one_data@AF12_|
                +005938    60606E4D F0F0F5F9 5D408699 85854DF0  A7F0F0F0 F0F0F0F0 F1F0F8F3 F5F8C1C2  |-->(0059) free(0x0000000108358AB|
                +005958    F05D4040 40404040 40404040 40404040  40404040 40404040 40404040 40404040  |0)                              |
                +005978    40404040 40404040                                                          |                                |

                +005980    Time 21.22.38.942079    Date 2007.01.16    Thread ID... 253E019000000000
                +005990    Member ID.... 03    Flags..... 000000    Entry Type..... 00000006
                +005998    4C60604D F0F0F5F9 5D40D9F1 7EF0F0F0  F0F0F0F0 F0F0F0F0 F0F0F0F1 F240D9F2  |<--(0059) R1=0000000000000012 R2|
                +0059B8    7EF0F0F0 F0F0F0F0 F0F2F5F5 F7F4F6C4  F040D9F3 7EF0F0F0 F0F0F0F0 F1F0F8F3  |=00000000255746D0 R3=00000001083|
                +0059D8    F5F8C2C3 F040C5D9 D9D5D67E F0F0F0F0  F0F0F7F9 40C5D9D9 D5D6F27E C3F2F5C6  |58BC0 ERRNO=00000079 ERRNO2=C25F|
                +0059F8    F0F0F0F1 00000000                                                          |0001....                        |

                +005A00    Time 21.22.38.942080    Date 2007.01.16    Thread ID... 253E019000000000
                +005A10    Member ID.... 03    Flags..... 000000    Entry Type..... 00000005
                +005A18    6D848497 896D8699 85856D81 93936D96  866D9695 856D8995 86967CC1 C6F1F36D  |_ddpi_free_all_of_one_info@AF13_|
                +005A38    60606E4D F0F0F5F9 5D408699 85854DF0  A7F0F0F0 F0F0F0F0 F1F0F8F3 C1F0F5C3  |-->(0059) free(0x00000001083A05C|
                +005A58    F05D4040 40404040 40404040 40404040  40404040 40404040 40404040 40404040  |0)                              |
                +005A78    40404040 40404040                                                          |                                |

                +005A80    Time 21.22.38.942084    Date 2007.01.16    Thread ID... 253E019000000000
                +005A90    Member ID.... 03    Flags..... 000000    Entry Type..... 00000006
                +005A98    4C60604D F0F0F5F9 5D40D9F1 7EF0F0F0  F0F0F0F0 F0F0F0F0 F0F0F0F0 F240D9F2  |<--(0059) R1=0000000000000002 R2|
                +005AB8    7EF0F0F0 F0F0F0F0 F0F2F5F5 F7F4F6C4  F040D9F3 7EF0F0F0 F0F0F0F0 F0F0F0F0  |=00000000255746D0 R3=00000000000|
                +005AD8    F0F0F0F0 F040C5D9 D9D5D67E F0F0F0F0  F0F0F7F9 40C5D9D9 D5D6F27E C3F2F5C6  |00000 ERRNO=00000079 ERRNO2=C25F|
                +005AF8    F0F0F0F1 00000000                                                          |0001....                        |
[8]  Process Control Blocks:
       Thread Synchronization Process Latch Table (PPALT): 00000001_08911F00
        +000000 00000001_08911F00  00000000 00000000 00000000 00000000 |................|
        +000010 00000001_08911F10 - +000000 00000001_089132FF            same as above
```

Figure 144. Example of formatted output from LEDATA Verbexit (Part 3 of 10)

```
[9] TCB: 007FF050                 LE Level: 15                  ASID: 0028

[10] Active Members: C/C++

[11]   CEELAA:  00000000_7F7547D8
       +000000  EYE_CATCHER:LAA   VERSION:00000001        PREVIOUS:00000000
       +00000C  NEXT:00000000     STCB:7F7543A0     ASID:0028
       +000018  FLOOR31:FFBAD000        OVERFLOW31:00000000     GTAB31:00000000
       +000024  LCA31:00000000    TRT31:00000000    FLOOR64:00000001_08200000
       +000048  OVERFLOW64:00000000_25250098        GTAB64:00000001_0871CA00
       +000058  LCA64:00000001_00000000       TRT64:00000001_00000030
       +0000C8  FLAG1:A1    FLAG2:00    CB_STG64:00000001_00000000
       +0000F8  CB_STG31:00000000_257520A0    SvcVec31:00000000
       +000104  SANC31:00000000   CurKey31:00       SvcVec64:00000000 00000000
       +000120  SANC64:00000001_00100000      CurKey64:80       ENSQ64:00000001_00100108
       +000138  LHEAP64ID:00000001 001002A8   LHEAP31ID:00000000 00000000
       +000148  IPTLAA:7F7547D8   SYSTEM_RETURN_CODE:00000000
       +000150  SYSTEM_REASON_CODE:00000000   SLE_REASON_CODE:00000000
       +000158  MSTRLAA:7F7547D8        SLEPC_ROUTER:829E9CE0   ALEI:00000000_00000000
[12]   CEELCA:  00000001_00000000
       +000000  EYE_CATCHER:LCA   VERSION:00000001        CAA:00000001_00007B18
       +000010  DIA:25752320      LAA:7F7547D8      SAVSTACK:00000000_00000000
       +000028  QINIT:00000000_25005010       TLC:00000000_255D39E0
[13]   CEECAA:  00000001_00007B18
       +000288  DLLF:00000000_00000000        INVAR:8000  FLAG0:00
       +000304  TORC:00000000     FLAG2:30    LEVEL:15    _PM:04
       +000368  DMC:00000000_00000000   CD:00000000       RS:00000000
       +000378  ERR:00000001_082FBE00   DDSA:00000001_082FF760
       +000388  EDB:00000001_00005340   PCB:00000001_00003CA0   EYEPTR:00000001_00007B00
       +0003A0  CAA:00000001_00007B18   SHAB:00000000_00000000
       +0003B0  PRGCK:00000000_00000000       URC:00000000      PICICB:00000000_00000000
       +0003C8  SIGSCTR:00000000        SIGSFLG:08000000        THDID:253E0190_00000000
       +0003D8  RCB:00000001_00003A10   MEMBR:00000001_000084D0
       +0003E8  SIGNAL_STATUS:00000000_00000008     HCOM_REG14:00000000_00000000
       +0003F8  EDCHPXV:00000000_25546C78     THREADHEAPID:00000000_00000000
       +000408  SYS_RTNCODE:00000000    SYS_RSNCODE:00000000    SIGNGPTR:00000001_00007F30
       +000418  SIGNG:00000001    AB_STATUS:00      STACKDIRECTION:00
       +000420  AB_GR0:00000000_00000000      AB_ICD1:00000000_00000000
       +000430  AB_ABCC:00000000_00000000     AB_CRC:00000000_00000000
       +000440  USERRTN:00000000_00000000     QINITDSA:00000001_082FF280
       +0004E8  IFLAG:0008  TRMRSN:00   DEVH:00000000_00000000
       +0004F8  PtatPtr:00000000_00000000     SQELADDR:00000000_257520A0
       +000510  VBA:00000001_08913350   TCS:00000001_08FEC450
       +000520  CONDWAITDSAREG:00000000_00000000    THDSTATUS:00000000_00000000
       +000570  FBTOK:00000000 00000000 00000000 00000000       PTXLPTR:00000000_00000000
       +000588  TICB_PTR:00000001_00006AB0    FWD_CHAIN:00000001_114013C8
       +0005A0  BKWD_CHAIN:00000001_199013C8        TCB:007FF050
       +0007EC  DIA:25752320      DLLFFLAG:00       MCBPTR:00000000_25773DA8
       +000838  MAD:00000000_25773048   MFD:00000000_25752998
 [14]   CEEPCB:  00000001_00003CA0
       +000000  EYE:CEEPCB        SYSTM:03    HRDWR:03    SBSYS:02    FLAG2:08
       +000108  DBGEH:00000000_00000000       DMEMBR:00000001_00004048
       +000118  ZLOD:00000000_00000000        ZDEL:00000000_00000000
       +000128  ZGETST:00000000_00000000      ZFREEST:00000000_00000000
       +000138  RCB:00000001_00003A10   OMVS_LEVEL:7FC00000     CHAIN:00000000_00000000
       +000150  PRFEH:00000000_00000000       FLAG6:00    HABD_CLEANUP:0000
       +000160  QFEXIT:00000000_252A3F48      ABENDCODE:00000000
       +0001C4  REASON:00000000   F3456:00000040    MEML:00000001_00004020
       +0001D8  MEMBR:00000001_00004048       LEHL:00000001_00001560
       +0001E8  CMXB:00000001_00001738        STV:02      PM_BYTE:00  FLAG1:00
       +0001F8  ISA:00000001_00000000   ISA_SIZE:0001CA00
       +000204  SRV_COUNT:00000000      SRV_UWORD:00000000 00000000
       +000210  WORKAR:00000000_00000000      LOAD:00000000_2571C250
       +000220  DELETE:00000000_2571C240      GETSTOR:00000000_00000000
       +000230  FREESTOR:00000000_00000000    EXCEPT:00000000_00000000
       +000240  ATTN:00000000_00000000        MSGS:00000000_00000000
       +000250  ABEND:00000000_00000000       MSGOU:00000000_00000000
       +000260  GLAT:00000000_2571C230        RLAT:00000000_2571C220
       +000270  ELAT:00000000_2571C210        1PTQ:00000000_2571C200
       +000280  1ENV:00000000_2571C1F0        LODTYP:FFFFFFFF   LEVEL:FFFFFFFF
       +000290  LLTPTR:00000001_00000738      RC:00000000       REASON:00000000
       +0002A0  RC_MOD:00000000   FBTOK:00000000 00000000 00000000 00000000
       +0002B8  PPALTADDR:00000001_08911F00   PPALTSIZE:00001400
       +0002C8  PICB:00000001_00003C80        XPLINKFLAGS:80    QICB:00000001_00010688
       +0002E0  CALLERS_SAVE:00000000_00006F58

      CEEMEML:  00000001_00004048
       +000000  MEMLDEF:........  EXIT:00000000_00000000        LLVTL:00000000_00000000
```

Figure 144. Example of formatted output from LEDATA Verbexit (Part 4 of 10)

```
 [15]   CEERCB:  00000001_00003A10
       +000000  EYE:CEERCB        SYSTEM:03   HARDWARE:03       SUBSYS:02
       +000043  FLAGS:00    DMEMBR:00000001_00004048      VERSION_ID:04010900
       +000058  PCB_CHAIN:00000001_00003CA0

[16]   CEEEDB:  00000001_00005340
       +000000  EYE:CEEEDB        FLAG:97     BIPM:00     CREATOR_ID:01
       +000108  BMEMBR:00000001_000068F8      OPTCB:00000001_00005DC8
       +000118  USER_RC:00000000        RSN_CODE:00000000       PCB:00000001_00003CA0
       +000128  APPL_STR:00000000_00000000    ENVAR:00000001_00004810
       +000140  ENV_ANCHOR:00000001_00005478        BOTRB:00000001_08910090
       +000150  CAACHAIN:00000001_00007B18    FLAGS1:82000000   THDSACT:00000000_00000003
       +000168  DCB:00000000      INPUT_R1:00000000_00006FF0
       +000178  LAST_RB:00000000        LAST_RBCT:00000000
       +000180  ENV_LGTH:00000000 00000200    ENVAR_A:00000001_00004A18
       +000190  ENV_ANCHOR_A:00000001_000054C8

      CEEMEML:  00000001_000068F8
       +000000  MEMLDEF:........  EXIT:00000000_00000000        LLVTL:FFFFFFFF_FFFFFFFF
 [17] Language Environment Run-Time Options in effect.

    LAST WHERE SET          Override   OPTIONS
    ******************************************************************************
    DD:CEEOPTS              OVR        CEEDUMP(00000000,SYSOUT=*,
                                              FREE=END,SPIN=UNALLOC)
    INSTALLATION DEFAULT    OVR        DYNDUMP(*USERID,
                                              NODYNAMIC,TDUMP)
    INSTALLATION DEFAULT    OVR        ENVAR("")
    INSTALLATION DEFAULT    OVR        FILETAG(NOAUTOCVT,NOAUTOTAG)
    DD:CEEOPTS              OVR        HEAPCHK(ON,00000001,00000000,00000010,
                                              00000010)
    PROGRAMMER DEFAULT      OVR        HEAPPOOLS(ON,
                                                 00000008,00000010,
                                                 00000032,00000010,
                                                 00000128,00000010,
                                                 00000256,00000010,
                                                 00001024,00000010,
                                                 00002048,00000010,
                                                 00000000,00000010,
                                                 00000000,00000010,
                                                 00000000,00000010,
                                                 00000000,00000010,
                                                 00000000,00000010,
                                                 00000000,00000010)

    DD:CEEOPTS              OVR        HEAPPOOLS64(ON,
                                                   00000008,00004000,
                                                   00000032,00002000,
                                                   00000128,00000700,
                                                   00000256,00000350,
                                                   00001024,00000100,
                                                   00002048,00000050)
                                                   00003072,00000050)
                                                   00004096,00000050)
                                                   00008192,00000025)
                                                   00016384,00000010)
                                                   00032768,00000005)
                                                   00065536,00000005)
     INSTALLATION DEFAULT    OVR         HEAP64(0000000000000001,0000000000000001,
                                              KEEP,00032768,00032768,KEEP,
                                              000004096,00004096,FREE)
    INSTALLATION DEFAULT    OVR        INFOMSGFILTER(OFF)
    INSTALLATION DEFAULT    OVR        IOHEAP64(0000000000000001,0000000000000001,
                                               FREE,00012288,00000081,FREE,
                                               00004096,00004096,FREE)
    INSTALLATION DEFAULT    OVR        LIBHEAP64(0000000000000001,0000000000000001,
                                                 FREE,00016384,00008192,FREE,
                                                 00008192,00004096,FREE)
    INSTALLATION DEFAULT    OVR        NATLANG(ENU)
    PROGRAMMER DEFAULT      OVR        POSIX(ON)
    INSTALLATION DEFAULT    OVR        PROFILE(OFF,"")
    DD:CEEOPTS              OVR        RPTOPTS(ON)
    DD:CEEOPTS              OVR        RPTSTG(ON)
    INSTALLATION DEFAULT    OVR        STACK64(0000000000000001,0000000000000001,
                                               0000000000000128)
    INSTALLATION DEFAULT    OVR        STORAGE(NONE,NONE,NONE)
    PROGRAMMER DEFAULT      OVR        TERMTHDACT(UADUMP,CESE,00000096)
    INSTALLATION DEFAULT    OVR      NOTEST(ALL,*,PROMPT,INSPPREF)
    INSTALLATION DEFAULT    OVR        THREADSTACK64(OFF,0000000000000001,
                                                     0000000000000001,
                                                     0000000000000128)
    PROGRAMMER DEFAULT      OVR        TRACE(ON,01048576,NODUMP,LE=00000001)
    INSTALLATION DEFAULT    OVR        TRAP(ON,SPIE)
```

Figure 144. Example of formatted output from LEDATA Verbexit (Part 5 of 10)

```
[18] Heap Storage Control Blocks
      Heappools trace available. To display: IP VERBX LEDATA 'HPT(*)'

        ENSQ:  00000001_00100108
       +000000  EYE_CATCHER:ENSQ  HEAPALLOC_VAL:00000000
       +000008  HEAPFREE_VAL:00000000   DSAALLOC_VAL:00000000   FLAGS1:80000000
       +000014  IPT_TOKEN:000000A0 00000002 00000016 007FF050
       +000024  HEAPLOCKWORD:00000000   RPT_STOR:00000001_00100410
       +000030  UHEAP64:C8D7C3D8 00000000 00000001 001005B0 00000001 001007F0 00000000 00000001 00
       +000060  LHEAP64:C8D7C3D8 00000000 00000001 001005E0 00000001 00100670 00000000 00000001 00
       +000090  UHEAP31:C8D7C3D8 00000000 00000001 00100198 00000001 00100198 00000000 00008000 00
       +0000C0  LHEAP31:C8D7C3D8 00000000 00000001 001007C0 00000001 001007C0 00000000 00004000 00
       +0000F0  UHEAP24:C8D7C3D8 00000000 00000001 001001F8 00000001 001001F8 00000000 00001000 00
       +000120  LHEAP24:C8D7C3D8 00000000 00000001 00100228 00000001 00100228 00000000 00002000 00
       +000174  IPT_TCB:007FF050        HEAPCHK:00000000_00000000
       +000188  STSB:00000000_00000000        SASB:00000000_00000000
       +000198  TOKEN:7F7547D8 00000000
       +0001A0  THDLHEAP64:C8D7C3D8 00000000 00000001 00100790 00000001 00100790 00000000 00000001 00
       +0001D0  IOHEAP64:C8D7C3D8 00000000 00000001 00100760 00000001 00100760 00000000 00000001 00
       +000200  IOHEAP31:C8D7C3D8 00000000 00000001 001006A0 00000001 001006A0 00000000 00003000 00
       +000230  IOHEAP24:C8D7C3D8 00000000 00000001 001006D0 00000001 001006D0 00000000 00001000 00
       +000260  SM_CELL_BLOCK:00000001_00100490     SPDE:00000001_00100730

        User Heap64 Control Blocks

        HPCQ:  00000001_00100138
       +000000  EYE_CATCHER:HPCQ  FIRST:00000001_001005B0       LAST:00000001_001007F0
       +000018  INITSIZE:00000000 00000001    INCRSIZE:00000000 00000001
       +00002C  OPTIONS:80000000

        HPSQ:  00000001_00005058
       +000000  BYTES_ALLOC:00000000 001C3320
       +000008  CURR_ALLOC:00000000 000CF080        GET_REQ:00000000 0000000D
       +000018  FREE_REQ:00000000 00000001    GETMAINS:00000000 00000001
       +000028  FREEMAINS:00000000 00000000

        THNQ:  00000001_001005B0
       +000000  EYE_CATCHER:THNQ  FLAGS:80000000    NEXT:00000001_001007F0
       +000010  PREV:00000001_00100138        HEAPID:00000001_00100138
       +000020  SEGMENT:00000001_08300000     SEG_LEN:00000000 00100000

        HANQ:  00000001_08300000
       +000000  EYE_CATCHER:HANQ  FLAGS:80000000    HEAPID:00000001_00100138
       +000020  SEGMENT:00000001_08300000     ROOT:00000001_083CF0C0
       +000030  SEG_LEN:00000000 00100000     ROOT_LEN:00000000 00030F40

       Free Storage Tree for Heap Segment 00000001
                    Node              Node             Parent            Left            Right               Left              Right
     Depth       Address            Length             Node            Node            Node               Length            Length
         0  00000001083CF0C0  0000000000030F40  0000000000000000  0000000000000000  0000000000000000  0000000000000000  0000000000000000

       Map of Heap Segment 00000001

     To display entire segment: IP LIST 0000000108300000 LEN(X'0000000000100000') ASID(X'0028')

      0000000108300040: Allocated storage element, length=0000000000000180.
     To display: IP LIST 0000000108300040 LEN(X'0000000000000180') ASID(X'0028')
      0000000108300050: C36DE6E2 C1F6F440 40404040 40404040  00000001 08300070 00000000 250005A8 |C_WSA64         ..............y|

      00000001083001C0: Allocated storage element, length=0000000000019660.
     To display: IP LIST 00000001083001C0 LEN(X'0000000000019660') ASID(X'0028')
      00000001083001D0: 00000000 00000005 00000000 00000005  00000001 08319840 00000001 08319A28 |.....................q ........|
    0000000108319820: Allocated storage element, length=0000000000025B40.

     To display: IP LIST 0000000108319820 LEN(X'0000000000025B40') ASID(X'0028')
      0000000108319830: 00000000 00000007 00000000 00000007  00000000 00000000 00000000 00000000 |................................|

   000000010833F360: Allocated storage element, length=0000000000019340.
     To display: IP LIST 000000010833F360 LEN(X'0000000000019340') ASID(X'0028')
      000000010833F370: 00000000 00000006 00000000 00000006  00000000 00000000 00000000 00000000 |................................|

      00000001083586A0: Allocated storage element, length=00000000000189E0.
     To display: IP LIST 00000001083586A0 LEN(X'00000000000189E0') ASID(X'0028')
      00000001083586B0: 00000000 00000003 00000000 00000003  C3C4D3D3 00000000 00000000 00000000 |................CDLL............|

     0000000108371080: Allocated storage element, length=0000000000000060.
     To display: IP LIST 0000000108371080 LEN(X'0000000000000060') ASID(X'0028')
      0000000108371090: C36DE6E2 C1F6F440 40404040 40404040  00000000 000006F0 00000000 25574500 |C_WSA64         .......0........|
```

Figure 144. Example of formatted output from LEDATA Verbexit (Part 6 of 10)

```
      00000001083710E0: Allocated storage element, length=000000000001F420.
    To display: IP LIST 00000001083710E0 LEN(X'000000000001F420') ASID(X'0028')
     00000001083710F0: 00000000 00000001 00000000 00000001  00000001 08358990 00000000 00000000 |.....................i.........|

     0000000108390500: Allocated storage element, length=0000000000005C00.
    To display: IP LIST 0000000108390500 LEN(X'0000000000005C00') ASID(X'0028')
     0000000108390510: C36DE6E2 C1F6F440 40404040 40404040  000000FF 00000000 00000001 08394360 |C_WSA64         ..............-|
     0000000108396100: Allocated storage element, length=000000000000A320.
    To display: IP LIST 0000000108396100 LEN(X'000000000000A320') ASID(X'0028')
     0000000108396110: C36DE6E2 C1F6F440 40404040 40404040  00000001 08399D80 00000000 258492C0 |C_WSA64         .............dk.|

     00000001083A0420: Allocated storage element, length=0000000000000180.
    To display: IP LIST 00000001083A0420 LEN(X'0000000000000180') ASID(X'0028')
     00000001083A0430: C36DE6E2 C1F6F440 40404040 40404040  00000000 00000000 00000001 08FEC410 |C_WSA64         .............D.|

     00000001083A05A0: Allocated storage element, length=0000000000017400.
    To display: IP LIST 00000001083A05A0 LEN(X'0000000000017400') ASID(X'0028')
     00000001083A05B0: 00000000 00000004 00000000 00000000  00000000 00000000 00000000 00000000 |................................|

     00000001083B79A0: Allocated storage element, length=0000000000017720.
    To display: IP LIST 00000001083B79A0 LEN(X'0000000000017720') ASID(X'0028')
     00000001083B79B0: 00000000 00000002 00000000 00000000  00000000 00000000 00000000 D3D4D9C5 |............................LMRE|

     00000001083CF0C0: Free storage element, length=0000000000030F40.
    To display: IP LIST 00000001083CF0C0 LEN(X'0000000000030F40') ASID(X'0028')

     Summary of analysis for Heap Segment 0000000108300000:
        Amounts of identified storage:  Free:00030F40          Allocated:000CF080          Total:000FFFC0
        Number of identified areas   :  Free:       1  Allocated:      12  Total:      13
        00000000 bytes of storage were not accounted for.
        No errors were found while processing this heap segment.
:
:
[19] Stack Storage Control Blocks

         SANC:  00000001_00100000
       +000000  EYE_CATCHER:SANC  VERSION:0001      LENGTH:0100
       +000008  SEGMENT_SIZE:00000000 00000081      ACTIVE_STACK:00000001_00200000
       +000018  BOS:00000001_082FFFE0   INIT_SIZE:00000000 00000001
       +000028  INCR_SIZE:00000000 00000001   USER_STACK:00000001_00200000
       +000038  USER_BOS:00000001_082FFFE0    USER_FLOOR:00000001_08200000
       +000048  RESERVE_STACK:00000001_08500000     SDCB:00000000_00000000
       +000060  PTDATA:00000000_00000000      OCB_INCRSZ:00000000 00000001
       +000070  CURR_ALLOC:00000000 00000001        FLAGS1:00000000
       +00007C  FLAGS2:00000000   USER_ORIGIN:00000001 00200000

     DSA backchain
          DSA:  00000001_082FA900
       +000800  HPR4:00000001 082FAAC0        HPR5:00000000 253C45F8
       +000810  HPR6:00000000 253C4500        HPR7:00000000 251B9B1A
       +000820  HPR8:00000001 082FBB08        HPR9:00000001 00000004
       +000830  HPR10:00000001 082FBABF       HPR11:00000001 082FBE00
       +000840  HPR12:00000001 082FCABE       HPR13:00000001 082FE680
       +000850  HPR14:00000001 00005DC8       HPR15:00000001 00006554
       +000860  HPHKSAV:00000001 082FBA80     HPTRAN:00000001 082FB208
       +000878  HPRENT:00000000 251181E8

      Contents of DSA at Location : 00000001_082FB100

       +000000 00000001_082FB100  00000001 082FAAC0 00000000 253C45F8 |...............8|
       +000010 00000001_082FB110  00000000 253C4500 00000000 251B9B1A |................|
       +000020 00000001_082FB120  00000001 082FBB08 00000001 00000004 |................|
       +000030 00000001_082FB130  00000001 082FBABF 00000001 082FBE00 |................|
       +000040 00000001_082FB140  00000001 082FCABE 00000001 082FE680 |..............W.|
       +000050 00000001_082FB150  00000001 00005DC8 00000001 00006554 |......)H........|
       +000060 00000001_082FB160  00000001 082FBA80 00000001 082FC6E0 |..............F.|
       +000070 00000001_082FB170  00000001 082FB208 00000000 251181E8 |..............aY|
       +000080 00000001_082FB180  00000001 082FAAC0 00000000 25743020 |................|
       +000090 00000001_082FB190  00000000 2558CB50 00000000 251B78DA |.......&........|
       +0000A0 00000001_082FB1A0  00000001 082FBE00 00000001 082FBF60 |...............-|
       +0000B0 00000001_082FB1B0  00000001 082FBABF 00000001 082FBA08 |................|
       +0000C0 00000001_082FB1C0  00000001 082FCABE 00000001 082FE680 |..............W.|
       +0000D0 00000001_082FB1D0  00000001 082FB208 00000000 251181D8 |..............aQ|
       +0000E0 00000001_082FB1E0  00000001 082FC6E0 89848540 85A78385 |......F.ide exce|
       +0000F0 00000001_082FB1F0  00000000 00000000 A8A2A385 9440C396 |........ystem Co|
```

Figure 144. Example of formatted output from LEDATA Verbexit (Part 7 of 10)

```
          DSA:  00000001_082FAAC0
       +000800  HPR4:00000001 082FD3E0        HPR5:00000000 251BABA0
       +000810  HPR6:00000000 251B6060        HPR7:00000000 2504B400
       +000820  HPR8:00000001 089135B0        HPR9:00000000 00000005
       +000830  HPR10:00000001 082FE3DF       HPR11:00000001 082FE0C0
       +000840  HPR12:00000001 089135B0       HPR13:00000001 082FE680
       +000850  HPR14:00000000 2504B300       HPR15:00000000 2530A300
       +000860  HPHKSAV:00000000 00000000     HPTRAN:00000000 00000000
       +000878  HPRENT:00000000 00000000

     Contents of DSA at Location : 00000001_082FB2C0

       +000000 00000001_082FB2C0  00000001 082FD3E0 00000000 251BABA0 |......L.........|
       +000010 00000001_082FB2D0  00000000 251B6060 00000000 2504B400 |......--........|
       +000020 00000001_082FB2E0  00000001 089135B0 00000000 00000005 |.....j..........|
       +000030 00000001_082FB2F0  00000001 082FE3DF 00000001 082FE0C0 |......T.........|
       +000040 00000001_082FB300  00000001 089135B0 00000001 082FE680 |.....j........W.|
       +000050 00000001_082FB310  00000000 2504B300 00000000 2530A300 |..............t.|
       +000060 00000001_082FB320  00000000 00000000 00000000 00000000 |................|
       +000070 00000001_082FB330 - +000000 00000001_082FB33F             same as above
       +000080 00000001_082FB340  00000001 082FBB08 00000001 00000003 |................|
       +000090 00000001_082FB350  00000001 00000003 00000001 00007208 |................|
       +0000A0 00000001_082FB360  00000001 082FC190 00000001 082FBF90 |......A.........|
       +0000B0 00000001_082FB370  00000000 25773048 00000000 00000000 |................|
       +0000C0 00000001_082FB380  00000000 00000000 00000000 00000000 |................|
       +0000D0 00000001_082FB390 - +000000 00000001_082FB3BF             same as above

          DSA:  00000001_082FD3E0
       +000800  HPR4:00000001 082FDDE0        HPR5:00000000 2504C3EC
       +000810  HPR6:00000000 2504AAB0        HPR7:00000000 251C96D0
       +000820  HPR8:00000000 25754AD8        HPR9:00000000 25754BD0
       +000830  HPR10:00000000 25754A30       HPR11:00000000 00000020
       +000840  HPR12:00000001 00007B18       HPR13:00000001 082FE680
       +000850  HPR14:00000000 253D6504       HPR15:00000000 00000003
       +000860  HPHKSAV:00000001 00000000     HPTRAN:082FDB18 00000000
       +000878  HPRENT:00000060 00000000

     Contents of DSA at Location : 00000001_082FDBE0

       +000000 00000001_082FDBE0  00000001 082FDDE0 00000000 2504C3EC |.............C.|
       +000010 00000001_082FDBF0  00000000 2504AAB0 00000000 251C96D0 |.............o.|
       +000020 00000001_082FDC00  00000000 25754AD8 00000000 25754BD0 |.......Q........|
       +000030 00000001_082FDC10  00000000 25754A30 00000000 00000020 |................|
       +000040 00000001_082FDC20  00000001 00007B18 00000001 082FE680 |......#.......W.|
       +000050 00000001_082FDC30  00000000 253D6504 00000000 00000003 |................|
⋮
 [20] Condition Management Control Blocks
        HCOM:  00000000_25753700
       +000000  PICA_AREA:00000000 00000000   EYES:HCOM   SIZE:28E0   LEVEL:0001
       +000010  CAA_PTR1:00000001_00007B18    CVTDCB:9B   FLAG1:60104000
       +000020  EXIT_STK:00000000_00000000    RSM_PTR:00000000_00000000
       +000030  HDLL_STK:00000000_00000000    SRP_TOKEN:00000000_00000000
       +000040  CURR_STK:00000000_00000000    CIBH:00000001_082FCFE0
       +000050  SPIE_TOKEN:00000000     DMCP:00000000_00000000
       +0000D0  COND_LOG:00000001_08FE9910    4083_DSA:00000000_00000000
       +000100  HCHK5_RESULTS:00000000        SHUNT_VALIDFLAG:00000000
       +000704  SHUNT_COUNTER:00000000        SHUNT_ADDR:00000000_00000000
       +000710  SHUNT_PSW:00000000 00000000 00000000 00000000
       +000720  SHUNT_REG0:00000000 00000000
       +000728  SHUNT_REG1:00000000 00000000
       +000730  SHUNT_REG2:00000000 00000000
       +000738  SHUNT_REG3:00000000 00000000
       +000740  SHUNT_REG4:00000000 00000000
       +000748  SHUNT_REG5:00000000 00000000
       +000750  SHUNT_REG6:00000000 00000000
       +000758  SHUNT_REG7:00000000 00000000
       +000760  SHUNT_REG8:00000000 00000000
       +000768  SHUNT_REG9:00000000 00000000
       +000770  SHUNT_REG10:00000000 00000000
       +000778  SHUNT_REG11:00000000 00000000
       +000780  SHUNT_REG12:00000000 00000000
       +000788  SHUNT_REG13:00000000 00000000
       +000790  SHUNT_REG14:00000000 00000000
       +000798  SHUNT_REG15:00000000 00000000       SHUNT_CODE1:00000000_00000000
       +0007A8  SHUNT_CODE2:00000000_00000000       SIGNAL_LOG:00000001_08913470
```

Figure 144. Example of formatted output from LEDATA Verbexit (Part 8 of 10)

```
  CIBH:  00000001_082FCFE0
+000000  EYE:CIBH    BACK:00000001_00006AB8        FWD:00000000_00000000
+000018  LEVEL:0002  SIZE:0C00   PTR_CIB:00000000_00000000
+000028  FLAG1:00000000    HDLQ:00000000_00000000        STATE:00000000
+000040  PRM_DESC:00000000_00000000    PRM_PREFIX:00000000_00000000
+000050  PRM_LIST:00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
+000070  PARM_DESC:00000000_00000000   PARM_PREFIX:00000000_00000000
+000080  PARM_LIST:00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
+0000A0  FUNC_CODE:00000000      SIZ:0000    VER:0000    FLAG5:00
+0000A9  FLAG6:00    FLAG7:00    FLAG8:00    FLAG1:00    FLAG2:00
+0000AE  FLAG3:00    FLAG4:00    ABCD:00000000     ABRC:00000000
+0000B8  OLD_COND64:00000000 00000000
+0000C0  OLD_MIB:00000000 00000000     COND64:00000000 00000000
+0000D0  MIB:00000000_00000000   PL:00000000_00000000    SV2:00000000_00000000
+0000E8  SV1:00000000_00000000   INT:00000000_00000000   MID:00000000
+000100  HDL_SF:00000000_00000000      HDL_EPT:00000000_00000000
+000110  HDL_RST:00000000_00000000     RSM_SF:00000000_00000000
+000120  RSM_PT:00000000_00000000      RSM_MACH:00000000_00000000
+000130  SUSPEND_EH:00000000_00000000        COND_DFT:00000000
+000140  Q_DATA_TOKEN:00000000 00000000      FDBK:00000000_00000000
+000150  ABNAME:........   BBRANCH_OFFSET:00000000
+00031C  BBRANCH_STMTID:........       BBRANCH_STMTLEN:0000
                  Machine State
+000348  MCH_EYE:....
+000350  GPR00:00000000 00000000       GPR01:00000000 00000000
+000360  GPR02:00000000 00000000       GPR03:00000000 00000000
+000370  GPR04:00000000 00000000       GPR05:00000000 00000000
+000380  GPR06:00000000 00000000       GPR07:00000000 00000000
+000390  GPR08:00000000 00000000       GPR09:00000000 00000000
+0003A0  GPR10:00000000 00000000       GPR11:00000000 00000000
+0003B0  GPR12:00000000 00000000       GPR13:00000000 00000000
+0003C0  GPR14:00000000 00000000       GPR15:00000000 00000000
+0003D0  PSW:00000000 00000000 00000000 00000000
+0003E0  ILC:0000    IC1:00      IC2:00      PFT:00000000_00000000
+0003F0  FLT_0:00000000 00000000       FLT_2:00000000 00000000
+000400  FLT_4:00000000 00000000       FLT_6:00000000 00000000
+000410  FLT_1:00000000 00000000
+000418  FLT_3:00000000 00000000
+000420  FLT_5:00000000 00000000
+000428  FLT_7:00000000 00000000
+000430  FLT_8:00000000 00000000       FLT_9:00000000 00000000
+000440  FLT_10:00000000 00000000      FLT_11:00000000 00000000
+000450  FLT_12:00000000 00000000      FLT_13:00000000 00000000
+000460  FLT_14:00000000 00000000      FLT_15:00000000 00000000
+000470  FPC:00000000      AFP_FLAGS:00      INT_SF:00000000_00000000
+00048F  FLAGS:00    EXT:00000000_00000000   BEA:00000000_00000000
+0004A8  SAVSTACK_ASYNC_PTR:00000000_00000000
+0004C8  AR00:00000000     AR01:00000000
+0004D0  AR02:00000000     AR03:00000000
+0004D8  AR04:00000000     AR05:00000000
+0004E0  AR06:00000000     AR07:00000000
+0004E8  AR08:00000000     AR09:00000000
+0004F0  AR10:00000000     AR11:00000000
+0004F8  AR12:00000000     AR13:00000000
+000500  AR14:00000000     AR15:00000000

   CIBH:  00000001_00006AB8
+000000  EYE:CIBH    BACK:00000000_00000000        FWD:00000001_082FCFE0
+000018  LEVEL:0002  SIZE:0C00   PTR_CIB:00000001_082FBE00
+000028  FLAG1:C12B0000    HDLQ:00000000_00000000        STATE:00000000
+000040  PRM_DESC:00000000_00000000    PRM_PREFIX:00000000_00000000
+000050  PRM_LIST:00000001 082FBE28 00000001 082FBF50 00000001 082FBF60 00000001 00007208
+000070  PARM_DESC:00000000_00000000   PARM_PREFIX:00000000_00000000
+000080  PARM_LIST:00000001 082FBF48 00000001 082FBE00 00000001 082FBF60 00000001 00007208
+0000A0  FUNC_CODE:00000067      SIZ:0190    VER:0004    FLAG5:48
+0000A9  FLAG6:22    FLAG7:04    FLAG8:00    FLAG1:00    FLAG2:00
+0000AE  FLAG3:00    FLAG4:05    ABCD:940C9000     ABRC:00000009
+0000B8  OLD_COND64:00030C89 59C3C5C5 (CEE3209S)
+0000C0  OLD_MIB:00000000 00000000     COND64:00030C89 59C3C5C5 (CEE3209S)
+0000D0  MIB:00000000_00000000   PL:00000000_250008C0    SV2:00000001_082FF080
+0000E8  SV1:00000001_082FF080   INT:00000000_2575B5E0   MID:00000003
+000100  HDL_SF:00000001_082FF280      HDL_EPT:00000000_251BB1D0
+000110  HDL_RST:00000000_00000000     RSM_SF:00000001_082FF080
+000120  RSM_PT:00000000_2575B5E2      RSM_MACH:00000001_00007000
+000130  SUSPEND_EH:00000000_00000000        COND_DFT:00000003
+000140  Q_DATA_TOKEN:00000000 00000000      FDBK:00000000_00000000
+000150  ABNAME:........   BBRANCH_OFFSET:00000000
+00031C  BBRANCH_STMTID:........       BBRANCH_STMTLEN:0000
```

Figure 144. Example of formatted output from LEDATA Verbexit (Part 9 of 10)

```
               Machine State
         +000348  MCH_EYE:ZMCH
         +000350  GPR00:00000000 00000000       GPR01:00000001 00009DF0
         +000360  GPR02:00000001 082FEEF8       GPR03:00000000 00000012
         +000370  GPR04:00000001 082FF080       GPR05:00000000 000006F0
         +000380  GPR06:00000000 00000000       GPR07:00000000 00000001
         +000390  GPR08:00000000 250000E4       GPR09:00000000 2575B630
         +0003A0  GPR10:00000000 250014E0       GPR11:00000001 08FC5E70
         +0003B0  GPR12:00000001 00005340       GPR13:00000000 00006F58
         +0003C0  GPR14:00000000 25250098       GPR15:00000000 0000001F
         +0003D0  PSW:07852401 80000000 00000000 2575B5E2
         +0003E0  ILC:0002    IC1:00      IC2:09      PFT:00000000_00000000
         +0003F0  FLT_0:4328007E 7DC78A9C       FLT_2:00000000 00000000
         +000400  FLT_4:3C100000 00000000       FLT_6:34100000 00000000
         +000410  FLT_1:00000000 00000000
         +000418  FLT_3:00000000 00000000
         +000420  FLT_5:00000000 00000000
         +000428  FLT_7:00000000 00000000
         +000430  FLT_8:00000000 00000000       FLT_9:00000000 00000000
         +000440  FLT_10:00000000 00000000      FLT_11:00000000 00000000
         +000450  FLT_12:00000000 00000000      FLT_13:00000000 00000000
         +000460  FLT_14:00000000 00000000      FLT_15:00000000 00000000
         +000470  FPC:00000000      AFP_FLAGS:00      INT_SF:00000001_082FF080
         +00048F  FLAGS:20    EXT:00000000_00000000   BEA:00000000_00000001
         +0004A8  SAVSTACK_ASYNC_PTR:00000000_00000000
         +0004C8  AR00:00000000     AR01:00000000
         +0004D0  AR02:00000000     AR03:00000000
         +0004D8  AR04:00000000     AR05:00000000
         +0004E0  AR06:00000000     AR07:00000000
         +0004E8  AR08:00000000     AR09:00000000
         +0004F0  AR10:00000000     AR11:00000000
         +0004F8  AR12:00000000     AR13:00000000
         +000500  AR14:00000000     AR15:00000000

               CIB:  00000001_082FBE00
         +000000  EYE:CIB     BACK:00000000_00000000        FWD:00000000_00000000
         +000018  SIZE:0190   VERSION:0004      PLAT_ID:00000000
         +000028  COND:000300C6 59C3C5C5 (CEE0198S)   MIB:00000000_00000000
         +000038  MACHINE:00000001 082FBF90     OLD_COND_64:00030C89 59C3C5C5 (CEE3209S)
         +000048  OLD_MIB:00000000_00000000     FLG_1:00    FLG_2:00    FLG_3:00
         +000053  FLG_4:04    HDL_SF:00000001_082FF180      HDL_EPT:00000000_251BB1D0
         +000068  HDL_RST:00000000_00000000     RSM_SF:00000001_082FF080
         +000078  RSM_PT:00000000_2575B5E2      RSM_MACH:00000001_00007000
         +000088  COND_DEFAULT:00000003   PH_CALLEE_SF:00000001_082FF080
         +000098  HDL_SF_FMT:01     PH_CALLEE_FMT:01  BBRANCH_STMTLEN:0000
         +00009C  BBRANCH_OFFSET:00000000       BBRANCH_STMTID:........
         +0000D0  VSR:00000000 00000000   VSTOR:00000000_00000000
         +0000E0  VRPSA:00000000_00000000       MCB:00000000_00000000
         +0000F0  MRN:........      MFLAG:00    FLG_5:48    FLG_6:22    FLG_7:04
         +000103  FLG_8:00    ABCD:940C9000     ABRC:00000009     ABNAME:........
         +000118  PL:00000000_250008C0    SV2:00000001_082FF080   SV1:00000001_082FF080
         +000130  INT:00000000_2575B5E0   Q_DATA_TOKEN:00000000 00000000
         +000140  FDBK:00000000_00000000        FUN:00000067
         +000150  TOKEN:00000001 082FF180       MID:00000003      STATE:00000000
         +000160  RTCC:00000014     PPAV:00000004     AB_TERM_EXIT:........
         +000170  SDWA:00000000_00000000        SIGNO:00000008    PPSD:00000001_00007220
      [21]  Message Processing Control Blocks
            CMXB:  00000001_00001738
         +000000  EYE:CMXB    SIZE:0160   FLAGS:8000  DHEAD1:00000000_00000000
         +000010  DHEAD2:00000000_00000000

           TMXB:  00000001_00007858
         +000000  EYE:TMXB    MIB_CHAIN_PTR:00000001_000078A0

            MGF:  00000001_000078A0
         +000000  EYE:CMIB    PREV:00000000_00000001        NEXT:000078A0_00000001
       [22] No PIPICB associated with CAA at address : 00000001_00007B18

      .
      .
      .
          Exiting Language Environment Data
```

Figure 144. Example of formatted output from LEDATA Verbexit (Part 10 of 10)

Sections of the Language Environment LEDATA Verbexit formatted output

The sections of the output listed here appear independently of the Language Environment-conforming languages used.

[1] - [8]CEEDUMP Formatted Control Blocks

These sections are included when the CEEDUMP parameter is specified on the LEDATA invocation.

[1] - [4] NTHREADS data

These sections are also includes, once for each thread, when the NTHREADS() parameter is specified on the LEDATA invocations. For a description of NTHREADS, see “Report type parameters” on page 398.

[1] Enclave Identifier

This statement names the enclave for which information is provided.

[2] Information for thread

This section shows the system identifier for the thread. Each thread has a unique identifier.

[3] Registers and PSW

This section displays the register and program status word (PSW) values that were used to create the traceback. These values may come from the TCB, the RTM2 work area, a linkage stack entry or output from the BPXGMSTA service. This section is not displayed when the DSA() parameter is specified on the LEDATA invocation.

[4] Traceback

For all active routines in a particular thread. The traceback section shows routine information in two parts. The first part contains:

- DSA number

  A number assigned to the information for this active routine by LEDATA. The number is only used to associate information from the first part of the traceback with information in the second part of the traceback.
- Entry

  For C/C++ routines, this is the function name. If a function name or entry point was not specified for a particular routine, then the string *** NoName ***** will appear.
- Entry point offset
- Load module
- Program unit

  The primary entry point of the external procedure. For C routines, this is the compile unit name. For Language Environment-conforming assemblers, this is the ENTNAME = value on the CELQPRLG macro.
- Service level

  The latest service level applied to the compile unit (for example, for IBM products, it would be the PTF number.
- Status

  Routine status can be call, exception, or running.

The second part contains:

- DSA number

  A number assigned to the information for this active routine by LEDATA. The number is only used to associate information from the first part of the traceback with information in the second part of the traceback.
- Stack frame (DSA) address
- Entry point address
- Program unit address
- Program unit offset

  The offset of the last instruction to run in the routine. If the offset is a negative number, zero, or a very large positive number, the routine associated with the offset probably did not allocate a save area, or the routine could have been called using SVC-assisted linkage. Adding the program unit address to the offset gives you the location of the current instruction in the routine. This offset is from the starting address of the routine.

[5] Control Blocks Associated with the Thread

This section lists the contents of the thread synchronization queue element (SQEL).

[6] Enclave Control Blocks

If the POSIX run-time option was set to ON, this section lists the contents of the mutex and condition variable control blocks, the enclave level latch table, and the thread synchronization trace block and trace table. If the HEAPCHK run-time option is set to ON, this section lists the contents of the HEAPCHK options control block (HCOP) and the HEAPCHK element tables (HCEL). A HEAPCHK element table contains the location and length of all allocated storage elements for a heap in the order that they were allocated.

[7] Language Environment Trace Table

If the TRACE run-time option was set to ON, this section shows the contents of the Language Environment trace table.

[8] Process Control Blocks

If the POSIX run-time option was set to ON, this section lists the contents of the process level latch table.

[9] - [17] Summary

These sections are included when the SUMMARY parameter is specified on the LEDATA invocation.

[9] Summary Header

The summary header section contains:
- Address of Thread control block (TCB)
- Release number
- Address Space ID (ASID)

[10] Active Members List

This list of active members is extracted from the enclave member list (MEML).

[11] CEELAA

This section formats the contents of the Language Environment library anchor area (LAA). See*z/OS Language Environment Vendor Interfaces* for a description of the fields in the LAA.

[12] CEELCA

This section formats the contents of the Language Environment library control area (LCA). See *z/OS Language Environment Vendor Interfaces* for a description of the fields in the LCA.

[13] CEECAA

This section formats the contents of the Language Environment common anchor area (CAA). See*z/OS Language Environment Vendor Interfaces* for a description of the fields in the CAA. If there is any, DLL failure data is also formatted.

[14] CEEPCB

This section formats the contents of the Language Environment process control block (PCB), and the process level member list.

[15] CEERCB

This section formats the contents of the Language Environment region control block (RCB).

[16] CEEEDB

This section formats the contents of the Language Environment enclave data block (EDB), and the enclave level member list.

[17] Run-Time Options

This section lists the run-time options in effect at the time of the dump, and indicates where they were set.

[18] Heap Storage Control Blocks

This section is included when the HEAP or SM parameter is specified on the LEDATA invocation.

This section formats the Enclave-level storage management control block (ENSQ) and for each different type of heap storage:

- Heap control block (HPCQ)
- Chain of heap anchor blocks (HANQ). A HANQ immediately precedes each segment of heap storage.

This section includes a detailed heap segment report for each segment in the dump. For more information about the detailed heap segment report, see “Understanding the HEAP LEDATA output” on page 418.

[19] Stack Storage Control Blocks

This section is included when the STACK or SM parameter is specified on the LEDATA invocation.

This section formats:

- Stack anchor (SANC)
- Chain of dynamic save areas (DSA)

[20] Condition Management Control Blocks

This section is included when the CM parameter is specified on the LEDATA invocation.

This section formats the chain of Condition Information Block Headers (CIBH) and Condition Information Blocks. The Machine State Information Block is contained with the CIBH starting with the field labeled MCH_EYE.

[21] Message Processing Control Blocks

This section is included when the MH parameter is specified on the LEDATA invocation.

[22] Preinitialization Information

This section is included when the PTBL parameter is specified on the LEDATA invocation.

This section formats information related to preinitialization. See section PTBL LEDATA output for more information. If the preinitialization service CELQPIPI was not used to initialize this environment, the message: `No PIPICB associated with CAA` is displayed instead.

PTBL LEDATA output

The Language Environment IPCS Verbexit LEDATA command generates formatted output of PreInit tables when the PTBL or ALL parameter are specified. If ALL is specified, PTBL defaults to CURRENT value. Figure 145 on page 417 illustrates the output produced when the Verbexit LEDATA command is invoked with the PTBL parameter.

```
PTBL(CURRENT)
********************************************************************************
                  64 BIT LANGUAGE ENVIRONMENT DATA
********************************************************************************

 Language Environment Product 04 V01 R09.00

PreInitialization Programming Interface Trace Data
CELQPIPI Environment Table Entry and Trace Entry :
 Active CELQPIPI Environment (  Address 00000001_00010B80 )
 Eyecatcher  : CELQIPTB
 TCB address : 008D6E88

 CELQPIPI Environment :
  Environment Type : MAIN
  Sequence of Calls not active
  Exits not established
  Signal Interrupt Routines not registered
  Service Routines are not active

  CELQPIPI Environment Enclave Initialized
  Number of CELQPIPI Table Entries = 3

 CELQPIPI Table Entry Information :
 CELQPIPI Table Index 0  ( Entry 1   )
  Routine Name  = ISJPPCA3
  Routine Type  = C/C++
  Routine Entry Point  = 00000000_21053000
  Routine Function Pointer  = 00000000_210530C0
  Routine was loaded by Language Environment
  Routine Address was resolved
  Routine Function Descriptor was valid
  Routine was valid
  Routine Return Code    = 0
  Routine Reason Code    = 0

  Entry of routine in CELQPIPI Table for Index 0  ( 00000001_00010D38 )

   +000000 00000001_00010D38  00000000 00000000 00000000 210530C0 |................|
   +000010 00000001_00010D48  00000000 2105A808 80000000 00000000 |......y.........|
   +000020 00000001_00010D58  00000000 00000000 00000000 00000000 |................|
   +000030 00000001_00010D68 - +000000 00000001_00010D77             same as above
   +000040 00000001_00010D78  00000000 00000000 00000000 21053000 |................|
   +000050 00000001_00010D88  00000000 00000003 00000000 2105A908 |.............z..|
   +000060 00000001_00010D98  00000000 00000000 00000003 00000000 |................|
   +000070 00000001_00010DA8  00000000 21053000 00000000 21053000 |................|
   +000080 00000001_00010DB8  00009000 00000000 C9E2D1D7 D7C3C1F3 |........ISJPPCA3|
   +000090 00000001_00010DC8  40404040 40404040 00000000 00000000 |        ........|

 CELQPIPI Table Index 1  ( Entry 2   ) not in use.

 CELQPIPI Table Index 2  ( Entry 3   ) not in use.
```

Figure 145. Example of formatted PTBL output from LEDATA Verbexit (Part 1 of 2)

```
CELQPIPI Trace Table Entries :
 Call Type =  INIT_MAIN
  PIPI Driver Address  = 00000000_2090082A
  Load Service Return Code   = 0
  Load Service Reason Code   = 0
  Most Recent Return Code    = 0
  Most Recent Reason Code    = 0
  An ABEND will be issued if storage can not be obtained
  Service RC = 0 :A new environment was initialized.

 Call Type =  ADD_ENTRY
  Routine Table Index        = 1
  Routine Name  = ISJPPCA1
  Routine Address = 00000000_2105E000
  Load Service Return Code   = 0
  Load Service Reason Code   = 3
  Service RC = 0 :The routine was added to the PreInit table.

 Call Type =  IDENTIFY_ENTRY
  Routine Table Index        = 1
  Routine Programming Language  = C/C++
  Service RC = 0 :The programming language has been returned.

 Call Type =  CALL_MAIN
  Routine Table Index     = 1
  Enclave Return Code     = 0
  Enclave Reason Code     = 0
  Routine Feedback Code   = 0000000000000000
  Service RC = 0 :The environment was activated and the routine called.

 Call Type =  DELETE_ENTRY
  Routine Table Index     = 1
  Routine Name  = ISJPPCA1
  Routine Address = 00000000_2105E000
  Service RC = 0 :The routine was deleted from the PreInit table.

 Call Type =  CALL_MAIN
  Routine Table Index     = 0
  Enclave Return Code     = 0
  Enclave Reason Code     = 0
  Routine Feedback Code   = 0000000000000000
  Service RC = 0 :The environment was activated and the routine called.

Exiting Language Environment Data
```

Figure 145. Example of formatted PTBL output from LEDATA Verbexit (Part 2 of 2)

Understanding the HEAP LEDATA output

The Language Environment IPCS Verbexit LEDATA generates a detailed heap segment report when the HEAP option is used with the DETAIL option, or when the SM,DETAIL option is specified. The detailed heap segment report is useful when trying to pinpoint damage because it provides very specific information. The report describes the nature of the damage, and specifies where the actual damage occurred. The report can also be used to diagnose storage leaks, and to identify heap fragmentation. Figure 146 on page 419 illustrates the output produced by specifying the HEAP option. “Heap report sections of the LEDATA output” on page 427 describes the information contained in the formatted output.

For easy reference, the sections of the dump are numbered to correspond with the description of each section that follows. Ellipses are used to summarize some sections of the dump.

Note: Language Environment does not provide support for alternative Vendor Heap Manager (VHM) data. LEDATA Verbexit will state that an alternative VHM is in use.

```
HEAP
********************************************************************************
                  64 BIT LANGUAGE ENVIRONMENT DATA
********************************************************************************

 Language Environment Product 04 V01 R09.00

 Heap Storage Control Blocks

  Heappools trace available. To display: IP VERBX LEDATA 'HPT(*)'

    ENSQ:  00000001_00100108
   +000000  EYE_CATCHER:ENSQ  HEAPALLOC_VAL:00000000
   +000008  HEAPFREE_VAL:00000000   DSAALLOC_VAL:00000000   FLAGS1:80000000
   +000014  IPT_TOKEN:000000A0 00000002 00000016 007FF050
   +000024  HEAPLOCKWORD:00000000   RPT_STOR:00000001_00100410
   +000030  UHEAP64:C8D7C3D8 00000000 00000001 001005B0 00000001 001007F0 00000000 00000001 00
   +000060  LHEAP64:C8D7C3D8 00000000 00000001 001005E0 00000001 00100670 00000000 00000001 00
   +000090  UHEAP31:C8D7C3D8 00000000 00000001 00100198 00000001 00100198 00000000 00008000 00
   +0000C0  LHEAP31:C8D7C3D8 00000000 00000001 001007C0 00000001 001007C0 00000000 00004000 00
   +0000F0  UHEAP24:C8D7C3D8 00000000 00000001 001001F8 00000001 001001F8 00000000 00001000 00
   +000120  LHEAP24:C8D7C3D8 00000000 00000001 00100228 00000001 00100228 00000000 00002000 00
   +000174  IPT_TCB:007FF050        HEAPCHK:00000000_00000000
   +000188  STSB:00000000_00000000        SASB:00000000_00000000
   +000198  TOKEN:7F7547D8 00000000
   +0001A0  THDLHEAP64:C8D7C3D8 00000000 00000001 00100790 00000001 00100790 00000000 00000001 00
   +0001D0  IOHEAP64:C8D7C3D8 00000000 00000001 00100760 00000001 00100760 00000000 00000001 00
   +000200  IOHEAP31:C8D7C3D8 00000000 00000001 001006A0 00000001 001006A0 00000000 00003000 00
   +000230  IOHEAP24:C8D7C3D8 00000000 00000001 001006D0 00000001 001006D0 00000000 00001000 00
   +000260  SM_CELL_BLOCK:00000001_00100490     SPDE:00000001_00100730

 User Heap64 Control Blocks

    HPCQ:  00000001_00100138
   +000000  EYE_CATCHER:HPCQ  FIRST:00000001_001005B0       LAST:00000001_001007F0
   +000018  INITSIZE:00000000 00000001    INCRSIZE:00000000 00000001
   +00002C  OPTIONS:80000000

    HPSQ:  00000001_00005058
   +000000  BYTES_ALLOC:00000000 001C3320
   +000008  CURR_ALLOC:00000000 000CF080        GET_REQ:00000000 0000000D
   +000018  FREE_REQ:00000000 00000001    GETMAINS:00000000 00000001
   +000028  FREEMAINS:00000000 00000000

    THNQ:  00000001_001005B0
   +000000  EYE_CATCHER:THNQ  FLAGS:80000000    NEXT:00000001_001007F0
   +000010  PREV:00000001_00100138        HEAPID:00000001_00100138
   +000020  SEGMENT:00000001_08300000     SEG_LEN:00000000 00100000

    HANQ:  00000001_08300000
   +000000  EYE_CATCHER:HANQ  FLAGS:80000000    HEAPID:00000001_00100138
   +000020  SEGMENT:00000001_08300000     ROOT:00000001_083CF0C0
   +000030  SEG_LEN:00000000 00100000     ROOT_LEN:00000000 00030F40

[1]    Free Storage Tree for Heap Segment 00000001

             Node            Node             Parent          Left            Right           Left            Right
Depth        Address         Length           Node            Node            Node            Length          Length
    0  00000001083CF0C0  0000000000030F40 0000000000000000 0000000000000000 0000000000000000 0000000000000000 0000000000000000
```

Figure 146. Example formatted detailed heap segment report from LEDATA Verbexit (Part 1 of 9)

```
[2]    Map of Heap Segment 00000001

     To display entire segment: IP LIST 0000000108300000 LEN(X'0000000000100000') ASID(X'0028')

     0000000108300040: Allocated storage element, length=0000000000000180.
    To display: IP LIST 0000000108300040 LEN(X'0000000000000180') ASID(X'0028')
     0000000108300050: C36DE6E2 C1F6F440 40404040 40404040  00000001 08300070 00000000 250005A8 |C_WSA64         ..............y|

     00000001083001C0: Allocated storage element, length=0000000000019660.
    To display: IP LIST 00000001083001C0 LEN(X'0000000000019660') ASID(X'0028')
     00000001083001D0: 00000000 00000005 00000000 00000005  00000001 08319840 00000001 08319A28 |.....................q ........|
⋮
     00000001083B79A0: Allocated storage element, length=0000000000017720.
    To display: IP LIST 00000001083B79A0 LEN(X'0000000000017720') ASID(X'0028')
     00000001083B79B0: 00000000 00000002 00000000 00000000  00000000 00000000 00000000 D3D4D9C5 |............................LMRE|

     00000001083CF0C0: Free storage element, length=0000000000030F40.
    To display: IP LIST 00000001083CF0C0 LEN(X'0000000000030F40') ASID(X'0028')

     Summary of analysis for Heap Segment 0000000108300000:
        Amounts of identified storage:  Free:00030F40          Allocated:000CF080          Total:000FFFC0
        Number of identified areas   :  Free:       1  Allocated:      12  Total:      13
        00000000 bytes of storage were not accounted for.
        No errors were found while processing this heap segment.

          THNQ:  00000001_001007F0
       +000000  EYE_CATCHER:THNQ  FLAGS:00000000    NEXT:00000001_00100138
       +000010  PREV:00000001_001005B0        HEAPID:00000001_00100138
       +000020  SEGMENT:00000001_19C00000     SEG_LEN:00000000 00100000

          HANQ:  00000001_19C00000
       +000000  EYE_CATCHER:HANQ  FLAGS:00000000    HEAPID:00000001_00100138
       +000020  SEGMENT:00000001_19C00000     ROOT:00000001_19C00040
       +000030  SEG_LEN:00000000 00100000     ROOT_LEN:00000000 000FFFC0

          This is the last heap segment in the current heap

[1]    Free Storage Tree for Heap Segment 00000001

                  Node              Node             Parent            Left            Right               Left              Right
     Depth      Address            Length             Node            Node            Node             Length            Length
         0  0000000119C00040  00000000000FFFC0  0000000000000000  0000000000000000  0000000000000000  0000000000000000  0000000000000000

[2]    Map of Heap Segment 00000001

     To display entire segment: IP LIST 0000000119C00000 LEN(X'0000000000100000') ASID(X'0028')

     0000000119C00040: Free storage element, length=00000000000FFFC0.
    To display: IP LIST 0000000119C00040 LEN(X'00000000000FFFC0') ASID(X'0028')

     Summary of analysis for Heap Segment 0000000119C00000:
        Amounts of identified storage:  Free:000FFFC0          Allocated:00000000          Total:000FFFC0
        Number of identified areas   :  Free:       1  Allocated:       0  Total:       1
        00000000 bytes of storage were not accounted for.
        No errors were found while processing this heap segment.
        This is the last heap segment in the current heap.

     Library Heap64 Control Blocks

          HPCQ:  00000001_00100168
       +000000  EYE_CATCHER:HPCQ  FIRST:00000001_001005E0       LAST:00000001_00100670
       +000018  INITSIZE:00000000 00000001    INCRSIZE:00000000 00000001
       +00002C  OPTIONS:90000000

          HPSQ:  00000001_000050E8
       +000000  BYTES_ALLOC:00000000 0067A940
       +000008  CURR_ALLOC:00000000 0067A840        GET_REQ:00000000 00000042
       +000018  FREE_REQ:00000000 00000003    GETMAINS:00000000 00000003
       +000028  FREEMAINS:00000000 00000000

          THNQ:  00000001_001005E0
       +000000  EYE_CATCHER:THNQ  FLAGS:80000000    NEXT:00000001_00100610
       +000010  PREV:00000001_00100168        HEAPID:00000001_00100168
       +000020  SEGMENT:00000001_08400000     SEG_LEN:00000000 00100000

          HANQ:  00000001_08400000
       +000000  EYE_CATCHER:HANQ  FLAGS:80000000    HEAPID:00000001_00100168
       +000020  SEGMENT:00000001_08400000     ROOT:00000001_08400040
       +000030  SEG_LEN:00000000 00100000     ROOT_LEN:00000000 000FFFC0
```

Figure 146. Example formatted detailed heap segment report from LEDATA Verbexit (Part 2 of 9)

```
[1]    Free Storage Tree for Heap Segment 00000001

                Node             Node             Parent           Left            Right               Left             Right
     Depth      Address          Length            Node            Node            Node              Length           Length
         0  0000000108400040  00000000000FFFC0  0000000000000000  0000000000000000  0000000000000000  0000000000000000  0000000000000000

[2]    Map of Heap Segment 00000001

     To display entire segment: IP LIST 0000000108400000 LEN(X'0000000000100000') ASID(X'0028')

     0000000108400040: Free storage element, length=00000000000FFFC0.
    To display: IP LIST 0000000108400040 LEN(X'00000000000FFFC0') ASID(X'0028')

     Summary of analysis for Heap Segment 0000000108400000:
        Amounts of identified storage:  Free:000FFFC0          Allocated:00000000          Total:000FFFC0
        Number of identified areas   :  Free:       1  Allocated:       0  Total:       1
        00000000 bytes of storage were not accounted for.
        No errors were found while processing this heap segment.

          THNQ:  00000001_00100610
        +000000  EYE_CATCHER:THNQ  FLAGS:00000000    NEXT:00000001_00100640
        +000010  PREV:00000001_001005E0        HEAPID:00000001_00100168
        +000020  SEGMENT:00000001_08800000     SEG_LEN:00000000 00200000

          HANQ:  00000001_08800000
        +000000  EYE_CATCHER:HANQ  FLAGS:00000000    HEAPID:00000001_00100168
        +000020  SEGMENT:00000001_08800000     ROOT:00000001_08943AC0
        +000030  SEG_LEN:00000000 00200000     ROOT_LEN:00000000 000BC540
[1]    Free Storage Tree for Heap Segment 00000001

                Node             Node             Parent           Left            Right               Left             Right
     Depth      Address          Length            Node            Node            Node              Length           Length
         0  0000000108943AC0  00000000000BC540  0000000000000000  0000000000000000  0000000000000000  0000000000000000  0000000000000000

[2]    Map of Heap Segment 00000001

     To display entire segment: IP LIST 0000000108800000 LEN(X'0000000000200000') ASID(X'0028')

     0000000108800040: Allocated storage element, length=0000000000100040.
    To display: IP LIST 0000000108800040 LEN(X'0000000000100040') ASID(X'0028')
     0000000108800050: C003F3EE 2540A23A 253E0190 00000000  03000000 00000005 94818995 40404040 |..3.. s.................main    |

     0000000108900080: Allocated storage element, length=00000000000132A0.
    To display: IP LIST 0000000108900080 LEN(X'00000000000132A0') ASID(X'0028')
     0000000108900090: 00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000 |................................|

⋮
     0000000108943600: Allocated storage element, length=00000000000004C0.
    To display: IP LIST 0000000108943600 LEN(X'00000000000004C0') ASID(X'0028')
     0000000108943610: D8D7C3C2 000004B0 0000000C 00010000  00000001 00000000 00000001 08E00050 |QPCB.........................&|

     0000000108943AC0: Free storage element, length=00000000000BC540.
    To display: IP LIST 0000000108943AC0 LEN(X'00000000000BC540') ASID(X'0028')

     Summary of analysis for Heap Segment 0000000108800000:
        Amounts of identified storage:  Free:000BC540          Allocated:00143A80          Total:001FFFC0
        Number of identified areas   :  Free:       1  Allocated:       8  Total:       9
        00000000 bytes of storage were not accounted for.
        No errors were found while processing this heap segment.

          THNQ:  00000001_00100640
        +000000  EYE_CATCHER:THNQ  FLAGS:00000000    NEXT:00000001_00100670
        +000010  PREV:00000001_00100610        HEAPID:00000001_00100168
        +000020  SEGMENT:00000001_08A00000     SEG_LEN:00000000 00400000
          HANQ:  00000001_08A00000

        +000000  EYE_CATCHER:HANQ  FLAGS:00000000    HEAPID:00000001_00100168
        +000020  SEGMENT:00000001_08A00000     ROOT:00000001_08D48340
        +000030  SEG_LEN:00000000 00400000     ROOT_LEN:00000000 000B7CC0
```

Figure 146. Example formatted detailed heap segment report from LEDATA Verbexit (Part 3 of 9)

```
[1]    Free Storage Tree for Heap Segment 00000001

                 Node              Node             Parent            Left            Right                Left              Right
     Depth      Address            Length             Node             Node            Node                Length            Length
         0  0000000108D48340  00000000000B7CC0  0000000000000000  0000000000000000  0000000000000000  0000000000000000  0000000000000000

[2]    Map of Heap Segment 00000001

     To display entire segment: IP LIST 0000000108A00000 LEN(X'0000000000400000') ASID(X'0028')

     0000000108A00040: Allocated storage element, length=0000000000348300.
    To display: IP LIST 0000000108A00040 LEN(X'0000000000348300') ASID(X'0028')
     0000000108A00050: C8D7E3C1 0000000C 00046030 000000F0  00000001 08A000C8 00000001 08A460F8 |HPTA......-....0.......H.....u-8|

     0000000108D48340: Free storage element, length=00000000000B7CC0.
    To display: IP LIST 0000000108D48340 LEN(X'00000000000B7CC0') ASID(X'0028')

     Summary of analysis for Heap Segment 0000000108A00000:
        Amounts of identified storage:  Free:000B7CC0          Allocated:00348300          Total:003FFFC0
        Number of identified areas   :  Free:       1  Allocated:       1  Total:       2
        00000000 bytes of storage were not accounted for.
        No errors were found while processing this heap segment.

         THNQ:  00000001_00100670
       +000000  EYE_CATCHER:THNQ  FLAGS:00000000    NEXT:00000001_00100168
       +000010  PREV:00000001_00100640        HEAPID:00000001_00100168
       +000020  SEGMENT:00000001_08E00000     SEG_LEN:00000000 00200000

         HANQ:  00000001_08E00000
       +000000  EYE_CATCHER:HANQ  FLAGS:00000000    HEAPID:00000001_00100168
       +000020  SEGMENT:00000001_08E00000     ROOT:00000001_08FEEC20
       +000030  SEG_LEN:00000000 00200000     ROOT_LEN:00000000 000113E0

         This is the last heap segment in the current heap

[1]    Free Storage Tree for Heap Segment 00000001

                 Node              Node             Parent            Left            Right                Left              Right
     Depth      Address            Length             Node             Node            Node                Length            Length
         0  0000000108FEEC20  00000000000113E0  0000000000000000  0000000108FEE960  0000000000000000  0000000000000120  0000000000000000
         1  0000000108FEE960  0000000000000120  0000000108FEEC20  0000000000000000  0000000000000000  0000000000000000  0000000000000000

[2]    Map of Heap Segment 00000001

     To display entire segment: IP LIST 0000000108E00000 LEN(X'0000000000200000') ASID(X'0028')

     0000000108E00040: Allocated storage element, length=00000000001C0040.
    To display: IP LIST 0000000108E00040 LEN(X'00000000001C0040') ASID(X'0028')
     0000000108E00050: 00000000 00000002 00000000 00000000  00000000 00000001 00000000 00000000 |................................|

     0000000108FC0080: Allocated storage element, length=0000000000003EC0.
    To display: IP LIST 0000000108FC0080 LEN(X'0000000000003EC0') ASID(X'0028')
     0000000108FC0090: C8C3C5D3 00000000 00000000 00000000  00000000 00000000 00000001 00100138 |HCEL............................|
⋮
     0000000108FEEA80: Allocated storage element, length=00000000000001A0.
    To display: IP LIST 0000000108FEEA80 LEN(X'00000000000001A0') ASID(X'0028')
     0000000108FEEA90: 00000000 25462598 00000000 00000000  C3C5D3D8 D3C9C240 00000008 C3C5D3D8 |.......q........CELQLIB ....CELQ|

     0000000108FEEC20: Free storage element, length=00000000000113E0.
    To display: IP LIST 0000000108FEEC20 LEN(X'00000000000113E0') ASID(X'0028')

     Summary of analysis for Heap Segment 0000000108E00000:
        Amounts of identified storage:  Free:00011500          Allocated:001EEAC0          Total:001FFFC0
        Number of identified areas   :  Free:       2  Allocated:      54  Total:      56
        00000000 bytes of storage were not accounted for.
        No errors were found while processing this heap segment.
        This is the last heap segment in the current heap.
```

Figure 146. Example formatted detailed heap segment report from LEDATA Verbexit (Part 4 of 9)

```
    User Heap31 Control Blocks

         HPCQ:  00000001_00100198
        +000000  EYE_CATCHER:HPCQ  FIRST:00000001_00100198       LAST:00000001_00100198
        +000018  INITSIZE:00000000 00008000    INCRSIZE:00000000 00008000
        +00002C  OPTIONS:40000000

                 ** NO SEGMENTS ALLOCATED **
         HPSQ:  00000001_00005088
        +000000  BYTES_ALLOC:00000000 00000000
        +000008  CURR_ALLOC:00000000 00000000        GET_REQ:00000000 00000000
        +000018  FREE_REQ:00000000 00000000    GETMAINS:00000000 00000000
        +000028  FREEMAINS:00000000 00000000

    Library Heap31 Control Blocks

         HPCQ:  00000001_001001C8
        +000000  EYE_CATCHER:HPCQ  FIRST:00000001_001007C0       LAST:00000001_001007C0
        +000018  INITSIZE:00000000 00004000    INCRSIZE:00000000 00002000
        +00002C  OPTIONS:50000000

         HPSQ:  00000001_00005118
        +000000  BYTES_ALLOC:00000000 00001128
        +000008  CURR_ALLOC:00000000 00001128        GET_REQ:00000000 00000001
        +000018  FREE_REQ:00000000 00000000    GETMAINS:00000000 00000001
        +000028  FREEMAINS:00000000 00000000

         THNQ:  00000001_001007C0
        +000000  EYE_CATCHER:THNQ  FLAGS:00000000    NEXT:00000001_001001C8
        +000010  PREV:00000001_001001C8        HEAPID:00000001_001001C8
        +000020  SEGMENT:00000000_25773000     SEG_LEN:00000000 00004000

         HANQ:  00000000_25773000
        +000000  EYE_CATCHER:HANQ  FLAGS:00000000    HEAPID:00000001_001001C8
        +000020  SEGMENT:25773000        ROOT:25774168     SEG_LEN:00004000
        +00002C  ROOT_LEN:00002E98

         This is the last heap segment in the current heap

[1]    Free Storage Tree for Heap Segment 00000000

               Node      Node     Parent     Left      Right     Left     Right
    Depth  Address    Length     Node      Node      Node     Length    Length
        0  25774168  00002E98  00000000  00000000  00000000  00000000  00000000

[2]    Map of Heap Segment 00000000

    To display entire segment: IP LIST 00000000 LEN(X'00004000') ASID(X'0028')

    25773040: Allocated storage element, length=00001128. To display: IP LIST 25773040 LEN(X'00001128') ASID(X'0028')
    25773048: 00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000 |................................|

    25774168: Free storage element, length=00002E98. To display: IP LIST 25774168 LEN(X'00002E98') ASID(X'0028')

    Summary of analysis for Heap Segment 00000000:
       Amounts of identified storage:  Free:00002E98  Allocated:00001128  Total:00003FC0
       Number of identified areas   :  Free:       1  Allocated:       1  Total:       2
       00000000 bytes of storage were not accounted for.
       No errors were found while processing this heap segment.
       This is the last heap segment in the current heap.

    User Heap24 Control Blocks

         HPCQ:  00000001_001001F8
        +000000  EYE_CATCHER:HPCQ  FIRST:00000001_001001F8       LAST:00000001_001001F8
        +000018  INITSIZE:00000000 00001000    INCRSIZE:00000000 00001000
        +00002C  OPTIONS:30000000

                 ** NO SEGMENTS ALLOCATED **
         HPSQ:  00000001_000050B8
        +000000  BYTES_ALLOC:00000000 00000000
        +000008  CURR_ALLOC:00000000 00000000        GET_REQ:00000000 00000000
        +000018  FREE_REQ:00000000 00000000    GETMAINS:00000000 00000000
        +000028  FREEMAINS:00000000 00000000
```

Figure 146. Example formatted detailed heap segment report from LEDATA Verbexit (Part 5 of 9)

```
   Library Heap24 Control Blocks

        HPCQ:  00000001_00100228
      +000000  EYE_CATCHER:HPCQ  FIRST:00000001_00100228       LAST:00000001_00100228
      +000018  INITSIZE:00000000 00002000    INCRSIZE:00000000 00001000
      +00002C  OPTIONS:30000000

               ** NO SEGMENTS ALLOCATED **
        HPSQ:  00000001_00005148
      +000000  BYTES_ALLOC:00000000 00000000
      +000008  CURR_ALLOC:00000000 00000000        GET_REQ:00000000 00000000
      +000018  FREE_REQ:00000000 00000000    GETMAINS:00000000 00000000
      +000028  FREEMAINS:00000000 00000000

    Library Thread Heap64 Control Blocks

        HPCQ:  00000001_001002A8
      +000000  EYE_CATCHER:HPCQ  FIRST:00000001_00100790       LAST:00000001_00100790
      +000018  INITSIZE:00000000 00000001    INCRSIZE:00000000 00000001
      +00002C  OPTIONS:90000000

        HPSQ:  00000001_00005208
      +000000  BYTES_ALLOC:00000000 00000340
      +000008  CURR_ALLOC:00000000 00000340        GET_REQ:00000000 00000001
      +000018  FREE_REQ:00000000 00000000    GETMAINS:00000000 00000001
      +000028  FREEMAINS:00000000 00000000

        THNQ:  00000001_00100790
      +000000  EYE_CATCHER:THNQ  FLAGS:00000000    NEXT:00000001_001002A8
      +000010  PREV:00000001_001002A8        HEAPID:00000001_001002A8
      +000020  SEGMENT:00000001_19B00000     SEG_LEN:00000000 00100000

        HANQ:  00000001_19B00000
      +000000  EYE_CATCHER:HANQ  FLAGS:00000000    HEAPID:00000001_001002A8
      +000020  SEGMENT:00000001_19B00000     ROOT:00000001_19B00380
      +000030  SEG_LEN:00000000 00100000     ROOT_LEN:00000000 000FFC80

        This is the last heap segment in the current heap

[1]   Free Storage Tree for Heap Segment 00000001

                 Node              Node             Parent            Left            Right               Left              Right
    Depth      Address            Length             Node            Node            Node              Length            Length
        0  0000000119B00380  00000000000FFC80  0000000000000000  0000000000000000  0000000000000000  0000000000000000  0000000000000000

[2]   Map of Heap Segment 00000001

    To display entire segment: IP LIST 0000000119B00000 LEN(X'0000000000100000') ASID(X'0028')

    0000000119B00040: Allocated storage element, length=0000000000000340.
   To display: IP LIST 0000000119B00040 LEN(X'0000000000000340') ASID(X'0028')
    0000000119B00050: D7C3C9C2 00000000 00000000 00000000  00000000 00000000 00010310 00000000 |PCIB............................|

    0000000119B00380: Free storage element, length=00000000000FFC80.
   To display: IP LIST 0000000119B00380 LEN(X'00000000000FFC80') ASID(X'0028')

    Summary of analysis for Heap Segment 0000000119B00000:
       Amounts of identified storage:  Free:000FFC80          Allocated:00000340          Total:000FFFC0
       Number of identified areas   :  Free:       1  Allocated:       1  Total:       2
       00000000 bytes of storage were not accounted for.
       No errors were found while processing this heap segment.
       This is the last heap segment in the current heap.

    I/O Heap64 Control Blocks

        HPCQ:  00000001_001002D8
      +000000  EYE_CATCHER:HPCQ  FIRST:00000001_00100760       LAST:00000001_00100760
      +000018  INITSIZE:00000000 00000001    INCRSIZE:00000000 00000001
      +00002C  OPTIONS:90000000

        HPSQ:  00000001_00005178
      +000000  BYTES_ALLOC:00000000 00010380
      +000008  CURR_ALLOC:00000000 00010380        GET_REQ:00000000 00000003
      +000018  FREE_REQ:00000000 00000000    GETMAINS:00000000 00000001
      +000028  FREEMAINS:00000000 00000000
```

Figure 146. Example formatted detailed heap segment report from LEDATA Verbexit (Part 6 of 9)

```
        THNQ:  00000001_00100760
       +000000  EYE_CATCHER:THNQ  FLAGS:00000000    NEXT:00000001_001002D8
       +000010  PREV:00000001_001002D8        HEAPID:00000001_001002D8
       +000020  SEGMENT:00000001_19A00000     SEG_LEN:00000000 00100000

        HANQ:  00000001_19A00000
       +000000  EYE_CATCHER:HANQ  FLAGS:00000000    HEAPID:00000001_001002D8
       +000020  SEGMENT:00000001_19A00000     ROOT:00000001_19A103C0
       +000030  SEG_LEN:00000000 00100000     ROOT_LEN:00000000 000EFC40

        This is the last heap segment in the current heap

[1]    Free Storage Tree for Heap Segment 00000001

                 Node              Node             Parent            Left            Right               Left              Right
     Depth      Address            Length            Node             Node            Node              Length            Length
         0  0000000119A103C0  00000000000EFC40  0000000000000000  0000000000000000  0000000000000000  0000000000000000  0000000000000000

[2]    Map of Heap Segment 00000001

     To display entire segment: IP LIST 0000000119A00000 LEN(X'0000000000100000') ASID(X'0028')

     0000000119A00040: Allocated storage element, length=0000000000000300.
    To display: IP LIST 0000000119A00040 LEN(X'0000000000000300') ASID(X'0028')
     0000000119A00050: 00000001 19A00120 00000000 00000001  00000000 00000000 00000000 00000000 |................................|

     0000000119A00340: Allocated storage element, length=0000000000000060.
    To display: IP LIST 0000000119A00340 LEN(X'0000000000000060') ASID(X'0028')
     0000000119A00350: 94859496 99A84B84 81A38100 00000000  00000000 00000000 00000000 00000000 |memory.data.....................|

     0000000119A003A0: Allocated storage element, length=0000000000010020.
    To display: IP LIST 0000000119A003A0 LEN(X'0000000000010020') ASID(X'0028')
     0000000119A003B0: A2969485 408481A3 81A29694 85409496  99854084 81A38185 A5859540 94969985 |some datasome more dataeven more|

     0000000119A103C0: Free storage element, length=00000000000EFC40.
    To display: IP LIST 0000000119A103C0 LEN(X'00000000000EFC40') ASID(X'0028')

     Summary of analysis for Heap Segment 0000000119A00000:
        Amounts of identified storage:  Free:000EFC40          Allocated:00010380          Total:000FFFC0
        Number of identified areas   :  Free:       1  Allocated:       3  Total:       4
        00000000 bytes of storage were not accounted for.
        No errors were found while processing this heap segment.
        This is the last heap segment in the current heap.

     I/O Heap31 Control Blocks

         HPCQ:  00000001_00100308
       +000000  EYE_CATCHER:HPCQ  FIRST:00000001_001006A0       LAST:00000001_001006A0
       +000018  INITSIZE:00000000 00003000    INCRSIZE:00000000 00002000
       +00002C  OPTIONS:50000000

         HPSQ:  00000001_000051A8
       +000000  BYTES_ALLOC:00000000 00002490
       +000008  CURR_ALLOC:00000000 00002490        GET_REQ:00000000 0000000E
       +000018  FREE_REQ:00000000 00000000    GETMAINS:00000000 00000001
       +000028  FREEMAINS:00000000 00000000

         THNQ:  00000001_001006A0
       +000000  EYE_CATCHER:THNQ  FLAGS:00000000    NEXT:00000001_00100308
       +000010  PREV:00000001_00100308        HEAPID:00000001_00100308
       +000020  SEGMENT:00000000_25757000     SEG_LEN:00000000 00003000

         HANQ:  00000000_25757000
       +000000  EYE_CATCHER:HANQ  FLAGS:00000000    HEAPID:00000001_00100308
       +000020  SEGMENT:25757000        ROOT:257594D0     SEG_LEN:00003000
       +00002C  ROOT_LEN:00000B30

     This is the last heap segment in the current heap

[1]    Free Storage Tree for Heap Segment 00000000

             Node      Node     Parent     Left      Right     Left     Right
     Depth  Address    Length     Node      Node      Node    Length    Length
         0  257594D0  00000B30  00000000  00000000  00000000  00000000  00000000
```

Figure 146. Example formatted detailed heap segment report from LEDATA Verbexit (Part 7 of 9)

```
[2]    Map of Heap Segment 00000000

     To display entire segment: IP LIST 00000000 LEN(X'00003000') ASID(X'0028')

     25757040: Allocated storage element, length=00000388. To display: IP LIST 25757040 LEN(X'00000388') ASID(X'0028')
     25757048: 00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000 |................................|

     257573C8: Allocated storage element, length=00000070. To display: IP LIST 257573C8 LEN(X'00000070') ASID(X'0028')
     257573D0: D6E2C9D6 00007048 00000000 000077F0  000078A8 00000001 00000001 FFFFFFFF |OSIO..........0...y............|

     25757438: Allocated storage element, length=00000040. To display: IP LIST 25757438 LEN(X'00000040') ASID(X'0028')
     25757440: C4C3C2C5 00380000 00007048 00000000  C0880000 80000000 00000000 00000000 |DCBE.............h..............|
:
     257590C8: Allocated storage element, length=00000370. To display: IP LIST 257590C8 LEN(X'00000370') ASID(X'0028')
     257590D0: C1C6C3C2 00000000 00000000 257590F8  AFCBAFCB 00000000 00000001 08371120 |AFCB...........8................|

     25759438: Allocated storage element, length=00000098. To display: IP LIST 25759438 LEN(X'00000098') ASID(X'0028')
     25759440: 007D0000 40404040 40404040 4040F0F0  F0F0F0F0 F0F0F2F5 F7F5C2F5 C5F04B84 |.'..          000000002575B5E0.d|

     257594D0: Free storage element, length=00000B30. To display: IP LIST 257594D0 LEN(X'00000B30') ASID(X'0028')

     Summary of analysis for Heap Segment 00000000:
        Amounts of identified storage:  Free:00000B30  Allocated:00002490  Total:00002FC0
        Number of identified areas   :  Free:       1  Allocated:      14  Total:      15
        00000000 bytes of storage were not accounted for.
        No errors were found while processing this heap segment.
        This is the last heap segment in the current heap.

     I/O Heap24 Control Blocks

         HPCQ:  00000001_00100338
       +000000  EYE_CATCHER:HPCQ  FIRST:00000001_001006D0       LAST:00000001_001006D0
       +000018  INITSIZE:00000000 00001000    INCRSIZE:00000000 00001000
       +00002C  OPTIONS:30000000

         HPSQ:  00000001_000051D8
       +000000  BYTES_ALLOC:00000000 00000B10
       +000008  CURR_ALLOC:00000000 00000B10        GET_REQ:00000000 0000000A
       +000018  FREE_REQ:00000000 00000000    GETMAINS:00000000 00000001
       +000028  FREEMAINS:00000000 00000000

         THNQ:  00000001_001006D0
       +000000  EYE_CATCHER:THNQ  FLAGS:00000000    NEXT:00000001_00100338
       +000010  PREV:00000001_00100338        HEAPID:00000001_00100338
       +000020  SEGMENT:00000000_00007000     SEG_LEN:00000000 00001000

         HANQ:  00000000_00007000
       +000000  EYE_CATCHER:HANQ  FLAGS:00000000    HEAPID:00000001_00100338
       +000020  SEGMENT:00007000        ROOT:00007B50     SEG_LEN:00001000
       +00002C  ROOT_LEN:000004B0

         This is the last heap segment in the current heap

[1]    Free Storage Tree for Heap Segment 00000000

              Node      Node     Parent     Left      Right     Left     Right
     Depth  Address    Length     Node      Node      Node     Length    Length
         0  00007B50  000004B0  00000000  00000000  00000000  00000000  00000000

[2]    Map of Heap Segment 00000000

     To display entire segment: IP LIST 00000000 LEN(X'00001000') ASID(X'0028')

     00007040: Allocated storage element, length=00000088. To display: IP LIST 00007040 LEN(X'00000088') ASID(X'0028')
     00007048: 25757440 00000000 00000000 0B000000  00020000 01008FF0 03724000 00006DD8 |... ...................0.. ..._Q|

     000070C8: Allocated storage element, length=00000248. To display: IP LIST 000070C8 LEN(X'00000248') ASID(X'0028')
     000070D0: 00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000 |................................|

     00007310: Allocated storage element, length=000004D8. To display: IP LIST 00007310 LEN(X'000004D8') ASID(X'0028')
     00007318: EBECD008 0024B909 00FFB904 00B1E3E0  10000004 E3E0E000 00040530 89E00002 |.............T.....T.......i...|
:
     00007B18: Allocated storage element, length=00000038. To display: IP LIST 00007B18 LEN(X'00000038') ASID(X'0028')
     00007B20: 00007B20 25759440 00000000 0000007D  00000000 00000000 00000000 00000000 |..#...m .......'................|

     00007B50: Free storage element, length=000004B0. To display: IP LIST 00007B50 LEN(X'000004B0') ASID(X'0028')
```

Figure 146. Example formatted detailed heap segment report from LEDATA Verbexit (Part 8 of 9)

```
  Summary of analysis for Heap Segment 00000000:
    Amounts of identified storage:  Free:000004B0  Allocated:00000B10  Total:00000FC0
    Number of identified areas   :  Free:       1  Allocated:      10  Total:      11
    00000000 bytes of storage were not accounted for.
    No errors were found while processing this heap segment.
    This is the last heap segment in the current heap.

Exiting Language Environment Data
```

Figure 146. Example formatted detailed heap segment report from LEDATA Verbexit (Part 9 of 9)

Heap report sections of the LEDATA output

The Heap Report sections of the LEDATA output provide information for each heap segment in the dump. The detailed heap segment reports include information on the free storage tree in the heap segments, the allocated storage elements, and the cause of heap management data structure problems.

[1]Free Storage Tree Report

Within each heap segment, Language Environment keeps track of unallocated storage areas by chaining them together into a tree. Each free area represents a node in the tree. Each node contains a header, which points to its left and right child nodes. The header also contains the length of each child.

The LEDATA HEAP option formats the free storage tree within each heap, and validates all node addresses and lengths within each node. Each node address is validated to ensure that it:

- Falls on a doubleword boundary
- Falls within the current heap segment
- Does not point to itself
- Does not point to a node that was previously traversed

Each node length is validated to ensure that it:

- Is a multiple of 8
- Is not larger than the heap segment length
- Does not cause the end of the node to fall outside of the current heap segment
- Does not cause the node to overlap another node

If the formatter finds a problem, then it will place an error message describing the problem directly after the formatted line of the node that failed validation

[2]Heap Segment Map Report

The LEDATA HEAP option produces a report that lists all of the storage areas within each heap segment, and identifies the area as either allocated or freed. For each allocated area the contents of the first X'20' bytes of the area are displayed in order to help identify the reason for the storage allocation.

Each allocated storage element has a prefix used by Language Environment to manage the area. The prefix contains a pointer to the start of the heap segment followed by the length of the allocated storage element. For HEAP64 heaps, the prefix is 16 bytes, with 8-byte pointer and length fields. For HEAP31 and HEAP24 heaps, the pointer is 8 bytes with 4-byte pointer and length field. The formatter validates this header to ensure that its heap segment pointer is valid. The length is also validated to ensure that it:

- Is a multiple of 8
- Is not zero

- Is not larger than the heap segment length
- Does not cause the end of the element to fall outside of the current heap segment
- Does not cause the element to overlap a free storage node

If the heap_free_value of the STORAGE run-time option was specified, then the formatter also checks that the free storage within each free storage element is set to the requested heap_free_value. If a problem is found, then an error message describing the problem is placed after the formatted line of the storage element that failed validation.

Diagnosing heap damage problems

Heap storage errors can occur when an application allocates a heap storage element that is too small for it to use, and therefore, accidently overlays heap storage. If this situation occurs then some of the typical error messages generated are:

- The node address does not represent a valid node within the heap segment
- The length of the segment is not valid, or
- The heap segment pointer is not valid.

If one of the above error messages is generated by one of the reports, then examine the storage element that immediately precedes the damaged node to determine if this storage element is owned by the application program. Check the size of the storage element and ensure that it is sufficient for the program's use. If the size of the storage element is not sufficient then adjust the allocation size.

If an error occurs indicating that the node's pointers form a circular loop within the free storage tree, then check the Free Storage Tree Report to see if such a loop exists. If a loop exists, then contact the IBM support center for assistance because this may be a problem in the Language Environment heap management routines.

Additional diagnostic information regarding heap damage can be obtained by using the HEAPCHK run-time option. This option provides a more accurate time perspective on when the heap damage actually occurred, which could help to determine the program that caused the damage. For more information on HEAPCHK, see *z/OS Language Environment Programming Reference*.

Diagnosing storage leak problems

A storage leak occurs when a program does not return storage back to the heap after it has finished using it. To determine if this problem exists, do one of the following:

- The *call-level* suboption of the HEAPCHK run-time option causes a report to be produced in the CEEDUMP. Any still-allocated (that is, not freed) storage identified by HEAPCHK is listed in the report, along with the corresponding traceback. This shows any storage that wasn't freed, as well as all the calls that were involved in allocating the storage. For more information about the HEAPCHK run-time option, see *z/OS Language Environment Programming Reference* .
- Examine the Heap Segment Map report to see if any data areas, within the allocated storage elements, appear more frequently than expected. If they do, then check to see if these data areas are still being used by the application program. If the data areas are not being used, then change the program to free the storage element after it is done with it.

Diagnosing heap fragmentation problems

Heap fragmentation occurs when allocated storage is interlaced with many free storage areas that are too small for the application to use. Heap fragmentation could indicate that the application is not making efficient use of its heap storage. Check the Heap Segment Map report for frequent free storage elements that are interspersed with the allocated storage elements.

Understanding the heappool LEDATA output

The Language Environment IPCS Verbexit LEDATA generates a detailed heappool report when heappools is ON. The detailed heappool report is useful when trying to find potential damaged cells because it provides very specific information.Figure 147 on page 430 illustrates the details of heappool report. “Heappool report sections of the LEDATA output” on page 435 describes the information contained in the formatted output.

```
Heap Pool Report
    QPCB:  00000008_08733600
  +000000  EYECATCHER:QPCB   LENGTH:00001800   NUMPOOLS:00000010
  +00000C  LARGEST_CELL_SIZE:00010000    BIG_REQUESTS:00000000
  +000018  STORAGE_HITS_ADDR:00000000_00000000       FLAGS:0400
  +000022  NUMGETARRAYS:05   NUMCELLSIZES:0C
  +000028  GET_POOLINFO_ARRAYS_PTR:00000008_08733800
-
  Data for pool 1:
POOLDATA:  00000008_08733D00
  +000000  POOL_INDEX:00000001     INPUT_CELL_SIZE:00000008
  +000008  CELL_SIZE:00000020      INPUT_COUNT:0000000A
  +000010  CELL_POOL_SIZE:00000140       CELL_POOL_NUM:0000000A
  +000018  POOL_LATCH_ADDR:00000008_087117E0   POOL_EXTENTS:00000001
  +000028  LAST_CELL:00000008_0862E680   NEXT_CELL:00000008_0862E580
  +000040  Q_CONTROL_INFO:00000000 00000005    Q_FIRST_CELL:00000008_0862E560
  +000050  POOL_NUM_GET_TOTAL:00000000 00000003
  +000058  POOL_NUM_FREE:00000000 00000001     POOL_EXTENTS_ANCHOR:00000008_0862E550
  +000068  POOL_INDEX_SAME_SIZE:01       POOL_INDEX_SIZE:01
  +00006A  POOL_NUM_SAME_SIZE:01   POOL_TRACE_TABLE:00000008_088000E0
    [2]Heap Pool Extent Mapping
EXTENT:  00000008_0862E550
  +000000  EYE_CATCHER:EX64  NEXT_EXTENT:00000000_00000000
    To display entire pool extent: IP LIST 000000080862E550 LEN(X'00000150') ASID(X'0021')
    000000080862E560: Free storage cell. To display: IP LIST 000000080862E560 LEN(X'00000020') ASID(X'0021')
    [1]Verifying free chain for pool: 1...
       No errors were found while processing free chain.
    Summary of analysis for Pool 1:
       Number of cells:  Unused:       9  Free:       1  Allocated:       0  Total Used:       10
       00000000 free cells were not accounted for.
       No errors were found while processing this Pool.
-
  Data for pool 2:
POOLDATA:  00000008_08733E00
  +000000  POOL_INDEX:00000002     INPUT_CELL_SIZE:00000020
  +000008  CELL_SIZE:00000030      INPUT_COUNT:00000004
  +000010  CELL_POOL_SIZE:000000C0       CELL_POOL_NUM:00000004
  +000018  POOL_LATCH_ADDR:00000008_08711808   POOL_EXTENTS:00000001
  +000028  LAST_CELL:00000008_0862E750   NEXT_CELL:00000008_0862E6F0
  +000040  Q_CONTROL_INFO:00000000 00000005    Q_FIRST_CELL:00000008_0862E6C0
  +000050  POOL_NUM_GET_TOTAL:00000000 00000003
  +000058  POOL_NUM_FREE:00000000 00000001     POOL_EXTENTS_ANCHOR:00000008_0862E6B0
  +000068  POOL_INDEX_SAME_SIZE:01       POOL_INDEX_SIZE:02
  +00006A  POOL_NUM_SAME_SIZE:01   POOL_TRACE_TABLE:00000008_08846110
  [2]Heap Pool Extent Mapping
  EXTENT:  00000008_0862E6B0
  +000000  EYE_CATCHER:EX64  NEXT_EXTENT:00000000_00000000
    To display entire pool extent: IP LIST 000000080862E6B0 LEN(X'000000D0') ASID(X'0021')
    000000080862E6C0: Free storage cell. To display: IP LIST 000000080862E6C0 LEN(X'00000030') ASID(X'0021')
  [1]Verifying free chain for pool: 2...
No errors were found while processing free chain.
    Summary of analysis for Pool 2:
       Number of cells:  Unused:       3  Free:       1  Allocated:       0  Total Used:       4
       00000000 free cells were not accounted for.
       No errors were found while processing this Pool.
-
  Data for pool 3:
POOLDATA:  00000008_08733F00
  +000000  POOL_INDEX:00000003     INPUT_CELL_SIZE:00000080
  +000008  CELL_SIZE:00000090      INPUT_COUNT:00000004
  +000010  CELL_POOL_SIZE:00000240       CELL_POOL_NUM:00000004
  +000018  POOL_LATCH_ADDR:00000008_08711830   POOL_EXTENTS:00000002
  +000028  LAST_CELL:00000008_0862E950   NEXT_CELL:00000008_0862E950
  +000040  Q_CONTROL_INFO:00000000 00000010    Q_FIRST_CELL:00000008_0862E830
  +000050  POOL_NUM_GET_TOTAL:00000000 0000000E
  +000058  POOL_NUM_FREE:00000000 00000002     POOL_EXTENTS_ANCHOR:00000008_0862E790
  +000068  POOL_INDEX_SAME_SIZE:01       POOL_INDEX_SIZE:03
  +00006A  POOL_NUM_SAME_SIZE:01   POOL_TRACE_TABLE:00000008_0888C140
```

Figure 147. Example formatted detailed heappool report from LEDATA Verbexit (Part 1 of 5)

```
[2]Heap Pool Extent Mapping
  EXTENT:  00000008_0862E790
  +000000  EYE_CATCHER:EX64  NEXT_EXTENT:00000008_0862E2F0
    To display entire pool extent: IP LIST 000000080862E790 LEN(X'00000250') ASID(X'0021')
    000000080862E7A0: Free storage cell. To display: IP LIST 000000080862E7A0 LEN(X'00000090') ASID(X'0021')
    000000080862E830: Free storage cell. To display: IP LIST 000000080862E830 LEN(X'00000090') ASID(X'0021')
    000000080862E8C0: Allocated storage cell. To display: IP LIST 000000080862EE8C0 LEN(X'00000090') ASID(X'0021')
    000000080862E8D0: 00000008 0862D2D0 00000000 000005E8 00000000 0000000B 00000000 00000008|......K}.......Y.............|
  EXTENT:  00000008_0862E2F0
  +000000  EYE_CATCHER:EX64  NEXT_EXTENT:00000000_00000000
    To display entire pool extent: IP LIST 000000080862E2F0 LEN(X'00000250') ASID(X'0021')
    000000080862E300: Allocated storage cell. To display: IP LIST 000000080862E300 LEN(X'00000090') ASID(X'0021')
    000000080862E310: C3C4D3D3 00000000 00000000 00000000 C0000000 00000000 00000000 00000000|CDLL............{.............|
    000000080862E390: Allocated storage cell. To display: IP LIST 000000080862E390 LEN(X'00000090') ASID(X'0021')
    000000080862E3A0: 00000000 00000000 00000008 08C65E90 20004000 00000000 00000000 00000000|.............F;... .............|
    000000080862E420: Allocated storage cell. To display: IP LIST 000000080862E420 LEN(X'00000090') ASID(X'0021')
    000000080862E430: 00000000 00000000 00000008 08C65EA8 20004000 00000000 00000000 00000000|.............F;y.. .............|
    000000080862E4B0: Allocated storage cell. To display: IP LIST 000000080862E4B0 LEN(X'00000090') ASID(X'0021')
    000000080862E4C0: 00000000 00000000 00000008 00005968 20004000 00000000 00000000 00000000|.................. .............|
  [1]Verifying free chain for pool: 3...
       No errors were found while processing free chain.
    Summary of analysis for Pool 3:
       Number of cells:  Unused:       1  Free:       2  Allocated:       5  Total Used:       8
       00000000 free cells were not accounted for.
       No errors were found while processing this Pool.
-
  Data for pool 4:
POOLDATA:  00000008_08734000
  +000000  POOL_INDEX:00000004     INPUT_CELL_SIZE:00000100
  +000008  CELL_SIZE:00000110      INPUT_COUNT:00000004
  +000010  CELL_POOL_SIZE:00000440       CELL_POOL_NUM:00000004
  +000018  POOL_LATCH_ADDR:00000008_08711858   POOL_EXTENTS:00000001
  +000028  LAST_CELL:00000008_0862ED30   NEXT_CELL:00000008_0862EC20
  +000040  Q_CONTROL_INFO:00000000 0000000A    Q_FIRST_CELL:00000008_0862EB10
  +000050  POOL_NUM_GET_TOTAL:00000000 00000006
  +000058  POOL_NUM_FREE:00000000 00000002     POOL_EXTENTS_ANCHOR:00000008_0862E9F0
  +000068  POOL_INDEX_SAME_SIZE:01       POOL_INDEX_SIZE:04
  +00006A  POOL_NUM_SAME_SIZE:01   POOL_TRACE_TABLE:00000008_088D2170
  [2]Heap Pool Extent Mapping
EXTENT:  00000008_0862E9F0
  +000000  EYE_CATCHER:EX64  NEXT_EXTENT:00000000_00000000
    To display entire pool extent: IP LIST 000000080862E9F0 LEN(X'00000450') ASID(X'0021')
    000000080862EA00: Free storage cell. To display: IP LIST 000000080862EA00 LEN(X'00000110') ASID(X'0021')
    000000080862EB10: Free storage cell. To display: IP LIST 000000080862EB10 LEN(X'00000110') ASID(X'0021')
  [1]Verifying free chain for pool: 4...
No errors were found while processing free chain.
    Summary of analysis for Pool 4:
       Number of cells:  Unused:       2  Free:       2  Allocated:       0  Total Used:       4
       00000000 free cells were not accounted for.
       No errors were found while processing this Pool.
  -
Data for pool 5.1:
POOLDATA:  00000008_08734100
  +000000  POOL_INDEX:00000005     INPUT_CELL_SIZE:00000400
  +000008  CELL_SIZE:00000410      INPUT_COUNT:00000004
  +000010  CELL_POOL_SIZE:00001040       CELL_POOL_NUM:00000004
  +000018  POOL_LATCH_ADDR:00000008_08711880   POOL_EXTENTS:00000001
  +000028  LAST_CELL:00000008_08606330   NEXT_CELL:00000008_08605B10
  +000040  Q_CONTROL_INFO:00000000 00000000    Q_FIRST_CELL:00000000_00000000
  +000050  POOL_NUM_GET_TOTAL:00000000 00000001
  +000058  POOL_NUM_FREE:00000000 00000000     POOL_EXTENTS_ANCHOR:00000008_086056F0
  +000068  POOL_INDEX_SAME_SIZE:01       POOL_INDEX_SIZE:05
  +00006A  POOL_NUM_SAME_SIZE:05   POOL_TRACE_TABLE:00000008_089181A0
```

Figure 147. Example formatted detailed heappool report from LEDATA Verbexit (Part 2 of 5)

```
   [2]Heap Pool Extent Mapping
EXTENT:  00000008_086056F0
  +000000  EYE_CATCHER:EX64  NEXT_EXTENT:00000000_00000000
    To display entire pool extent: IP LIST 00000008086056F0 LEN(X'00001050') ASID(X'0021')
    0000000808605700: Allocated storage cell. To display: IP LIST 0000000808605700 LEN(X'00000410') ASID(X'0021')
    0000000808605710: 00000008 08606770 00000008 08606958 00000008 08606995 00000008 086069D2|.....-.......-........-.n.....-.K|
    Summary of analysis for Pool 5.1:
       Number of cells:  Unused:       3  Free:       0  Allocated:       1  Total Used:       4
       00000000 free cells were not accounted for.
       No errors were found while processing this Pool.
  -
  Data for pool 5.2:
POOLDATA:  00000008_08734200
  +000000  POOL_INDEX:00000006     INPUT_CELL_SIZE:00000400
  +000008  CELL_SIZE:00000410      INPUT_COUNT:00000004
  +000010  CELL_POOL_SIZE:00001040       CELL_POOL_NUM:00000004
  +000018  POOL_LATCH_ADDR:00000008_08711880   POOL_EXTENTS:00000001
  +000028  LAST_CELL:00000008_0862FA90   NEXT_CELL:00000008_0862FA90
  +000040  Q_CONTROL_INFO:00000000 0000000F    Q_FIRST_CELL:00000008_0862F680
  +000050  POOL_NUM_GET_TOTAL:00000000 00000009
  +000058  POOL_NUM_FREE:00000000 00000003     POOL_EXTENTS_ANCHOR:00000008_0862EE50
  +000068  POOL_INDEX_SAME_SIZE:02       POOL_INDEX_SIZE:05
  +00006A  POOL_NUM_SAME_SIZE:05   POOL_TRACE_TABLE:00000008_0895E1D0
  [2]Heap Pool Extent Mapping
  EXTENT:  00000008_0862EE50
  +000000  EYE_CATCHER:EX64  NEXT_EXTENT:00000000_00000000
    To display entire pool extent: IP LIST 000000080862EE50 LEN(X'00001050') ASID(X'0021')
    000000080862EE60: Free storage cell. To display: IP LIST 000000080862EE60 LEN(X'00000410') ASID(X'0021')
    000000080862F270: Free storage cell. To display: IP LIST 000000080862F270 LEN(X'00000410') ASID(X'0021')
    000000080862F680: Free storage cell. To display: IP LIST 000000080862F680 LEN(X'00000410') ASID(X'0021')
  [1]Verifying free chain for pool: 5.2...
    Verifying free chain for pool: 5.2...
       No errors were found while processing free chain.
    Summary of analysis for Pool 5.2:
       Number of cells:  Unused:       1  Free:       3  Allocated:       0  Total Used:       4
       00000000 free cells were not accounted for.
       No errors were found while processing this Pool.
  -
  Data for pool 5.3:
POOLDATA:  00000008_08734300
  +000000  POOL_INDEX:00000007     INPUT_CELL_SIZE:00000400
  +000008  CELL_SIZE:00000410      INPUT_COUNT:00000004
  +000010  CELL_POOL_SIZE:00001040       CELL_POOL_NUM:00000004
  +000018  POOL_LATCH_ADDR:00000008_08711880   POOL_EXTENTS:00000000
  +000028  LAST_CELL:00000000_00000000   NEXT_CELL:00000000_00000000
  +000040  Q_CONTROL_INFO:00000000 00000000    Q_FIRST_CELL:00000000_00000000
  +000050  POOL_NUM_GET_TOTAL:00000000 00000000
  +000058  POOL_NUM_FREE:00000000 00000000     POOL_EXTENTS_ANCHOR:00000000_00000000
  +000068  POOL_INDEX_SAME_SIZE:03       POOL_INDEX_SIZE:05
  +00006A  POOL_NUM_SAME_SIZE:05   POOL_TRACE_TABLE:00000008_089A4200
    There are no extents for this pool.
-
  Data for pool 5.4:
POOLDATA:  00000008_08734400
  +000000  POOL_INDEX:00000008     INPUT_CELL_SIZE:00000400
  +000008  CELL_SIZE:00000410      INPUT_COUNT:00000004
  +000010  CELL_POOL_SIZE:00001040       CELL_POOL_NUM:00000004
  +000018  POOL_LATCH_ADDR:00000008_08711880   POOL_EXTENTS:00000000
  +000028  LAST_CELL:00000000_00000000   NEXT_CELL:00000000_00000000
  +000040  Q_CONTROL_INFO:00000000 00000000    Q_FIRST_CELL:00000000_00000000
  +000050  POOL_NUM_GET_TOTAL:00000000 00000000
  +000058  POOL_NUM_FREE:00000000 00000000     POOL_EXTENTS_ANCHOR:00000000_00000000
  +000068  POOL_INDEX_SAME_SIZE:04       POOL_INDEX_SIZE:05
  +00006A  POOL_NUM_SAME_SIZE:05   POOL_TRACE_TABLE:00000008_089EA230
    There are no extents for this pool.
```

Figure 147. Example formatted detailed heappool report from LEDATA Verbexit (Part 3 of 5)

```
  -
-
  Data for pool 5.5:
POOLDATA:  00000008_08734500
  +000000  POOL_INDEX:00000009     INPUT_CELL_SIZE:00000400
  +000008  CELL_SIZE:00000410      INPUT_COUNT:00000004
  +000010  CELL_POOL_SIZE:00001040       CELL_POOL_NUM:00000004
  +000018  POOL_LATCH_ADDR:00000008_08711880   POOL_EXTENTS:00000000
  +000028  LAST_CELL:00000000_00000000   NEXT_CELL:00000000_00000000
  +000040  Q_CONTROL_INFO:00000000 00000000    Q_FIRST_CELL:00000000_00000000
  +000050  POOL_NUM_GET_TOTAL:00000000 00000000
  +000058  POOL_NUM_FREE:00000000 00000000     POOL_EXTENTS_ANCHOR:00000000_00000000
  +000068  POOL_INDEX_SAME_SIZE:05       POOL_INDEX_SIZE:05
  +00006A  POOL_NUM_SAME_SIZE:05   POOL_TRACE_TABLE:00000008_08A30260
    There are no extents for this pool.
-
  Data for pool 6:
POOLDATA:  00000008_08734600
  +000000  POOL_INDEX:0000000A     INPUT_CELL_SIZE:00000800
  +000008  CELL_SIZE:00000810      INPUT_COUNT:00000004
  +000010  CELL_POOL_SIZE:00002040       CELL_POOL_NUM:00000004
  +000018  POOL_LATCH_ADDR:00000008_087118A8   POOL_EXTENTS:00000001
  +000028  LAST_CELL:00000008_0862DAD0   NEXT_CELL:00000008_0862DAD0
  +000040  Q_CONTROL_INFO:00000000 0000000B    Q_FIRST_CELL:00000008_0862CAB0
  +000050  POOL_NUM_GET_TOTAL:00000000 00000008
  +000058  POOL_NUM_FREE:00000000 00000001     POOL_EXTENTS_ANCHOR:00000008_0862C290
  +000068  POOL_INDEX_SAME_SIZE:01       POOL_INDEX_SIZE:06
  +00006A  POOL_NUM_SAME_SIZE:01   POOL_TRACE_TABLE:00000008_08A76290
    [2]Heap Pool Extent Mapping
EXTENT:  00000008_0862C290
  +000000  EYE_CATCHER:EX64  NEXT_EXTENT:00000000_00000000
    To display entire pool extent: IP LIST 000000080862C290 LEN(X'00002050') ASID(X'0021')
    000000080862C2A0: Allocated storage cell. To display: IP LIST 000000080862C2A0 LEN(X'00000810') ASID(X'0021')
    000000080862C2B0: 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000|................................|
    000000080862CAB0: Free storage cell. To display: IP LIST 000000080862CAB0 LEN(X'00000810') ASID(X'0021')
    000000080862D2C0: Allocated storage cell. To display: IP LIST 000000080862D2C0 LEN(X'00000810') ASID(X'0021')
    000000080862D2D0: 00000008 082FA5A8 00000000 00000000 00000008 082FAE20 00000000 00000008|......vy........................|
    [1]Verifying free chain for pool: 6...
       No errors were found while processing free chain.
    Summary of analysis for Pool 6:
       Number of cells:  Unused:       1  Free:       1  Allocated:       2  Total Used:       4
       00000000 free cells were not accounted for.
       No errors were found while processing this Pool.
-
  Data for pool 7:
POOLDATA:  00000008_08734700
  +000000  POOL_INDEX:0000000B     INPUT_CELL_SIZE:00000C00
  +000008  CELL_SIZE:00000C10      INPUT_COUNT:00000032
  +000010  CELL_POOL_SIZE:00025B20       CELL_POOL_NUM:00000032
  +000018  POOL_LATCH_ADDR:00000008_087118D0   POOL_EXTENTS:00000001
  +000028  LAST_CELL:00000008_0862B670   NEXT_CELL:00000008_08607F80
  +000040  Q_CONTROL_INFO:00000000 00000000    Q_FIRST_CELL:00000000_00000000
  +000050  POOL_NUM_GET_TOTAL:00000000 00000002
  +000058  POOL_NUM_FREE:00000000 00000000     POOL_EXTENTS_ANCHOR:00000008_08606750
  +000068  POOL_INDEX_SAME_SIZE:01       POOL_INDEX_SIZE:07
  +00006A  POOL_NUM_SAME_SIZE:01   POOL_TRACE_TABLE:00000008_08ABC2C0
    [2]Heap Pool Extent Mapping
  EXTENT:  00000008_08606750
  +000000  EYE_CATCHER:EX64  NEXT_EXTENT:00000000_00000000
    To display entire pool extent: IP LIST 0000000808606750 LEN(X'00025B30') ASID(X'0021')
    0000000808606760: Allocated storage cell. To display: IP LIST 0000000808606760 LEN(X'00000C10') ASID(X'0021')
    0000000808606770: 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000|................................|
    0000000808607370: Allocated storage cell. To display: IP LIST 0000000808607370 LEN(X'00000C10') ASID(X'0021')
    0000000808607380: 00000000 00000000 00000008 08C65DD8 60004000 00000000 00000000 00000000|.............F)Q-. .............|
    Summary of analysis for Pool 7:
       Number of cells:  Unused:       48  Free:       0  Allocated:       2  Total Used:       50
       00000000 free cells were not accounted for.
       No errors were found while processing this Pool.
```

Figure 147. Example formatted detailed heappool report from LEDATA Verbexit (Part 4 of 5)

```
-
  Data for pool 8:
POOLDATA:  00000008_08734800
  +000000  POOL_INDEX:0000000C     INPUT_CELL_SIZE:00001000
  +000008  CELL_SIZE:00001010      INPUT_COUNT:00000032
  +000010  CELL_POOL_SIZE:00032320       CELL_POOL_NUM:00000032
  +000018  POOL_LATCH_ADDR:00000008_087118F8   POOL_EXTENTS:00000000
  +000028  LAST_CELL:00000000_00000000   NEXT_CELL:00000000_00000000
  +000040  Q_CONTROL_INFO:00000000 00000000    Q_FIRST_CELL:00000000_00000000
  +000050  POOL_NUM_GET_TOTAL:00000000 00000000
  +000058  POOL_NUM_FREE:00000000 00000000     POOL_EXTENTS_ANCHOR:00000000_00000000
  +000068  POOL_INDEX_SAME_SIZE:01       POOL_INDEX_SIZE:08
  +00006A  POOL_NUM_SAME_SIZE:01   POOL_TRACE_TABLE:00000008_08B022F0
    There are no extents for this pool.
-
  Data for pool 9:
POOLDATA:  00000008_08734900
  +000000  POOL_INDEX:0000000D     INPUT_CELL_SIZE:00002000
  +000008  CELL_SIZE:00002010      INPUT_COUNT:00000019
  +000010  CELL_POOL_SIZE:00032190       CELL_POOL_NUM:00000019
  +000018  POOL_LATCH_ADDR:00000008_08711920   POOL_EXTENTS:00000000
  +000028  LAST_CELL:00000000_00000000   NEXT_CELL:00000000_00000000
  +000040  Q_CONTROL_INFO:00000000 00000000    Q_FIRST_CELL:00000000_00000000
  +000050  POOL_NUM_GET_TOTAL:00000000 00000000
  +000058  POOL_NUM_FREE:00000000 00000000     POOL_EXTENTS_ANCHOR:00000000_00000000
  +000068  POOL_INDEX_SAME_SIZE:01       POOL_INDEX_SIZE:09
  +00006A  POOL_NUM_SAME_SIZE:01   POOL_TRACE_TABLE:00000008_08B48320
    There are no extents for this pool.
-
  Data for pool 10:
POOLDATA:  00000008_08734A00
  +000000  POOL_INDEX:0000000E     INPUT_CELL_SIZE:00004000
  +000008  CELL_SIZE:00004010      INPUT_COUNT:0000000A
  +000010  CELL_POOL_SIZE:000280A0       CELL_POOL_NUM:0000000A
  +000018  POOL_LATCH_ADDR:00000008_08711948   POOL_EXTENTS:00000000
  +000028  LAST_CELL:00000000_00000000   NEXT_CELL:00000000_00000000
  +000040  Q_CONTROL_INFO:00000000 00000000    Q_FIRST_CELL:00000000_00000000
  +000050  POOL_NUM_GET_TOTAL:00000000 00000000
  +000058  POOL_NUM_FREE:00000000 00000000     POOL_EXTENTS_ANCHOR:00000000_00000000
  +000068  POOL_INDEX_SAME_SIZE:01       POOL_INDEX_SIZE:0A
  +00006A  POOL_NUM_SAME_SIZE:01   POOL_TRACE_TABLE:00000008_08B8E350
    There are no extents for this pool.
-
  Data for pool 11:
POOLDATA:  00000008_08734B00
  +000000  POOL_INDEX:0000000F     INPUT_CELL_SIZE:00008000
  +000008  CELL_SIZE:00008010      INPUT_COUNT:00000005
  +000010  CELL_POOL_SIZE:00028050       CELL_POOL_NUM:00000005
  +000018  POOL_LATCH_ADDR:00000008_08711970   POOL_EXTENTS:00000000
  +000028  LAST_CELL:00000000_00000000   NEXT_CELL:00000000_00000000
  +000040  Q_CONTROL_INFO:00000000 00000000    Q_FIRST_CELL:00000000_00000000
  +000050  POOL_NUM_GET_TOTAL:00000000 00000000
  +000058  POOL_NUM_FREE:00000000 00000000     POOL_EXTENTS_ANCHOR:00000000_00000000
  +000068  POOL_INDEX_SAME_SIZE:01       POOL_INDEX_SIZE:0B
  +00006A  POOL_NUM_SAME_SIZE:01   POOL_TRACE_TABLE:00000008_08BD4380
    There are no extents for this pool.
-
  Data for pool 12:
POOLDATA:  00000008_08734C00
  +000000  POOL_INDEX:00000010     INPUT_CELL_SIZE:00010000
  +000008  CELL_SIZE:00010010      INPUT_COUNT:00000005
  +000010  CELL_POOL_SIZE:00050050       CELL_POOL_NUM:00000005
  +000018  POOL_LATCH_ADDR:00000008_08711998   POOL_EXTENTS:00000000
  +000028  LAST_CELL:00000000_00000000   NEXT_CELL:00000000_00000000
  +000040  Q_CONTROL_INFO:00000000 00000000    Q_FIRST_CELL:00000000_00000000
  +000050  POOL_NUM_GET_TOTAL:00000000 00000000
  +000058  POOL_NUM_FREE:00000000 00000000     POOL_EXTENTS_ANCHOR:00000000_00000000
  +000068  POOL_INDEX_SAME_SIZE:01       POOL_INDEX_SIZE:0C
  +00006A  POOL_NUM_SAME_SIZE:01   POOL_TRACE_TABLE:00000008_08C1A3B0
    There are no extents for this pool.
```

Figure 147. Example formatted detailed heappool report from LEDATA Verbexit (Part 5 of 5)

Heappool report sections of the LEDATA output

The Heappool report provides the information regarding the following items:

- Each cell pool.
- The free chain associated with every qpcb pool data area, and all the free and allocated cells in the extent chain.
- Errors found when the cells are validated.

[1]Free Chain Validation

Within each cell pool, Language Environment keeps track of unallocated cells by chaining them together.

The LEDATA HEAP option validates the free chain within each cell pool. It verifies that the cell pointer is within a valid extent and that the cell pool number is valid.

If the formatter finds a problem, it will place an error message describing the problem directly after the formatted line of the cell that failed validation.

[2]Heap Pool Extent Mapping Report

The LEDATA HEAP option produces a report that lists all of the cells within each pool extent, and identifies the cells as either allocated or freed. For each allocated cell, the contents of the first X'20' bytes of the area are displayed in order to identify the reason for the storage allocation.

The formatter validates if cell pool number in header is correct.

Understanding the heap pools trace LEDATA output

The Language Environment IPCS Verbexit LEDATA generates a detailed HEAPPOOLS trace report when the HPT option is used. The argument *value* is the id of the pool to be formatted in the report.

```
    HPT(3)
    ********************************************************************************
                  64 BIT LANGUAGE ENVIRONMENT DATA
    ********************************************************************************

    Language Environment Product 04 V01 R0A.00

[1] HEAPPOOLS64 Trace Table

[2] POOLID: 3  ASID: 001F  AVAILABLE ENTRIES: 12 OF 12

[3] Timestamp: 2008/03/14           18:20:40.239878
    Type: FREE  Cell Address: 00000001086588E0  Cpuid: 01  Tcb: 008D7820
[4] CALL NAME                           CALL ADDRESS       CALL OFFSET
    GetStorage::~GetStorage()           0000000025B001B0   00000056
    foo8()                              0000000025B00348   0000006A
    foo7()                              0000000025B003D8   00000010
    foo6()                              0000000025B00410   00000010
    foo5()                              0000000025B00448   00000010
    foo4()                              0000000025B00480   00000010
    foo3()                              0000000025B004B8   00000010
    foo2()                              0000000025B004F0   00000010
    foo1()                              0000000025B00528   00000010
    thread                              0000000025B005C8   00000000

    Timestamp: 2008/03/14           18:20:40.239875
    Type: FREE  Cell Address: 0000000108658970  Cpuid: 01  Tcb: 008D7820
    CALL NAME                           CALL ADDRESS       CALL OFFSET
    GetStorage::~GetStorage()           0000000025B001B0   00000056
    foo9()                              0000000025B00260   0000006E
    foo8()                              0000000025B00348   00000046
    foo7()                              0000000025B003D8   00000010
    foo6()                              0000000025B00410   00000010
    foo5()                              0000000025B00448   00000010
    foo4()                              0000000025B00480   00000010
    foo3()                              0000000025B004B8   00000010
    foo2()                              0000000025B004F0   00000010
    foo1()                              0000000025B00528   00000000

    Timestamp: 2008/03/14           18:20:40.239873
    Type: GET   Cell Address: 0000000108658970  Cpuid: 01  Tcb: 008D7820
    CALL NAME                           CALL ADDRESS       CALL OFFSET
    GetStorage::GetStorage(int)         0000000025B00118   00000058
    foo9()                              0000000025B00260   0000003A
    foo8()                              0000000025B00348   00000046
    foo7()                              0000000025B003D8   00000010
    foo6()                              0000000025B00410   00000010
    foo5()                              0000000025B00448   00000010
    foo4()                              0000000025B00480   00000010
    foo3()                              0000000025B004B8   00000010
    foo2()                              0000000025B004F0   00000010
    foo1()                              0000000025B00528   00000000
```

Figure 148. Example formatted detailed HEAPPOOLS trace report from LEDATA Verbexit (Part 1 of 5)

```
Timestamp: 2008/03/14           18:20:40.239870
Type: GET   Cell Address: 00000001086588E0  Cpuid: 01  Tcb: 008D7820
CALL NAME                           CALL ADDRESS       CALL OFFSET
GetStorage::GetStorage(int)         0000000025B00118   00000058
foo8()                              0000000025B00348   00000036
foo7()                              0000000025B003D8   00000010
foo6()                              0000000025B00410   00000010
foo5()                              0000000025B00448   00000010
foo4()                              0000000025B00480   00000010
foo3()                              0000000025B004B8   00000010
foo2()                              0000000025B004F0   00000010
foo1()                              0000000025B00528   00000010
thread                              0000000025B005C8   00000000

Timestamp: 2008/03/14           18:20:40.238024
Type: FREE  Cell Address: 00000001086588E0  Cpuid: 01  Tcb: 008D7AD0
CALL NAME                           CALL ADDRESS       CALL OFFSET
GetStorage::~GetStorage()           0000000025B001B0   00000056
foo8()                              0000000025B00348   0000006A
foo7()                              0000000025B003D8   00000010
foo6()                              0000000025B00410   00000010
foo5()                              0000000025B00448   00000010
foo4()                              0000000025B00480   00000010
foo3()                              0000000025B004B8   00000010
foo2()                              0000000025B004F0   00000010
foo1()                              0000000025B00528   00000010
thread                              0000000025B005C8   00000000

Timestamp: 2008/03/14           18:20:40.238021
Type: FREE  Cell Address: 0000000108658970  Cpuid: 01  Tcb: 008D7AD0
CALL NAME                           CALL ADDRESS       CALL OFFSET
GetStorage::~GetStorage()           0000000025B001B0   00000056
foo9()                              0000000025B00260   0000006E
foo8()                              0000000025B00348   00000046
foo7()                              0000000025B003D8   00000010
foo6()                              0000000025B00410   00000010
foo5()                              0000000025B00448   00000010
foo4()                              0000000025B00480   00000010
foo3()                              0000000025B004B8   00000010
foo2()                              0000000025B004F0   00000010
foo1()                              0000000025B00528   00000000

Timestamp: 2008/03/14           18:20:40.238016
Type: GET   Cell Address: 0000000108658970  Cpuid: 01  Tcb: 008D7AD0
CALL NAME                           CALL ADDRESS       CALL OFFSET
GetStorage::GetStorage(int)         0000000025B00118   00000058
foo9()                              0000000025B00260   0000003A
foo8()                              0000000025B00348   00000046
foo7()                              0000000025B003D8   00000010
foo6()                              0000000025B00410   00000010
foo5()                              0000000025B00448   00000010
foo4()                              0000000025B00480   00000010
foo3()                              0000000025B004B8   00000010
foo2()                              0000000025B004F0   00000010
foo1()                              0000000025B00528   00000000

Timestamp: 2008/03/14           18:20:40.238013
Type: GET   Cell Address: 00000001086588E0  Cpuid: 01  Tcb: 008D7AD0
CALL NAME                           CALL ADDRESS       CALL OFFSET
GetStorage::GetStorage(int)         0000000025B00118   00000058
foo8()                              0000000025B00348   00000036
foo7()                              0000000025B003D8   00000010
```

Figure 148. Example formatted detailed HEAPPOOLS trace report from LEDATA Verbexit (Part 2 of 5)

```
foo6()                                0000000025B00410   00000010
foo5()                                0000000025B00448   00000010
foo4()                                0000000025B00480   00000010
foo3()                                0000000025B004B8   00000010
foo2()                                0000000025B004F0   00000010
foo1()                                0000000025B00528   00000010
thread                                0000000025B005C8   00000000

Timestamp: 2008/03/14           18:20:40.158670
Type: GET   Cell Address: 0000000108658850  Cpuid: 01  Tcb: 008FF038
CALL NAME                             CALL ADDRESS       CALL OFFSET
CEEOPMI                               0000000025D95900   00000C8C
CEEOPC                                0000000025D588C0   00001672
pthread_create                        0000000025D6F7E8   00000628
main                                  0000000025B00640   000000AE
CELQINIT                              0000000025B04010   00000000

Timestamp: 2008/03/14           18:20:40.140382
Type: GET   Cell Address: 00000001086587C0  Cpuid: 01  Tcb: 008FF038
CALL NAME                             CALL ADDRESS       CALL OFFSET
CEEOPMI                               0000000025D95900   00000C8C
pthread_mutex_init                    000000002604E6E0   0000005C
pthread_create                        0000000025D6F7E8   0000033A
main                                  0000000025B00640   000000AE
CELQINIT                              0000000025B04010   00000000

Timestamp: 2008/03/14           18:20:40.140373
Type: GET   Cell Address: 0000000108658730  Cpuid: 01  Tcb: 008FF038
CALL NAME                             CALL ADDRESS       CALL OFFSET
CEEOPMI                               0000000025D95900   00000C8C
pthread_mutex_init                    000000002604E6E0   0000005C
pthread_create                        0000000025D6F7E8   000002A2
main                                  0000000025B00640   000000AE
CELQINIT                              0000000025B04010   00000000

Timestamp: 2008/03/14           18:20:40.023500
Type: GET   Cell Address: 00000001086586A0  Cpuid: 01  Tcb: 008FF038
CALL NAME                             CALL ADDRESS       CALL OFFSET
dllinit                               0000000025B767B8   00000090
CEEZIDT                               0000000025CE0738   00000ADC
CELQINMN                              0000000025CEA830   00000F52
CELQINIT                              0000000025B04010   00000000

HEAPPOOLS Trace Table

POOLID: 3  ASID: 001F  AVAILABLE ENTRIES: 8 OF 8

Timestamp: 2008/03/14           18:20:40.239877
Type: FREE  Cell Address: 000000002635E058  Cpuid: 01  Tcb: 008D7820
CALL NAME                             CALL ADDRESS       CALL OFFSET
GetStorage::~GetStorage()             0000000025B001B0   0000003A
foo8()                                0000000025B00348   0000006A
foo7()                                0000000025B003D8   00000010
foo6()                                0000000025B00410   00000010
foo5()                                0000000025B00448   00000010
foo4()                                0000000025B00480   00000010
foo3()                                0000000025B004B8   00000010
foo2()                                0000000025B004F0   00000010
foo1()                                0000000025B00528   00000010
thread                                0000000025B005C8   00000000
```

Figure 148. Example formatted detailed HEAPPOOLS trace report from LEDATA Verbexit (Part 3 of 5)

```
Timestamp: 2008/03/14           18:20:40.239874
Type: FREE  Cell Address: 000000002635E0E0  Cpuid: 01  Tcb: 008D7820
CALL NAME                           CALL ADDRESS       CALL OFFSET
GetStorage::~GetStorage()           0000000025B001B0   0000003A
foo9()                              0000000025B00260   0000006E
foo8()                              0000000025B00348   00000046
foo7()                              0000000025B003D8   00000010
foo6()                              0000000025B00410   00000010
foo5()                              0000000025B00448   00000010
foo4()                              0000000025B00480   00000010
foo3()                              0000000025B004B8   00000010
foo2()                              0000000025B004F0   00000010
foo1()                              0000000025B00528   00000000

Timestamp: 2008/03/14           18:20:40.239872
Type: GET   Cell Address: 000000002635E0E0  Cpuid: 01  Tcb: 008D7820
CALL NAME                           CALL ADDRESS       CALL OFFSET
GetStorage::GetStorage(int)         0000000025B00118   0000002E
foo9()                              0000000025B00260   0000003A
foo8()                              0000000025B00348   00000046
foo7()                              0000000025B003D8   00000010
foo6()                              0000000025B00410   00000010
foo5()                              0000000025B00448   00000010
foo4()                              0000000025B00480   00000010
foo3()                              0000000025B004B8   00000010
foo2()                              0000000025B004F0   00000010
foo1()                              0000000025B00528   00000000

Timestamp: 2008/03/14           18:20:40.239869
Type: GET   Cell Address: 000000002635E058  Cpuid: 01  Tcb: 008D7820
CALL NAME                           CALL ADDRESS       CALL OFFSET
GetStorage::GetStorage(int)         0000000025B00118   0000002E
foo8()                              0000000025B00348   00000036
foo7()                              0000000025B003D8   00000010
foo6()                              0000000025B00410   00000010
foo5()                              0000000025B00448   00000010
foo4()                              0000000025B00480   00000010
foo3()                              0000000025B004B8   00000010
foo2()                              0000000025B004F0   00000010
foo1()                              0000000025B00528   00000010
thread                              0000000025B005C8   00000000

Timestamp: 2008/03/14           18:20:40.238023
Type: FREE  Cell Address: 000000002635E058  Cpuid: 01  Tcb: 008D7AD0
CALL NAME                           CALL ADDRESS       CALL OFFSET
GetStorage::~GetStorage()           0000000025B001B0   0000003A
foo8()                              0000000025B00348   0000006A
foo7()                              0000000025B003D8   00000010
foo6()                              0000000025B00410   00000010
foo5()                              0000000025B00448   00000010
foo4()                              0000000025B00480   00000010
foo3()                              0000000025B004B8   00000010
foo2()                              0000000025B004F0   00000010
foo1()                              0000000025B00528   00000010
thread                              0000000025B005C8   00000000
```

Figure 148. Example formatted detailed HEAPPOOLS trace report from LEDATA Verbexit (Part 4 of 5)

```
 Timestamp: 2008/03/14           18:20:40.238018
 Type: FREE  Cell Address: 000000002635E0E0  Cpuid: 01  Tcb: 008D7AD0
 CALL NAME                          CALL ADDRESS       CALL OFFSET
 GetStorage::~GetStorage()          0000000025B001B0   0000003A
 foo9()                             0000000025B00260   0000006E
 foo8()                             0000000025B00348   00000046
 foo7()                             0000000025B003D8   00000010
 foo6()                             0000000025B00410   00000010
 foo5()                             0000000025B00448   00000010
 foo4()                             0000000025B00480   00000010
 foo3()                             0000000025B004B8   00000010
 foo2()                             0000000025B004F0   00000010
 foo1()                             0000000025B00528   00000000

 Timestamp: 2008/03/14           18:20:40.238015
 Type: GET   Cell Address: 000000002635E0E0  Cpuid: 01  Tcb: 008D7AD0
 CALL NAME                          CALL ADDRESS       CALL OFFSET
 GetStorage::GetStorage(int)        0000000025B00118   0000002E
 foo9()                             0000000025B00260   0000003A
 foo8()                             0000000025B00348   00000046
 foo7()                             0000000025B003D8   00000010
 foo6()                             0000000025B00410   00000010
 foo5()                             0000000025B00448   00000010
 foo4()                             0000000025B00480   00000010
 foo3()                             0000000025B004B8   00000010
 foo2()                             0000000025B004F0   00000010
 foo1()                             0000000025B00528   00000000

 Timestamp: 2008/03/14           18:20:40.238005
 Type: GET   Cell Address: 000000002635E058  Cpuid: 01  Tcb: 008D7AD0
 CALL NAME                          CALL ADDRESS       CALL OFFSET
 GetStorage::GetStorage(int)        0000000025B00118   0000002E
 foo8()                             0000000025B00348   00000036
 foo7()                             0000000025B003D8   00000010
 foo6()                             0000000025B00410   00000010
 foo5()                             0000000025B00448   00000010
 foo4()                             0000000025B00480   00000010
 foo3()                             0000000025B004B8   00000010
 foo2()                             0000000025B004F0   00000010
 foo1()                             0000000025B00528   00000010
 thread                             0000000025B005C8   00000000
Exiting Language Environment Data
```

Figure 148. Example formatted detailed HEAPPOOLS trace report from LEDATA Verbexit (Part 5 of 5)

[1] Trace Header

HEAPPOOLS trace header information.

[2] Pool Information

Information includes the number of the pool (POOLID) which is currently being formatted, the ASID, and the number of entries formatted and the total number of entries taken.

Note: The trace wraps for each poolid after a specific number of entries. The number of entries is controlled by the HEAPCHK run-time option.

[3] Timestamp

The time this trace entry was taken.

Note: The trace entries are formatted in reverse order (most recent trace entry first).

[4] Trace Table Entry contents

The individual trace entry:

- The TYPE - GET or FREE.
- The Cell within the pool being acted upon.
- The CPU and TCB which requested or freed the cell.
- A traceback at the time of the request. The number of entries in this traceback is limited by the HEAPCHK run-time option.

Understanding the C/C++-specific LEDATA output

The Language Environment IPCS Verbexit LEDATA generates formatted output of C/C++-specific control blocks from a system dump when the ALL parameter is specified and C/C++ is active in the dump. Figure 149 on page 443 illustrates the C/C++-specific output produced. The system dump being formatted was obtained by specifying the TERMTHDACT(UADUMP) run-time option when running the program CELQSAMP Figure 5 on page 44. “C/C++-specific sections of the LEDATA output” on page 454 describes the information contained in the formatted output. Ellipses are used to summarize some sections of the dump.

For easy reference, the sections of the dump are numbered to correspond with the description of each section that follows.

```
    ********************************************************************************
                          64 BIT CRTL ENVIRONMENT DATA
    ********************************************************************************

[1]      CGEN:  00000001_00007B18
   +000310  CGENE:00000001_0000BAE0       CRENT:00000000_00000000
   +000320  CPRMS:00000001_00005598       TRACE:00000001    CTHD:00000001_00008F08
   +000338  CURR_FECB:00000001_0000B400   CGEN_CPCB:00000001_00008688
   +000348  CGEN_CEDB:00000001_0000A620   CFLG3:00    CIO:00000001_000088D8

[2]     CGENE:  00000001_0000BAE0
   +000000  CGENEYE:.-./      CGENESIZE:00C200C4      CGENEPTR:007C00C1_00C300C5
   +0000D4  CERRNO:006000A3   TEMPLONG:00E000A6 00E200E3    AMRC:00E400E5_00E600E7
   +000110  STDINFILE:00E800E9_00F200E3   STDOUTFILE:00E500D9_00E200E4
   +000120  STDERRFILE:00F000F1_00F200F3        CTYPE:00F400F5_00F600F7
   +000138  LC_CTYPE:00E000E8_00E9001F    LC_CHARMAP:08FC4E90_00000000
   +00052C  MIN_FLT:00000000 00000000 00000000 00000000
   +00053C  MAX_FLT:00000000 00000000 00000000 00000000
   +00054C  FLT_EPS:00000000        DBL_EPS:00000000 00000000
   +00055C  LDBL_EPS:00000000 00000000 00000000 C7C5D5C5
   +000574  IMSPCBLIST:0000C048_00000000        ADDRTBL:00000000_00000001
   +000710  ABND_CODE:00000000      RSN_CODE:00000000

[3]      CEDB:  00000001_0000A620
   +000000  EYE:CEDB    SIZE:00000C48     PTR:00000001_0000A620
   +000010  CLLST:00000000_20C02DB8       CEELANG:0003      CASWITCH:0000
   +000020  CLWA:00000001_0000C088        CALTLWA:00000000_00000000
   +000030  CCADDR:00000000_20C000D8      CFLGS:00000080    CANCHOR:00000000_00000000
   +000050  RPLLEN:00000000_00000000      ACBLEN:00000000_00000000
   +000060  LC:00000001_0000B270    VALID_HIGH:00000000_20C53BF0
   +000070  _LOW:00000000_20C53690        HEAD_FECB:00000000_00000000
   +000080  ATEXIT_CHAIN:00000000_00000000       _EMPTY_CHAIN:00000001_0000A770
   +000090  MAINPRMS:00000001_08FC5E70    STDINFILE:00000001_0000A2B8
   +0000A0  STDOUTFILE:00000001_00009BE8        STDERRFILE:00000001_00009F50
   +0000B0  CTYPE:00000000_21324876       TZDFLT:00000000 00003840
   +0000C0  CINFO:00000001_0000B370       CMS_WRITE_DISK:4040
   +0000CC  _DISK_SET:00000000
   +0000D0  MIN_FLT:00100000 00000000 00000000 00000000
   +0000E0  MAX_FLT:7FFFFFFF FFFFFFFF 71FFFFFF FFFFFFFF
   +0000F0  FLT_EPS:3C100000        DBL_EPS:34100000 00000000
   +000100  LDBL_EPS:26100000 00000000 18000000 00000000    FLAGS1:02080000
```

Figure 149. Example formatted C/C++ output from LEDATA Verbexit (Part 1 of 12)

```
+000118  MTF_MAINTASK_BLK:00000000_00000000        EMSG_SETTING:00
+000124  DEPTH:00000000    SCREEN_WIDTH:00000000   USERID:HEALY  .
+000138  HEAP24_ANCHOR:00000000_00000000     TCIC:00000000_00000000
+000148  TKCLI:00000000_00000000
+000150  ATEXIT_FUNCS01:00000001 0000A798 00000000 00000000 00000000 00000000 00000000 00000000 00
+000178  ATEXIT_FUNCS02:00000001 0000A7C0 00000000 00000000 00000000 00000000 00000000 00000000 00
+0001A0  ATEXIT_FUNCS03:00000001 0000A7E8 00000000 00000000 00000000 00000000 00000000 00000000 00
+0001C8  ATEXIT_FUNCS04:00000001 0000A810 00000000 00000000 00000000 00000000 00000000 00000000 00
+0001F0  ATEXIT_FUNCS05:00000001 0000A838 00000000 00000000 00000000 00000000 00000000 00000000 00
+000218  ATEXIT_FUNCS06:00000001 0000A860 00000000 00000000 00000000 00000000 00000000 00000000 00
+000240  ATEXIT_FUNCS07:00000001 0000A888 00000000 00000000 00000000 00000000 00000000 00000000 00
+000268  ATEXIT_FUNCS08:00000001 0000A8B0 00000000 00000000 00000000 00000000 00000000 00000000 00
+000290  ATEXIT_FUNCS09:00000001 0000A8D8 00000000 00000000 00000000 00000000 00000000 00000000 00
+0002B8  ATEXIT_FUNCS10:00000001 0000A900 00000000 00000000 00000000 00000000 00000000 00000000 00
+0002E0  ATEXIT_FUNCS11:00000001 0000A928 00000000 00000000 00000000 00000000 00000000 00000000 00
+000308  ATEXIT_FUNCS12:00000001 0000A950 00000000 00000000 00000000 00000000 00000000 00000000 00
+000330  ATEXIT_FUNCS13:00000001 0000A978 00000000 00000000 00000000 00000000 00000000 00000000 00
+000358  ATEXIT_FUNCS14:00000001 0000A9A0 00000000 00000000 00000000 00000000 00000000 00000000 00
+000380  ATEXIT_FUNCS15:00000001 0000A9C8 00000000 00000000 00000000 00000000 00000000 00000000 00
+0003A8  ATEXIT_FUNCS16:00000001 0000A9F0 00000000 00000000 00000000 00000000 00000000 00000000 00
+0003D0  ATEXIT_FUNCS17:00000001 0000AA18 00000000 00000000 00000000 00000000 00000000 00000000 00
+0003F8  ATEXIT_FUNCS18:00000001 0000AA40 00000000 00000000 00000000 00000000 00000000 00000000 00
+000420  ATEXIT_FUNCS19:00000001 0000AA68 00000000 00000000 00000000 00000000 00000000 00000000 00
+000448  ATEXIT_FUNCS20:00000001 0000AA90 00000000 00000000 00000000 00000000 00000000 00000000 00
+000470  ATEXIT_FUNCS21:00000001 0000AAB8 00000000 00000000 00000000 00000000 00000000 00000000 00
+000498  ATEXIT_FUNCS22:00000001 0000AAE0 00000000 00000000 00000000 00000000 00000000 00000000 00
+0004C0  ATEXIT_FUNCS23:00000001 0000AB08 00000000 00000000 00000000 00000000 00000000 00000000 00
+0004E8  ATEXIT_FUNCS24:00000001 0000AB30 00000000 00000000 00000000 00000000 00000000 00000000 00
+000510  ATEXIT_FUNCS25:00000001 0000AB58 00000000 00000000 00000000 00000000 00000000 00000000 00
+000538  ATEXIT_FUNCS26:00000001 0000AB80 00000000 00000000 00000000 00000000 00000000 00000000 00
+000560  ATEXIT_FUNCS27:00000001 0000ABA8 00000000 00000000 00000000 00000000 00000000 00000000 00
+000588  ATEXIT_FUNCS28:00000001 0000ABD0 00000000 00000000 00000000 00000000 00000000 00000000 00
+0005B0  ATEXIT_FUNCS29:00000001 0000ABF8 00000000 00000000 00000000 00000000 00000000 00000000 00
+0005D8  ATEXIT_FUNCS30:00000001 0000AC20 00000000 00000000 00000000 00000000 00000000 00000000 00
+000600  ATEXIT_FUNCS31:00000001 0000AC48 00000000 00000000 00000000 00000000 00000000 00000000 00
+000628  ATEXIT_FUNCS32:00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00
+000650  HEAD_FOREIGN_FECB:00000000_00000000
+000658  SNAP_DUMP_COUNT:00000000      ENVIRON:00000000_00000000
+000668  GETENV_BUF:00000000_00000000        _BUF_LEN:00000000 00000000
+000678  CDLL:00000001_08FEE770        INSPECT_GLOBALS:00000000_00000000
+000688  _JMP_BUFF:00000000_00000000   _BACK_END:00000000_00000000
+000698  _FLAGS:00000000   _TAB:00000000 00000000
+0006A8  INTOFFLIST:00000000_00000000        CGEN_CRENT:00000000_00000000
+0006B8  _CPRMS:00000001_00005598      _CEDCXV:00000000_00000000
+0006C8  _CEDCOV:00000000_00000000     _EPCBLIST:00000000_00000000
+0006D8  CAA_ADDR:00000001_00007B18    USERIDLENGTH:00000000 00000005
+0006F0  TZSHR:00000001 0000B520 00000001 0000B528
+000700  MAXUNGETCOUNT:0004      RWSTATIC:00000001_08300050
+000710  RWLEN:00000000 00000170       CSGDLLI:00000000_00000000
+000720  DLLISIZE:00000000 00000000    IOGET_ANY:00000000_2131EC80
+000730  _BELOW:00000000_2131EC70      IOFREE_ANY:00000000_2131EC60
+000740  _BELOW:00000000_2131EC50      CSGSTINIT:00000000_00000000
+000750  STINITSIZE:00000000 00000000        MTFMAINTASKBLK:00000000_00000000
+000760  SIGTABLE:00000001_0000B668    INIT_STDIN:00000001_0000A2B8
```

Figure 149. Example formatted C/C++ output from LEDATA Verbexit (Part 2 of 12)

```
  +000770  _STDOUT:00000001_00009BE8     _STDERR:00000001_00009F50
  +000788  TABNUM:00000000 00000008      REDIR:00    AVAIL13:00000000_00000000
  +0007A0  OPENMVS_FLAGS:00  MRPSTDR:00000000_2131EC10     MWPSTDR:00000000_2131EC00
  +0007B8  MRPSTDC:00000000_00000000     MWPSTDC:00000000_00000000
  +0007C8  OWRP1:00000000_00000000       OWRP3:00000000_00000000
  +0007D8  STATIC_EDCOV:00000000_00000000      GETENV_BUF2:00000000_00000000
  +0007E8  _BUF2_LEN:00000000 00000000   DLCB_MUTEX:00000001_08FC7328
  +0007F8  _CONDV:00000001_08FC7330      EDCOV:00000000_00000000
  +000808  LCX:00000001_0000B520   MUTEX_ATTR:00000001 08FC7250
  +000818  STOR_INIT_B:00001000    _INCR_B:00001000
  +000820  STOR_INIT:00003000      _INCR:00002000    DEMANGLE:00000000_00000000
  +000838  TEMPR15:00000000 00000000     TERMINATE:00000000_2131EC40
  +000848  CXX_INV:00000000_00000000     D4_JOIN_MUTEX_ATTR:00000001_08FC7308
  +000860  _MUTEX:00000001_08FC7310      _CONDV_ATTR:00000001_08FC7318
  +000870  _CONDV:00000001_08FC7320      DLLANCHOR:00000000_00000000
  +000880  DLLLAST:00000000_00000000     MEM24P:00000000_00000000
  +000890  RTLMUTEX_ARRAYPTR:00000001_08FC7258       MSGCATLIST:00000000_00000000
  +0008A0  SRCHP:00000000_00000000       ETOAP:00000000_00000000
  +0008B0  ATOEP:00000000_00000000       NDMGMTP:00000000_00000000
  +0008C0  POPENP:00000000_00000000      RND48P:00000000_00000000
  +0008D0  BRK_HEAPID:00000000_00000000        _START:00000000_00000000
  +0008E0  _CURRENT:00000000_00000000    _END:00000000_00000000
  +0008F8  RESTARTTABLE:00000000_00000000      SYSLOGP:00000000_00000000
  +000908  LOGIN_NAME:.........    PREV_UMASK_VAL:00000000
  +000918  HFP_LDBL_LMS:00100000 00000000 00000000 00000000 7FFFFFFF FFFFFFFF 71FFFFFF FFFFFFFF 26
  +000948  BFP_LDBL_LMS:00010000 00000000 00000000 00000000 7FFEFFFF FFFFFFFF FFFFFFFF FFFFFFFF 3F
  +0009D8  HFP_DBL_LMS:00100000 00000000 7FFFFFFF FFFFFFFF 34100000 00000000
  +0009F0  BFP_DBL_LMS:00100000 00000000 7FEFFFFF FFFFFFFF 3CB00000 00000000 7FF00000 00000000 FF
  +000A38  HFP_MHDC:412B7E15 1628AED3 41171547 652B82FE 406F2DEC 549B9439 40B17217 F7D1CF7A 41
  +000AA8  BFP_MHDC:4005BF0A 8B145769 3FF71547 652B82FE 3FDBCB7B 1526E50E 3FE62E42 FEFA39EF 40
  +000B18  HFP_FLT_LMS:00100000 7FFFFFFF 3C100000
  +000B24  BFP_FLT_LMS:00800000 7F7FFFFF 34000000 7F800000 FF800000 7FA00000 FFA00000 7FC00000 FF
  +000B48  HFP_FHDC:00000010 0006000E 001C0006 000F0020 FFC0FFC0 FFC0FFB2 FFB2FFB2 003F003F 00
  +000B70  BFP_FHDC:00010002 00180035 00710006 000F0021 FF83FC03 C003FFDB FECDECBD 00800400 40
  +000B98  ASCII_CCSID:0333  EBCDIC_CCSID:0417       LOGIN_NAME_A:.........
  +000BA8  CINFO_A:00000001 0000BD88     LC_C:00000001_0000BC40
  +000BB8  _A:00000001_0000BCA0    LCX_A:00000001_0000BE18
  +000BC8  CORRESTABLE:00000000_214CFD58
  +000BD0  TZSHR_A:00000001 0000BE18 00000001 0000BE20     CGENVEC3:00000000_00000000
  +000BE8  CEDBVEC3:00000000_00000000    FORKQ_HEAD:00000000_00000000
  +000BF8  FORKQ_TAIL:00000000_00000000        PTHREAD_YIELD1:0001D100
  +000C04  PTHREAD_YIELD2:00002E80       ICONV_MODE:.      _TECH:.........
  +000C12  _USERSET:.

 [4]      CTHD:  00000001_00008F08
       +000000  CTHDEYE:CTHD      SIZE:00000528     CTHDPTR:00000001_00008F08
       +000010  STORPTR:00000000_00000000     TOKPTR:00000000_251DEF20
       +000020  ASCTIME_RESULT:.........................
       +00003A  SNAP_DUMP_FLAG:00       FP_MODE:C4  GMTIME_BKDN:00000001_00009638
       +000048  TIMECALLED:00000000     DATECALLED:00000000
       +000050  DTCALLED:00000000       LOC_CALLED:00000000
       +000058  DOFMTO_DISCARDS:00000000 00000000   CERRNO:00000079
       +000068  AMRC:00000000_25757278        AMRC2:00000000_25757380
       +000078  GDATE:00000000_00000000       OPTARGV:00000000_00000000
       +000088  OPTERRV:00000001        OPTINDV:00000001
       +000090  OPTOPTV:00000000        OPTSIND:00000000        DLGHTV:00000000
       +0000A0  TZONEV:00000000 00000000      GTDTERRV:00000000
       +0000B0  OPTARGP:00000001_00008F88     OPTERRP:00000001_00008F90
       +0000C0  OPTINDP:00000001_00008F94     OPTOPTP:00000001_00008F98
       +0000D0  DLGHTP:00000001_00008FA0      TZONEP:00000001_00008FA8
       +0000E0  GTDTERRP:00000001_00008FB0    RNDSTGP:00000000_00000000
       +0000F0  LOCNAME:00000000_00000000     ENCRYPTP:00000000_00000000
       +000100  CRYPTP:00000000_00000000      RND48P:00000000_00000000
```

Figure 149. Example formatted C/C++ output from LEDATA Verbexit (Part 3 of 12)

```
+000110  L64AP:00000000_00000000       WCSTOKP:00000000_00000000
+000120  CUSERP:00000000_00000000      GPASSP:00000000_00000000
+000130  UTMPXP:00000000_00000000      NDMGMTP:00000000_00000000
+000140  RECOMP:00000000_00000000      STACKPTR:00000000_00000000
+000150  STACKSIZE:00000000 00000000   STACKFLAGS:40     MCVTP:00000000
+000160  H_ERRNO:00000000        SD:FFFFFFFF       HOSTENT_DATA_P:00000000_00000000
+000170  HOSTENT_P:00000000_00000000   NETENT_DATA_P:00000000_00000000
+000180  NETENT_P:00000000_00000000    PROTOENT_DATA_P:00000000_00000000
+000190  PROTOENT_P:00000000_00000000       SERVENT_DATA_P:00000000_00000000
+0001A0  SERVENT_P:00000000_00000000   NTOA_BUF:................
+0001C0  __LOC1V:00000000_00000000     __LOCSV:00000000_00000000
+0001D0  HERRNOP:00000001_00009068     __LOC1P:00000000_00000000
+0001E0  REXECP:00000000_00000000      CXXEXCEPTION:00000000_00000000
+0001F0  TEMPDCBE:00000000_2135A068    T_ERRNOV:00000000
+000200  T_ERRNOP:00000001_00009100    _LOC1P:00000000_00000000
+000210  __loc2p:00000000_00000000     __locsp:00000000_00000000
+000220  _loc1v:00000000_00000000      __loc2v:00000000_00000000
+000230  THD_STORAGE:00000000_00000000       CONTEXT_LINK:00000000_00000000
+000240  FLAGS1:00000000   LABEL_VAR:00000001_00009768
+000250  ABND_CODE:00000000      RSN_CODE:00000000
+000258  STRFTIME_ERADTCALLED:00000000
+00025C  STRFTIME_ERADATECALLED:00000000
+000260  STRFTIME_ERATIMECALLED:00000000
+000264  STRFTIME_ERAYEARCALLED:00000000     MBRLEN_STATE:0000
+00026A  MBRTOWC_STATE:0000      WCRTOMB_STATE:0000
+00026E  MBSRTOWCS_STATE:0000    WCSRTOMBS_STATE:0000    MBLEN_STATE:0000
+000274  MBTOWC_STATE:0000       CURR_HEAP_ID:00000000   CURR_CAA:00000000_00000000
+000288  CURR_MOD_HANDLE:00000000_00000000   CURR_BMR:00000000_00000000
+000298  CU_LIST:00000000_00000000     CURR_STATUS:00
+0002A8  RAND_NEXT:00000000 00000001   STRERRORBUF:00000001_00008C90
+0002B8  TMPAREA:00000000_00000000     IOWORKAREA:00000000_2135A140
+0002C8  TEMPDCB:00000000_000070D0     TEMPJFCB:00000000_00007130
+0002D8  TEMPDSCB:00000000_2135A0A0    NAMEBUF:00000000_00000000
+0002E8  ERRNO_JR:C25F0001       RET_STRUCT:00000000_00000000
+0002F8  BKDN_IS_LOCALTIME:00000000    SWPRINTF_SIZE:00008000
+000300  SWPRINTF_BUF:00000000_00000000      S99P:2135A048
+000310  MUTEXCTARRAY:00000001_000099C0
+000318  STRFTIME_ERANAMECALLED:00000000     DLL_LOADLEVEL:00000000
+000340  _CONSTLIST:00000000_00000000        FCB_MUTEX:00000000_00000000
+000350  HSPABHWA:00000000_00000000    MUTEX_SAVE:00000001_00009A78
+000368  INITIAL_CPU_TIME:40C065E0 00000000        FCB_MUTEX_OK:00000001
+000378  FCB_MUTEX_SAVE:00000000_00000000
+000380  ENTRY_ADDRTABLESIZE:00000000        ADDRESS:00000000
+000388  NUMBEROFNAMES:00000000        NAMES1:.......................
+0003A5  NAMES2:.......................
+0003BE  NAMES3:.......................
+0003D7  NAMES4:.......................
+0003F0  NAMES5:.......................
+000409  NAMES6:.......................
+000424  ENTRY_SITETABLESIZE:00000000        KIND:00
+00042C  NUM_ADDRS:00000000
+000430  ADDRESSES:00000000 00000000 00000000 00000000 00000000 00000000
+000448  NAME:00000000 00000000 00000000 00000000 00000000 00000000
+000460  T_STRERRORBUF:00000001_00008DBC     CTHD_OURFDSET:00000000_00000000
+000470  IEEECWAP:00000000_00000000    RETVAL_P:00000000_00000000
+000490  CTHD_SETENV_FB:.............     LIBASCIIWAP:00000000
+0004AC  SETLOCALE_ACALLED:00    ASCIINAMEBUFL:0000
+0004B8  ASCIINAMEBUF:00000000 00000000      LOCNAME_A:00000000_00000000
+0004C8  EBCDICENTRY:00000001_08358B40       ASCIIENTRY:00000001_08358B58
+0004D8  CTHD_NASCIIWAP:00000000_00000000    CTHD_PROCRESP:00000000_00000000
+0004E8  CTHD_OPTN_P:00000000_00000000       CTHD_GAI_STRERROR_P:00000000_00000000
+0004F8  CTHD_CKPATHDD_PARMS:00000000        CTHD_HEXDEC_PTR:00000000
+000504  CTHD_DECHEX_PTR:00000000
```

Figure 149. Example formatted C/C++ output from LEDATA Verbexit (Part 4 of 12)

```
[5]      CPCB:  00000001_00008688
   +000000  CPCB_EYE:CPCB     CPCB_SIZE:000000C0      CPCB_PTR:00000000_00000000
   +000010  FLAGS1:40000000   TTKNHDR:00000000_00000000     TTKN:00000000_00000000
   +000024  FOOTPRINT:00000000_00000001   CODE370:0000A620_00000000
   +000034  CIO:00000000_00000001   _Reuse:000088D8   _RSAbove:00000000_00000001
   +00004C  _RSAbovelen:00008688    _RSBelow:00000000_00000000
   +00005C  _RSBelowlen:00000000

[6]       CIO:  00000001_000088D8
   +000000  EYE:CIO     SIZE:00000108     PTR:00000000_00000000   FLG1:01
   +000011  FLG2:80     FLG3:00     FLG4:00     DUMMYF:00000001_000089E0
   +000020  EDCZ24:00000000_00000000      FCBSTART:00000000_2135C0F8
   +000030  DUMMYFCB:00000001_00008A08    MFCBSTART:00000001_19A00050
   +000040  IOANYLIST:00000000_00000000   IOBELOWLIST:00000000_00000000
   +000050  FCBDDLIST:00000001_00009C08   PERRORBUF:00000001_000087A0
   +000060  TMPCOUNTER:00000000 00000000        TEMPMEM:00000000
   +000070  PROMPTBUF:00000000_00000000   IO24:00000000_00007318
   +000080  IOEXITS:00000000_000077D0     TERMINALCHAIN:00000000_00000000
   +000090  VANCHOR:00000000_00000000     XTI:00000000_00000000
   +0000A0  ENOWP24:00000000_2131F200     MAXNUMDESCRPS:00000000 00000000
   +0000B0  DESCARRAY:00000000_00000000   TEMPFILENUM:00000000
   +0000C8  CSS:00000000_00000000   DUMMY_NAME:........
   +0000D8  HOSTNAME_CACHE:00000000_00000000    HOSTADDR_CACHE:00000000_00000000
   +0000E8  IO31:00000000_2131FC10        LAST_FD_CLOSE:00000000 00000000
   +0000F8  IOGET64:00000000_2131EC30     IOFREE64:00000000_2131EC20

Exiting CRTL Environment Data

*******************************************************************************
                    64 BIT CRTL I/O CONTROL BLOCKS
*******************************************************************************

      CIO:  00000001_000088D8
   +000000  EYE:CIO     SIZE:00000108     PTR:00000000_00000000   FLG1:01
   +000011  FLG2:80     FLG3:00     FLG4:00     DUMMYF:00000001_000089E0
   +000020  EDCZ24:00000000_00000000      FCBSTART:00000000_2135C0F8
   +000030  DUMMYFCB:00000001_00008A08    MFCBSTART:00000001_19A00050
   +000040  IOANYLIST:00000000_00000000   IOBELOWLIST:00000000_00000000
   +000050  FCBDDLIST:00000001_00009C08   PERRORBUF:00000001_000087A0
   +000060  TMPCOUNTER:00000000 00000000        TEMPMEM:00000000
   +000070  PROMPTBUF:00000000_00000000   IO24:00000000_00007318
   +000080  IOEXITS:00000000_000077D0     TERMINALCHAIN:00000000_00000000
   +000090  VANCHOR:00000000_00000000     XTI:00000000_00000000
   +0000A0  ENOWP24:00000000_2131F200     MAXNUMDESCRPS:00000000 00000000
   +0000B0  DESCARRAY:00000000_00000000   TEMPFILENUM:00000000
   +0000C8  CSS:00000000_00000000   DUMMY_NAME:........
   +0000D8  HOSTNAME_CACHE:00000000_00000000    HOSTADDR_CACHE:00000000_00000000
   +0000E8  IO31:00000000_2131FC10        LAST_FD_CLOSE:00000000 00000000
   +0000F8  IOGET64:00000000_2131EC30     IOFREE64:00000000_2131EC20
```

Figure 149. Example formatted C/C++ output from LEDATA Verbexit (Part 5 of 12)

```
[7]     FFIL:  00000000_2135C0D0
   +000000  MARKER1:AFCB       __FP:00000000_2135C0F8
   +000010  MARKER2:AFCBAFCB        FCBMUTEX:00000001_08371120
   +000020  THREADID:2109B260 00000000

    File name: memory.data
      FCB:  00000000_2135C0F8
   +000000  BUFPTR:00000001_19A003D5      COUNTIN:00000000 00000000
   +000010  COUNTOUT:00000000 0000FFDB    READFUNC:00000000_2131F210
   +000020  WRITEFUNC:00000000_2131FC00   FLAGS1:1000       DEPTH:0000
   +000030  NAME:00000000_2135C3F0        _LENGTH:00000000 0000000B
   +000040  _BUFSIZE:00000000 00000048    MEMBER:.........   NEXT:00000000_2135A6A0
   +000058  PREV:00000000_00000000        PARENT:00000000_2135C0F8
   +000068  CHILD:00000000_00000000       DDNAME:.........   FD:FFFFFFFF
   +00007D  DEVTYPE:08  FCBTYPE:0055      FSCE:00000000_2135C2E0
   +000088  UNGETBUF:00000000_2135C2E0    REPOS:00000000_2131FBF0
   +000098  GETPOS:00000000_2131FB80      CLOSE:00000000_2131FB70
   +0000A8  FLUSH:00000000_2131FBE0       UTILITY:00000000_2131FB60
   +0000B8  USERBUF:00000000_00000000     LRECL:00000000 00000400
   +0000C8  BLKSIZE:00000000 00010000     REALBUFPTR:00000000_00000000
   +0000D8  UNGETCOUNT:00000000 00000000        BUFSIZE:00000000 00010000
   +0000E8  BUF:00000001_19A003B0   CURSOR:00000001_19A003B0
   +0000F8  ENDOFDATA:00000000_00000000   SAVEDBUF:00000000_00000000
   +000108  REALCOUNTIN:00000000 00000000
   +000110  REALCOUNTOUT:00000000 00000000      POSMAJOR:00000000 00000000
   +000120  SAVEMAJOR:00000000 00000000   POSMINOR:00000000 00000000
   +000130  SAVEMINOR:00000000 00000000   STATE:0000  SAVESTATE:0000
   +000140  EXITFTELL:00000000_00000000   EXITUNGETC:00000000_2131F780
   +000150  DBCSTART:00000000_00000000    UTILITYAREA:00000000_00000000
   +000160  INTERCEPT:00000000_00000000   FLAGS2:43020008 40001100
   +000170  DBCSSTATE:0000    FCB_CPCB:00000001_00008688
   +0001C0  LLPOSMAJOR:00000000 00000000
   +0001C8  LLSAVEMAJOR:00000000 00000000
   +0001D0  LLPOSMINOR:00000000 00000000
   +0001D8  LLSAVEMINOR:00000000 00000000

     MEMO:  00000000_2135C2E0
   +000000  MEMO_EYE:MEMO     MFCB:00000001_19A00050        NEBULA:00000001_19A00120
   +000018  NEBINDEX:0001     CURRDS:00000000 00000000      READ:00000000_2131F210
   +000030  WRITE:00000000_2131FC00       REPOS:00000000_2131FBF0
   +000040  FLUSH:00000000_2131FBE0

     FFIL:  00000000_2135A678
   +000000  MARKER1:AFCB       __FP:00000000_2135A6A0
   +000010  MARKER2:AFCBAFCB        FCBMUTEX:00000001_08371100
   +000020  THREADID:2109B260 00000000

    File name: myfile.data

      FCB:  00000000_2135A6A0
   +000000  BUFPTR:00000000_2135B0E3      COUNTIN:00000000 00000000
   +000010  COUNTOUT:00000000 00000FE5    READFUNC:00000000_2131F210
   +000020  WRITEFUNC:00000000_2131F7A0   FLAGS1:1000       DEPTH:0000
   +000030  NAME:00000000_2135A998        _LENGTH:00000000 0000000B
   +000040  _BUFSIZE:00000000 00000048    MEMBER:.........   NEXT:00000001_0000A2D8
   +000058  PREV:00000000_2135C0F8        PARENT:00000000_2135A6A0
   +000068  CHILD:00000000_00000000       DDNAME:.........   FD:00000000
   +00007D  DEVTYPE:09  FCBTYPE:007C      FSCE:00000000_2135A888
   +000088  UNGETBUF:00000000_2135A888    REPOS:00000000_2131F870
   +000098  GETPOS:00000000_2131F860      CLOSE:00000000_2131F840
   +0000A8  FLUSH:00000000_2131F850       UTILITY:00000000_2131F800
   +0000B8  USERBUF:00000000_00000000     LRECL:00000000 00000000
   +0000C8  BLKSIZE:00000000 00000000     REALBUFPTR:00000000_2135B0C8
   +0000D8  UNGETCOUNT:00000000 00000000        BUFSIZE:00000000 00001000
```

Figure 149. Example formatted C/C++ output from LEDATA Verbexit (Part 6 of 12)

```
+0000E8  BUF:00000000_2135B0C8   CURSOR:00000000_00000000
+0000F8  ENDOFDATA:00000000_00000000   SAVEDBUF:00000000_00000000
+000108  REALCOUNTIN:00000000 00000000
+000110  REALCOUNTOUT:00000000 00000000      POSMAJOR:FFFFFFFF FFFFFFFF
+000120  SAVEMAJOR:00000000 00000000   POSMINOR:00000000 00000000
+000130  SAVEMINOR:00000000 00000000   STATE:0000  SAVESTATE:0000
+000140  EXITFTELL:00000000_00000000   EXITUNGETC:00000000_2131F780
+000150  DBCSTART:00000000_00000000    UTILITYAREA:00000000_00000000
+000160  INTERCEPT:00000000_00000000   FLAGS2:40120040 00001300
+000170  DBCSSTATE:0000    FCB_CPCB:00000001_00008688
+0001C0  LLPOSMAJOR:00000000 00000000
+0001C8  LLSAVEMAJOR:00000000 00000000
+0001D0  LLPOSMINOR:00000000 00000000
+0001D8  LLSAVEMINOR:00000000 00000000

  HFSF:  00000000_2135A888
+000000  HFSF_EYE:HFSF     READ:00000000_2131F210        WRITE:00000000_2131F7A0
+000018  REPOS:00000000_2131F870       GETPOS:00000000_2131F860
+000028  FLUSH:00000000_2131F850       READBUFLEN:00000000 00000000
+000038  OPENFLAG:00000491       FLAG1:00000000    HFSF_ST_MODE:030001A4
+000048  HFSF_LAST_FSTAT:43281E34 A142E3FC

  FFIL:  00000001_0000A2B0
+000000  MARKER1:AFCB       __FP:00000001_0000A2D8
+000010  MARKER2:AFCBAFCB       FCBMUTEX:00000001_08FC7290
+000020  THREADID:2109B260 00000000

 File name: DD:SYSIN

   FCB:  00000001_0000A2D8
+000000  BUFPTR:00000000_00000000      COUNTIN:00000000 00000000
+000010  COUNTOUT:00000000 00000000    READFUNC:00000000_2131FEC0
+000020  WRITEFUNC:00000000_2131F200   FLAGS1:8000       DEPTH:0000
+000030  NAME:00000001_0000A5D0        _LENGTH:00000000 0000000B
+000040  _BUFSIZE:00000000 00000048    MEMBER:........   NEXT:00000001_00009F70
+000058  PREV:00000000_2135A6A0        PARENT:00000001_0000A2D8
+000068  CHILD:00000000_00000000       DDNAME:SYSIN      FD:FFFFFFFF
+00007D  DEVTYPE:06  FCBTYPE:0041      FSCE:00000001_0000A4C0
+000088  UNGETBUF:00000001_0000A4C0    REPOS:00000000_213206C0
+000098  GETPOS:00000000_2131FC60      CLOSE:00000000_2131FD80
+0000A8  FLUSH:00000000_2131FEB0       UTILITY:00000000_2131FEA0
+0000B8  USERBUF:00000000_00000000     LRECL:00000000 00000000
+0000C8  BLKSIZE:00000000 00001800     REALBUFPTR:00000000_00000000
+0000D8  UNGETCOUNT:00000000 00000000        BUFSIZE:00000000 00001801
+0000E8  BUF:00000000_00000000   CURSOR:00000000_00000000
+0000F8  ENDOFDATA:00000000_00000000   SAVEDBUF:00000000_00000000
+000108  REALCOUNTIN:00000000 00000000
+000110  REALCOUNTOUT:00000000 00000000      POSMAJOR:00000000 00000000
+000120  SAVEMAJOR:00000000 00000000   POSMINOR:00000000 00000000
+000130  SAVEMINOR:00000000 00000000   STATE:0000  SAVESTATE:0000
+000140  EXITFTELL:00000000_2131FC20   EXITUNGETC:00000000_00000000
+000150  DBCSTART:00000000_00000000    UTILITYAREA:00000000_00000000
+000160  INTERCEPT:00000000_00000000   FLAGS2:00110000 60088040
+000170  DBCSSTATE:0000    FCB_CPCB:00000001_00008688
+0001C0  LLPOSMAJOR:00000000 00000000
+0001C8  LLSAVEMAJOR:00000000 00000000
+0001D0  LLPOSMINOR:00000000 00000000
+0001D8  LLSAVEMINOR:00000000 00000000
```

Figure 149. Example formatted C/C++ output from LEDATA Verbexit (Part 7 of 12)

```
  OSNS:  00000001_0000A4C0
+000000  OSNS_EYE:OSNS     READ:00000000_2131FD70        WRITE:00000000_2131F200
+000018  REPOS:00000000_213206C0       GETPOS:00000000_2131FC60
+000028  CLOSE:00000000_2131FD80       FLUSH:00000000_2131FD50
+000038  UTILITY:00000000_2131FD40     EXITFTELL:00000000_2131FC20
+000048  EXITUNGETC:00000000_00000000        OSIOBLK:00000000_2135A5C8
+000058  NEWLINEPTR:00000000_00000000        RECLENGTH:00000000 00001800
+000068  FLAGS:01800000

  OSIO:  00000000_2135A5C8
+000000  OSIO_EYE:OSIO     DCBW:00000000     DCBRU:00007A00
+00000C  JFCB:00007A68     CURRMBUF:00000000       MBUFCOUNT:00000001
+000018  READMAX:00000000        CURBLKNUM:FFFFFFFF
+000020  LASTBLKNUM:FFFFFFFE     BLKSPERTRK:0000   OSIO_ACCESS_METHOD:02
+000027  OSIO_NOSEEK_TO_SEEK:00  FIRSTPOS:00000000
+00002C  LASTPOS:00000000        NEWPOS:00000000   READFUNCNUM:00000003
+000038  WRITEFUNCNUM:00000004   FCB:00000001_0000A2D8   PARENT:2135A5C8
+00004C  FLAGS1:90000000   DCBERU:2135A638   DCBEW:00000000
+000058  OSIO_VOLSEQ:0000  OSIO_NEWVOLSEQ:0000     OSIO_EXT:00000000
+000060  OSIO_HIGHVOL:0000       APPENDEDLASTVOLSEQ:0000
+000064  OSIO_JFCBX:00000000

   DCB:  00000000_00007A00
+000000  DCBRELAD:2135A638       DCBFDAD:00000000 00000000
+000014  DCBBUFNO:05       DCBSRG1:40  DCBEODAD:000000   DCBRECFM:C0
+000025  DCBEXLSA:0077D8   DCBDDNAM:.u......       DCBMACR1:CD
+000033  DCBMACR2:9A       DCBSYNAD:000000   DCBBLKSI:1800     DCBNCP:00
+000052  DCBLRECL:0000

  DCBE:  00000000_2135A638
+000000  DCBEID:DCBE       DCBELEN:0038      RESERVED0:0000
+000008  DCBEDCB:00007A00        DCBERELA:00000000       DCBEFLG1:C0
+000011  DCBEFLG2:88       DCBENSTR:0000     DCBEFLG3:80
+000024  DCBESIZE:00000000       DCBEEODA:20E0FE54
+00002C  DCBESYNA:20E0FDD8       MULTSDN:00

  JFCB:  00000000_00007A68
+000000  JFCBDSNM:NULLFILE
+00002C  JFCBELNM:               JFCBTSDM:00       JFCBDSCB:000000
+000046  JFCBVLSQ:0000     JFCBIND1:00       JFCBIND2:C1
+000058  JFCBUFNO:00       JFCDSRG1:00       JFCDSRG2:00
+000064  JFCRECFM:00       JFCBLKSI:0000     JFCLRECL:0000     JFCNCP:00
+000075  JFCBNVOL:00       JFCBNVOLS:
+000094  JFCBEXTL:00       JFCBEXAD:000000   JFCFLGS1:00
+0000AE  JFCBVLCT:01

  FFIL:  00000001_00009F48
+000000  MARKER1:AFCB      __FP:00000001_00009F70
+000010  MARKER2:AFCBAFCB        FCBMUTEX:00000001_08FC7268
+000020  THREADID:2109B260 00000000
```

Figure 149. Example formatted C/C++ output from LEDATA Verbexit (Part 8 of 12)

```
 File name: DD:SYSOUT

   FCB:  00000001_00009F70
+000000  BUFPTR:00000000_2135C45F      COUNTIN:00000000 00000000
+000010  COUNTOUT:00000000 0000006A    READFUNC:00000000_2131F210
+000020  WRITEFUNC:00000000_2131FDC0   FLAGS1:9000       DEPTH:0000
+000030  NAME:00000001_0000A268        _LENGTH:00000000 0000000B
+000040  _BUFSIZE:00000000 00000048    MEMBER:........   NEXT:00000001_00009C08
+000058  PREV:00000001_0000A2D8        PARENT:00000001_00009F70
+000068  CHILD:00000000_00000000       DDNAME:SYSOUT     FD:FFFFFFFF
+00007D  DEVTYPE:02  FCBTYPE:0043      FSCE:00000001_0000A158
+000088  UNGETBUF:00000001_0000A158    REPOS:00000000_213206C0
+000098  GETPOS:00000000_2131FC60      CLOSE:00000000_2131FDE0
+0000A8  FLUSH:00000000_2131FDB0       UTILITY:00000000_2131FDA0
+0000B8  USERBUF:00000000_00000000     LRECL:00000000 00000089
+0000C8  BLKSIZE:00000000 00000372     REALBUFPTR:00000000_00000000
+0000D8  UNGETCOUNT:00000000 00000000        BUFSIZE:00000000 0000008A
+0000E8  BUF:00000000_2135C440   CURSOR:00000000_2135C444
+0000F8  ENDOFDATA:00000000_00000000   SAVEDBUF:00000000_00000000
+000108  REALCOUNTIN:00000000 00000000
+000110  REALCOUNTOUT:00000000 00000000      POSMAJOR:00000000 00000000
+000120  SAVEMAJOR:00000000 00000000   POSMINOR:00000000 00000000
+000130  SAVEMINOR:00000000 00000000   STATE:0004  SAVESTATE:0000
+000140  EXITFTELL:00000000_2131FC20   EXITUNGETC:00000000_2131F780
+000150  DBCSTART:00000000_00000000    UTILITYAREA:00000000_00000000
+000160  INTERCEPT:00000000_00000000   FLAGS2:42228020 2A188040
+000170  DBCSSTATE:0000    FCB_CPCB:00000001_00008688
+0001C0  LLPOSMAJOR:00000000 00000000
+0001C8  LLSAVEMAJOR:00000000 00000000
+0001D0  LLPOSMINOR:00000000 00000000
+0001D8  LLSAVEMINOR:00000000 00000000

  OSNS:  00000001_0000A158
+000000  OSNS_EYE:OSNS     READ:00000000_2131F210        WRITE:00000000_2131FDC0
+000018  REPOS:00000000_213206C0       GETPOS:00000000_2131FC60
+000028  CLOSE:00000000_2131FDE0       FLUSH:00000000_2131FDB0
+000038  UTILITY:00000000_2131FDA0     EXITFTELL:00000000_2131FC20
+000048  EXITUNGETC:00000000_2131F780        OSIOBLK:00000000_2135A518
+000058  NEWLINEPTR:00000000_2135C4C9        RECLENGTH:00000000 00000085
+000068  FLAGS:84800000

  OSIO:  00000000_2135A518
+000000  OSIO_EYE:OSIO     DCBW:000078E0     DCBRU:00000000
+00000C  JFCB:00007948     CURRMBUF:00007B20       MBUFCOUNT:00000001
+000018  READMAX:00000001        CURBLKNUM:FFFFFFFF
+000020  LASTBLKNUM:FFFFFFFF     BLKSPERTRK:0000   OSIO_ACCESS_METHOD:02
+000027  OSIO_NOSEEK_TO_SEEK:00  FIRSTPOS:00000000
+00002C  LASTPOS:00000000        NEWPOS:00000000   READFUNCNUM:00000002
+000038  WRITEFUNCNUM:00000005   FCB:00000001_00009F70   PARENT:2135A518
+00004C  FLAGS1:80000000   DCBERU:00000000   DCBEW:2135A588
+000058  OSIO_VOLSEQ:0000  OSIO_NEWVOLSEQ:0000     OSIO_EXT:00000000
+000060  OSIO_HIGHVOL:0000       APPENDEDLASTVOLSEQ:0000
+000064  OSIO_JFCBX:00000000

   DCB:  00000000_000078E0
+000000  DCBRELAD:2135A588       DCBFDAD:00000000 00000002
+000014  DCBBUFNO:01       DCBSRG1:40  DCBEODAD:000000   DCBRECFM:54
+000025  DCBEXLSA:0077D8   DCBDDNAM:...&....       DCBMACR1:56
+000033  DCBMACR2:00       DCBSYNAD:000000   DCBBLKSI:0372     DCBNCP:21
+000052  DCBLRECL:007D
```

Figure 149. Example formatted C/C++ output from LEDATA Verbexit (Part 9 of 12)

```
    DCBE:  00000000_2135A588
+000000  DCBEID:DCBE       DCBELEN:0038      RESERVED0:0000
+000008  DCBEDCB:000078E0        DCBERELA:00000000       DCBEFLG1:C0
+000011  DCBEFLG2:88       DCBENSTR:0000     DCBEFLG3:80
+000024  DCBESIZE:00000000       DCBEEODA:20E0FE54
+00002C  DCBESYNA:20E0FDD8       MULTSDN:00

  JFCB:  00000000_00007948
+000000  JFCBDSNM:HEALY.CELQSAMP.JOB24799.D0000104.?
+00002C  JFCBELNM:               JFCBTSDM:20       JFCBDSCB:000000
+000046  JFCBVLSQ:0000     JFCBIND1:00       JFCBIND2:81
+000058  JFCBUFNO:00       JFCDSRG1:00       JFCDSRG2:00
+000064  JFCRECFM:00       JFCBLKSI:0000     JFCLRECL:0000     JFCNCP:00
+000075  JFCBNVOL:00       JFCBNVOLS:
+000094  JFCBEXTL:00       JFCBEXAD:000000   JFCFLGS1:00
+0000AE  JFCBVLCT:01

  MBUF:  00000000_00007B20
+000000  NEXTMBUF:00007B20_      BUFFER:2135C440_  CHECKRESULT:00000000
+00000C  BLKSIZE:0000007D
+000010  DECB:00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000

  FFIL:  00000001_00009BE0
+000000  MARKER1:AFCB      __FP:00000001_00009C08
+000010  MARKER2:AFCBAFCB        FCBMUTEX:00000001_08FC7268
+000020  THREADID:2109B260 00000000

 File name: DD:SYSPRINT

   FCB:  00000001_00009C08
+000000  BUFPTR:00000000_2135A485      COUNTIN:00000000 00000000
+000010  COUNTOUT:00000000 00000084    READFUNC:00000000_2131F210
+000020  WRITEFUNC:00000000_2131FDC0   FLAGS1:9000       DEPTH:0000
+000030  NAME:00000001_00009F00        _LENGTH:00000000 0000000B
+000040  _BUFSIZE:00000000 00000048    MEMBER:.........   NEXT:00000001_00008A08
+000058  PREV:00000001_00009F70        PARENT:00000001_00009C08
+000068  CHILD:00000000_00000000       DDNAME:SYSPRINT   FD:FFFFFFFF
+00007D  DEVTYPE:02  FCBTYPE:0043      FSCE:00000001_00009DF0
+000088  UNGETBUF:00000001_00009DF0    REPOS:00000000_213206C0
+000098  GETPOS:00000000_2131FC60      CLOSE:00000000_2131FDE0
+0000A8  FLUSH:00000000_2131FDB0       UTILITY:00000000_2131FDA0
+0000B8  USERBUF:00000000_00000000     LRECL:00000000 00000089
+0000C8  BLKSIZE:00000000 00000372     REALBUFPTR:00000000_00000000
+0000D8  UNGETCOUNT:00000000 00000000        BUFSIZE:00000000 0000008A
+0000E8  BUF:00000000_2135A480   CURSOR:00000000_2135A484
+0000F8  ENDOFDATA:00000000_00000000   SAVEDBUF:00000000_00000000
+000108  REALCOUNTIN:00000000 00000000
+000110  REALCOUNTOUT:00000000 00000000      POSMAJOR:00000000 00000000
+000120  SAVEMAJOR:00000000 00000000   POSMINOR:00000000 00000000
+000130  SAVEMINOR:00000000 00000000   STATE:0002  SAVESTATE:0000
+000140  EXITFTELL:00000000_2131FC20   EXITUNGETC:00000000_2131F780
+000150  DBCSTART:00000000_00000000    UTILITYAREA:00000000_00000000
```

Figure 149. Example formatted C/C++ output from LEDATA Verbexit (Part 10 of 12)

```
+000160  INTERCEPT:00000000_00000000   FLAGS2:43128020 2A188040
+000170  DBCSSTATE:0000    FCB_CPCB:00000001_00008688
+0001C0  LLPOSMAJOR:00000000 00000000
+0001C8  LLSAVEMAJOR:00000000 00000000
+0001D0  LLPOSMINOR:00000000 00000000
+0001D8  LLSAVEMINOR:00000000 00000000

  OSNS:  00000001_00009DF0
+000000  OSNS_EYE:OSNS     READ:00000000_2131F210        WRITE:00000000_2131FDC0
+000018  REPOS:00000000_213206C0       GETPOS:00000000_2131FC60
+000028  CLOSE:00000000_2131FDE0       FLUSH:00000000_2131FDB0
+000038  UTILITY:00000000_2131FDA0     EXITFTELL:00000000_2131FC20
+000048  EXITUNGETC:00000000_2131F780        OSIOBLK:00000000_2135A3D0
+000058  NEWLINEPTR:00000000_2135A509        RECLENGTH:00000000 00000085
+000068  FLAGS:84800000

  OSIO:  00000000_2135A3D0
+000000  OSIO_EYE:OSIO     DCBW:00007048     DCBRU:00000000
+00000C  JFCB:000077F0     CURRMBUF:000078A8       MBUFCOUNT:00000001
+000018  READMAX:00000001        CURBLKNUM:FFFFFFFF
+000020  LASTBLKNUM:FFFFFFFF     BLKSPERTRK:0000   OSIO_ACCESS_METHOD:02
+000027  OSIO_NOSEEK_TO_SEEK:00  FIRSTPOS:00000000
+00002C  LASTPOS:00000000        NEWPOS:00000000   READFUNCNUM:00000002
+000038  WRITEFUNCNUM:00000005   FCB:00000001_00009C08   PARENT:2135A3D0
+00004C  FLAGS1:80000000   DCBERU:00000000   DCBEW:2135A440
+000058  OSIO_VOLSEQ:0000  OSIO_NEWVOLSEQ:0000     OSIO_EXT:00000000
+000060  OSIO_HIGHVOL:0000       APPENDEDLASTVOLSEQ:0000
+000064  OSIO_JFCBX:00000000

   DCB:  00000000_00007048
+000000  DCBRELAD:2135A440       DCBFDAD:00000000 0000000B
+000014  DCBBUFNO:01       DCBSRG1:40  DCBEODAD:000000   DCBRECFM:54
+000025  DCBEXLSA:0077D8   DCBDDNAM:.@.&.. .       DCBMACR1:56
+000033  DCBMACR2:00       DCBSYNAD:000000   DCBBLKSI:0372     DCBNCP:21
+000052  DCBLRECL:0016

  DCBE:  00000000_2135A440
+000000  DCBEID:DCBE       DCBELEN:0038      RESERVED0:0000
+000008  DCBEDCB:00007048        DCBERELA:00000000       DCBEFLG1:C0
+000011  DCBEFLG2:88       DCBENSTR:0000     DCBEFLG3:80
+000024  DCBESIZE:00000000       DCBEEODA:20E0FE54
+00002C  DCBESYNA:20E0FDD8       MULTSDN:00

  JFCB:  00000000_000077F0
+000000  JFCBDSNM:HEALY.CELQSAMP.JOB24799.D0000102.?
+00002C  JFCBELNM:               JFCBTSDM:20       JFCBDSCB:000000
+000046  JFCBVLSQ:0000     JFCBIND1:00       JFCBIND2:81
+000058  JFCBUFNO:00       JFCDSRG1:00       JFCDSRG2:00
+000064  JFCRECFM:00       JFCBLKSI:0000     JFCLRECL:0000     JFCNCP:00
+000075  JFCBNVOL:00       JFCBNVOLS:
+000094  JFCBEXTL:00       JFCBEXAD:000000   JFCFLGS1:00
+0000AE  JFCBVLCT:01
```

Figure 149. Example formatted C/C++ output from LEDATA Verbexit (Part 11 of 12)

```
     MBUF:  00000000_000078A8
   +000000  NEXTMBUF:000078A8_      BUFFER:2135A480_  CHECKRESULT:00000000
   +00000C  BLKSIZE:00000016
   +000010  DECB:00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000

Dummy FCB encountered at location 0000000100008A08

     AMRC:  00000000_2135A278
   +000000  CODE:00000000     RBA:00000000      LAST_OP:00000098
   +00000C  FILL_LEN:00000000       MSG_LEN:00000000
   +000014  STR1:............................................................
   +000050  STR1_CONT:........................................................
   +00008C  PARM0R0:00000000        PARMR1:00000000
   +00009C  STR2:............................................................
   +0000DC  RPLFDBWD:00000000       XRBA:00000000 00000000
   +0000E8  AMRC_NOSEEK_TO_SEEK:00

    AMRC2:  00000000_2135A380
   +000000  __ERROR2:00000000 00000000    __FILEPTR:00000000_

    File name: memory.data

[8]     MFCB:  00000001_19A00050
   +000000  FIRSTNEBULA:00000001_19A00120       REFCNT:00000000 00000001
   +000010  RESERVED:00000000 00000000    NEXTMFCB:00000000_00000000
   +000020  WRITEFCB:00000000_2135C0F8    FLAG1:0001  DEPTH:0000
   +000030  NAME:00000001_19A00350        NAMELENGTH:00000000 0000000B
   +000040  NAMEBUFSIZE:00000000 00000048       MEMBER:........
   +000050  NEXTFCB:00000000_00000000     PREVFCB:00000000_00000000
   +000060  PARENTFCB:00000000_2135C0F8   CHILDFCB:00000000_00000000
   +000070  PREVMFCB:00000000_00000000    PARENTMFCB:00000001_19A00050
   +000080  CHILDMFCB:00000000_00000000   HIPERKEY:00000000 00000000
   +000090  CURHSPBYTES:00000000 00000000       LASTBYTE:0000
   +00009A  CREATELEVEL:0000  FLAG2:00000000
   +0000A0  LASTNEBULA:00000001 19A00120        LASTNEBINDEX:0001
   +0000B0  LASTDS:00000000 00000000      MAXHSPBYTES:00000000 00000000
   +0000C0  LASTBLKOFFSET:00000000 00000000     MFCB_CPCB:00000001_00008688

Exiting CRTL I/O Control Blocks
Exiting Language Environment Data
```

Figure 149. Example formatted C/C++ output from LEDATA Verbexit (Part 12 of 12)

C/C++-specific sections of the LEDATA output

For the LEDATA output:

[1] CGEN

This section formats the C/C++-specific portion of the Language Environment common anchor area (CAA).

[2] CGENE

This section formats the extension to the C/C++-specific portion of the Language Environment common anchor area (CAA).

[3] CEDB

This section formats the C/C++-specific portion of the Language Environment enclave data block (EDB).

[4] CTHD

This section formats the C/C++ thread-level control block (CTHD).

[5] CPCB

This section formats the C/C++-specific portion of the Language Environment process control block (PCB).

[6] CIO

This section formats the C/C++ IO control block (CIO).

[7] File Control Blocks

This section formats the C/C++ file control block (FCB). The FCB and its related control blocks represent the information needed by each open stream.

Related Control Blocks

FFIL This section formats the header of the C/C++ file control block (FCB).

FSCE The file specific category extension control block. The FSCE represents the specific type of IO being performed. The following is a list of FSCEs that may be formatted.

HFSF — UNIX file system file

HSPF — Hiper-Space file

INTC — Intercept file

MEMF — Memory file

OSNS — OS no seek

OSFS — OS fixed text

OSVF — OS variable text

OSUT — OS undefined format text

TDQF — CICS Transient Data Queue file

TERM — Terminal file

VSAM — VSAM file

Other FSCEs will be displayed using a generic overlay.

OSIO The OS IO interface control block.

OSIOE
The OS IO extended interface control block.

DCB The data control block. For more information about the DCB, see *z/OS DFSMS Macro Instructions for Data Sets*.

DCBE The data control block extension. For more information about the DCBE, see *z/OS DFSMS Macro Instructions for Data Sets*.

JFCB The job file control block (JFCB). For more information about the JFCB, see *z/OS MVS Data Areas, Vol 3 (IVT-RCWK)*.

JFCBX
The job file control block extension (JFCBX).

MBUF
The message buffer control block (MBUF).

[8] Memory File Control Blocks

This section formats the C/C++ memory file control block (MFCB).

Understanding the AUTH LEDATA output

The Language Environment IPCS Verbexit LEDATA generates formatted output of Preinitialized Environments for Authorized Programs-specific control blocks from a system dump when the AUTH parameter is specified. Figure Figure 150 on page 457 illustrates the output produced when the LEDATA verbexit is invoked with the AUTH parameter. Ellipses are used to summarize some sections of the dump.

For easy reference, the sections of the dump are numbered to correspond with the description of each section that follows.

```
     *******************************************************************************
                     Authorized Language Environment Control Blocks
     *******************************************************************************

[1]      ALEC:  00000000_7F6F7000
        +000000  ID:ALEC     Ascb:00FBBE00     Flags1:40000000
        +00000C  UseCount:00000001       ASATable@1:7F6E8414
        +000014  ASATable@2:7F6E8754     ASATable@3:00000000
        +00001C  ASATable@4:00000000     MCallRtn:82991A80
        +000024  UCallRtn:82999DB8       LatchSetTok:7F6C0B40 00000074
        +000030  Alei:00000001_001053A0        Ales:00000001_00107CD0
        +000040  StackCPID:7F6C3F00      AROTCB:008FF028   EnvTypeNum:00000000
        +00004C  WorkECB:808E6F10
        +000050  AROTToken:0000006C 00000003 00000003 008FF028
        +000060  WTPE:00000053 023B8240 00000000 00000000        ALELVT:00000001
        +000074  SLELVT:00100140   FuncTable@:00000000_00000000
        +000080  WorkQueue:00000000_00000000   ALESeqNum:00000000 00000027
        +000090  ALESCount:00000000_00000001   SystemRtnCode:00000000
        +00009C  SystemRsnCode:00000000        SystemRtnCodeJr:00000000
        +0000A4  SystemRsnCodeJr:00000000      WorkerTCB:008D8E88
        +0000B0  SystemOCB@:00000000_00000000

[2]  Load Module Control Blocks

       Queue #: 0000000000000000

          ALMI:  00000001_00100F40
        +000000  ID:ALMI     ModuleSize:00000600     ModuleName:CELQDSNF
        +000010  UseCount:00000000 00000001    LoadPoint:00000000 264E3000
        +000020  EntryPoint:00000000 264E3001

          ALMI:  00000001_00100B40
        +000000  ID:ALMI     ModuleSize:0000F000     ModuleName:CDAEQED
        +000010  UseCount:00000000 00000001    LoadPoint:00000000 26396000
        +000020  EntryPoint:00000000 26396001

          ALMI:  00000001_00100540
        +000000  ID:ALMI     ModuleSize:000017AD     ModuleName:CEEMENU3
        +000010  UseCount:00000000 00000000    LoadPoint:00000000 26386298
        +000020  EntryPoint:00000000 26386298

       Queue #: 0000000000000002

          ALMI:  00000001_00101340
        +000000  ID:ALMI     ModuleSize:00000450     ModuleName:EDCUCSNM
        +000010  UseCount:00000000 00000001    LoadPoint:00000000 05F15640
        +000020  EntryPoint:00000000 05F15640

       Queue #: 0000000000000003

          ALMI:  00000001_00100D40
        +000000  ID:ALMI     ModuleSize:00018800     ModuleName:CDAEQDPI
        +000010  UseCount:00000000 00000001    LoadPoint:00000000 26414000
        +000020  EntryPoint:00000000 26414001

          ALMI:  00000001_00100340
        +000000  ID:ALMI     ModuleSize:00000200     ModuleName:ALEM001
        +000010  UseCount:00000000 00000003    LoadPoint:00000000 26384000
        +000020  EntryPoint:00000000 26384001

       Queue #: 0000000000000006

          ALMI:  00000001_00100740
        +000000  ID:ALMI     ModuleSize:00000400     ModuleName:CDIVZERO
        +000010  UseCount:00000000 00000001    LoadPoint:00000000 26393000
        +000020  EntryPoint:00000000 26393001

       Queue #: 0000000000000007

          ALMI:  00000001_00101140
        +000000  ID:ALMI     ModuleSize:00000655     ModuleName:CEL4CTBL
        +000010  UseCount:00000000 00000001    LoadPoint:00000000 264E7D58
        +000020  EntryPoint:00000000 264E7D58

[3]  User Managed Control Blocks
```

Figure 150. Example of formatted AUTH output from LEDATA Verbexit (Part 1 of 4)

```
[4]      ALEI:  00000001_001053A0
        +000000  ID:ALEI     Flags1:80000000   InstanceNum:00000000 00000025
        +000010  Next:00000000_00000000        Prev:00000000_00000000
        +000020  Flags2:40000000   EnclaveSeq#:00000001    LAA:01ED6498
        +00002C  SavedLAA:7F710E80       Alec:00000000_7F6F7000
        +000038  CallerPSWKey:00000000 00000070      ASAStack:00000000_7F6C4A28
        +000048  ParmListPtr:00000000_7F705D58       ParmListPtrK0:00000000_7F6C42F8
        +000058  RTOPtr:00000001_0050042C      RTOLen:00000000 00000012
        +000068  RTBL0:00000001_001055B8       CallAlri:00000001_00100940
        +000078  EnvAlris:00000000_00000000    SystemRtnCode:00000000
        +000084  SystemRsnCode:00000000        SystemRtnCodeJr:00000000
        +00011C  SystemRsnCodeJr:00000000      ALES:00000000_00000000

[5]  Routine Control Blocks

      Queue #: 0000000000000010

       Routine: CDIVZERO
         ALRI:  00000001_00100940
       +000000  ID:ALRI     Flags:80000000    InstanceNum:00000000 00000026
       +000010  NEXT:00000000_00000000        ALEC:00000000_7F6F7000
       +000020  AleiAddress:00000001_001053A0       AleiInstanceNum:00000000_00000025
       +000030  DllName:........  RoutineNamePtr:00000001_00100B20
       +000040  RoutineNameLen:00000000 00000008    RoutineAddr:00000000_26393178
       +000050  QSTRTAddr:00000000_26393000   DllKeyPtr:00000000_00000000
       +000060  DllKeyLen:00000000 00000000   ParmLen:00000000
       +00006C  EnvFlags:40000000       FuncEnv:00000000_00000010
       +000078  FuncEntry:00000000_26393178   MasterAlri:00000000_00000000
       +0000E8  Ales:00000000_00000000        LUAlri:00000000 00000000
       +0000F8  EnvType:00000000        EnclaveSeq#:00000001
       +000100  NextEnvAlri:00000000_00000000

      Queue #: 0000000000000015

       Routine: CDIVZERO
         ALRI:  00000001_00100940
       +000000  ID:ALRI     Flags:80000000    InstanceNum:00000000 00000026
       +000010  NEXT:00000000_00000000        ALEC:00000000_7F6F7000
       +000020  AleiAddress:00000001_001053A0       AleiInstanceNum:00000000_00000025
       +000030  DllName:........  RoutineNamePtr:00000001_00100B20
       +000040  RoutineNameLen:00000000 00000008    RoutineAddr:00000000_26393178
       +000050  QSTRTAddr:00000000_26393000   DllKeyPtr:00000000_00000000
       +000060  DllKeyLen:00000000 00000000   ParmLen:00000000
       +00006C  EnvFlags:40000000       FuncEnv:00000000_00000010
       +000078  FuncEntry:00000000_26393178   MasterAlri:00000000_00000000
       +0000E8  Ales:00000000_00000000        LUAlri:00000000 00000000
       +0000F8  EnvType:00000000        EnclaveSeq#:00000001
       +000100  NextEnvAlri:00000000_00000000

[6]  System Managed Control Blocks

[7]      ALES:  00000001_00107CD0
        +000000  ID:ALES     UseCount:00000000
        +000008  InstanceNum:00000000 00000000       Next:00000000_00000000
        +000018  ENVID:RTOTCB5A    Flags1:00000000 00000000      Alec:00000000_7F6F7000
        +000030  NumEnvType:00000000 00000003        CPPtr:00000001_001082C8
        +000040  AllocSize:00000000 00000B48   SystemRtnCode:00000000
        +00004C  SystemRsnCode:00000000        SystemRtnCodeJr:00000000
        +000054  SystemRsnCodeJr:00000000      DiagRtn:00000000_00000000
        +000060  DiagTkn:00000000 00000000

[8]   ETINDEX: 00000001

      ALESETE:  00000001_00107E18
       +000000  Flags:00000000    ALEI:00000001_0010E0D8
       +000010  WTime:00000000 00000000       InitNum:00000000 0000000A
       +000020  IncrNum:00000000 00000005     MaxNum:00000000 00000014
       +000030  CurNum:00000000 0000000A      RTOPtr:00000001_00207CD0
       +000040  RTOLen:00000000 00000400
```

Figure 150. Example of formatted AUTH output from LEDATA Verbexit (Part 2 of 4)

```
[9]  Routine Control Blocks

      Queue #: 0000000000000017

       Routine: ALEM001
         ALRI:  00000001_00200140
       +000000  ID:ALRI     Flags:88000000    InstanceNum:00000000 00000022
       +000010  NEXT:00000001_00200340        ALEC:00000000_7F6F7000
       +000020  AleiAddress:00000000_00000000       AleiInstanceNum:00000000_00000000
       +000030  DllName:........  RoutineNamePtr:00000001_00200320
       +000040  RoutineNameLen:00000000 00000008    RoutineAddr:00000000_263840C0
       +000050  QSTRTAddr:00000000_26384000   DllKeyPtr:00000000_00000000
       +000060  DllKeyLen:00000000 00000000   ParmLen:00000000
       +00006C  EnvFlags:00000000       FuncEnv:00000000_00000000
       +000078  FuncEntry:00000000_00000000   MasterAlri:00000000_00000000
       +0000E8  Ales:00000001_00107CD0        LUAlri:00000001 00200340
       +0000F8  EnvType:00000001        EnclaveSeq#:00000000
       +000100  NextEnvAlri:00000000_00000000

       Routine: ALEM001
         ALRI:  00000001_00200140
       +000000  ID:ALRI     Flags:88000000    InstanceNum:00000000 00000022
       +000010  NEXT:00000001_00200340        ALEC:00000000_7F6F7000
       +000020  AleiAddress:00000000_00000000       AleiInstanceNum:00000000_00000000
       +000030  DllName:........  RoutineNamePtr:00000001_00200320
       +000040  RoutineNameLen:00000000 00000008    RoutineAddr:00000000_263840C0
       +000050  QSTRTAddr:00000000_26384000   DllKeyPtr:00000000_00000000
       +000060  DllKeyLen:00000000 00000000   ParmLen:00000000
       +00006C  EnvFlags:00000000       FuncEnv:00000000_00000000
       +000078  FuncEntry:00000000_00000000   MasterAlri:00000000_00000000
       +0000E8  Ales:00000001_00107CD0        LUAlri:00000001 00200340
       +0000F8  EnvType:00000001        EnclaveSeq#:00000000
       +000100  NextEnvAlri:00000000_00000000

[10]     ALEI:  00000001_0010E0D8
       +000000  ID:ALEI     Flags1:00000000   InstanceNum:00000000 0000000A
       +000010  Next:00000001_0010DEC0        Prev:00000000_00000000
       +000020  Flags2:00000000   EnclaveSeq#:00000002    LAA:01ED8E18
       +00002C  SavedLAA:7F710E80       Alec:00000000_7F6F7000
       +000038  CallerPSWKey:00000000 00000070      ASAStack:00000000_7F6C4AC0
       +000048  ParmListPtr:00000000_7F704AA8       ParmListPtrK0:00000000_7F6C4348
       +000058  RTOPtr:00000001_0000042C      RTOLen:00000000 00000401
       +000068  RTBL@:00000000_00000000       CallAlri:00000001_00200340
       +000078  EnvAlris:00000001_00200340    SystemRtnCode:00000000
       +000084  SystemRsnCode:00000000        SystemRtnCodeJr:00000000
       +00011C  SystemRsnCodeJr:00000000      ALES:00000001_00107CD0

       Routine: ALEM001
[11]     ALRI:  00000001_00200340
       +000000  ID:ALRI     Flags:80000000    InstanceNum:00000000 00000022
       +000010  NEXT:00000000_00000000        ALEC:00000000_7F6F7000
       +000020  AleiAddress:00000001_0010E0D8       AleiInstanceNum:00000000_00000000
       +000030  DllName:........  RoutineNamePtr:00000001_00200320
       +000040  RoutineNameLen:00000000 00000008    RoutineAddr:00000000_263840C0
       +000050  QSTRTAddr:00000000_26384000   DllKeyPtr:00000000_00000000
       +000060  DllKeyLen:00000000 00000000   ParmLen:00000010
       +00006C  EnvFlags:40000000       FuncEnv:00000000_00000010
       +000078  FuncEntry:00000000_263840C0   MasterAlri:00000001_00200140
       +0000E8  Ales:00000001_00107CD0        LUAlri:00000000 00000000
       +0000F8  EnvType:00000001        EnclaveSeq#:00000001
       +000100  NextEnvAlri:00000000_00000000

[10]     ALEI:  00000001_0010DEC0
       +000000  ID:ALEI     Flags1:00000000   InstanceNum:00000000 00000009
       +000010  Next:00000001_0010DCA8        Prev:00000000_00000000
       +000020  Flags2:80000000   EnclaveSeq#:00000000    LAA:01ED8C98
       +00002C  SavedLAA:00000000       Alec:00000000_7F6F7000
       +000038  CallerPSWKey:00000000 00000070      ASAStack:00000000_00000000
       +000048  ParmListPtr:00000000_00000000       ParmListPtrK0:00000000_00000000
       +000058  RTOPtr:00000001_00207CD0      RTOLen:00000000 00000400
       +000068  RTBL@:00000000_00000000       CallAlri:00000000_00000000
       +000078  EnvAlris:00000000_00000000    SystemRtnCode:00000000
       +000084  SystemRsnCode:00000000        SystemRtnCodeJr:00000000
       +00011C  SystemRsnCodeJr:00000000      ALES:00000001_00107CD0
```

Figure 150. Example of formatted AUTH output from LEDATA Verbexit (Part 3 of 4)

```
[10]     ALEI:  00000001_0010DCA8
       +000000  ID:ALEI     Flags1:00000000   InstanceNum:00000000 00000008
       +000010  Next:00000001_0010DA90        Prev:00000000_00000000
       +000020  Flags2:80000000   EnclaveSeq#:00000000    LAA:01ED8B18
       +00002C  SavedLAA:00000000       Alec:00000000_7F6F7000
       +000038  CallerPSWKey:00000000 00000070      ASAStack:00000000_00000000
       +000048  ParmListPtr:00000000_00000000       ParmListPtrK0:00000000_00000000
       +000058  RTOPtr:00000001_00207CD0      RTOLen:00000000 00000400
       +000068  RTBL@:00000000_00000000       CallAlri:00000000_00000000
       +000078  EnvAlris:00000000_00000000    SystemRtnCode:00000000
       +000084  SystemRsnCode:00000000        SystemRtnCodeJr:00000000
       +00011C  SystemRsnCodeJr:00000000      ALES:00000001_00107CD0
.
.
.
[8]   ETINDEX: 00000002

      ALESETE:  00000001_00107FA8
       +000000  Flags:00000000    ALEI:00000001_001102F0
       +000010  WTime:00000000 00000000       InitNum:00000000 0000000B
       +000020  IncrNum:00000000 00000006     MaxNum:00000000 00000017
       +000030  CurNum:00000000 0000000B      RTOPtr:00000001_002080D0
       +000040  RTOLen:00000000 00000400
[9]  Routine Control Blocks

      Queue #: 0000000000000017

       Routine: ALEM001
         ALRI:  00000001_00200540
       +000000  ID:ALRI     Flags:88000000    InstanceNum:00000000 00000023
       +000010  NEXT:00000001_00200740        ALEC:00000000_7F6F7000
       +000020  AleiAddress:00000000_00000000       AleiInstanceNum:00000000_00000000
       +000030  DllName:........  RoutineNamePtr:00000001_00200720
       +000040  RoutineNameLen:00000000 00000008    RoutineAddr:00000000_263840C0
       +000050  QSTRTAddr:00000000_26384000   DllKeyPtr:00000000_00000000
       +000060  DllKeyLen:00000000 00000000   ParmLen:00000000
       +00006C  EnvFlags:00000000       FuncEnv:00000000_00000000
       +000078  FuncEntry:00000000_00000000   MasterAlri:00000000_00000000
       +0000E8  Ales:00000001_00107CD0        LUAlri:00000001 00200740
       +0000F8  EnvType:00000002        EnclaveSeq#:00000000
       +000100  NextEnvAlri:00000000_00000000

       Routine: ALEM001
         ALRI:  00000001_00200540
       +000000  ID:ALRI     Flags:88000000    InstanceNum:00000000 00000023
       +000010  NEXT:00000001_00200740        ALEC:00000000_7F6F7000
       +000020  AleiAddress:00000000_00000000       AleiInstanceNum:00000000_00000000
       +000030  DllName:........  RoutineNamePtr:00000001_00200720
       +000040  RoutineNameLen:00000000 00000008    RoutineAddr:00000000_263840C0
       +000050  QSTRTAddr:00000000_26384000   DllKeyPtr:00000000_00000000
       +000060  DllKeyLen:00000000 00000000   ParmLen:00000000
       +00006C  EnvFlags:00000000       FuncEnv:00000000_00000000
       +000078  FuncEntry:00000000_00000000   MasterAlri:00000000_00000000
       +0000E8  Ales:00000001_00107CD0        LUAlri:00000001 00200740
       +0000F8  EnvType:00000002        EnclaveSeq#:00000000
       +000100  NextEnvAlri:00000000_00000000

[10]     ALEI:  00000001_001102F0
       +000000  ID:ALEI     Flags1:00000000   InstanceNum:00000000 00000015
       +000010  Next:00000001_001100D8        Prev:00000000_00000000
       +000020  Flags2:00000000   EnclaveSeq#:00000002    LAA:01ED7018
       +00002C  SavedLAA:7F710E80       Alec:00000000_7F6F7000
       +000038  CallerPSWKey:00000000 00000070      ASAStack:00000000_7F6C4AC0
       +000048  ParmListPtr:00000000_7F705AA8       ParmListPtrK0:00000000_7F6C4348
       +000058  RTOPtr:00000001_0030042C      RTOLen:00000000 00000401
       +000068  RTBL@:00000000_00000000       CallAlri:00000001_00200740
       +000078  EnvAlris:00000001_00200740    SystemRtnCode:00000000
       +000084  SystemRsnCode:00000000        SystemRtnCodeJr:00000000
       +00011C  SystemRsnCodeJr:00000000      ALES:00000001_00107CD0
.
.
.
[8]   ETINDEX: 00000003

      ALESETE:  00000001_00108138
       +000000  Flags:00000000    ALEI:00000001_00112508
       +000010  WTime:00000000 00000000       InitNum:00000000 0000000C
       +000020  IncrNum:00000000 00000007     MaxNum:00000000 0000001A
       +000030  CurNum:00000000 0000000C      RTOPtr:00000001_002084D0
       +000040  RTOLen:00000000 00000400
.
.
.
    Exiting Language Environment Data
```

Figure 150. Example of formatted AUTH output from LEDATA Verbexit (Part 4 of 4)

Sections of the AUTH LEDATA Verbexit formatted output

[1]ALEC

The ALEC is the anchor control block for all other Preinitialized Environments for Authorized Programs control blocks within the address space. The ALEC is located from the ASXB (Address Space Extension Block).

[2]Load Module Control Blocks

This section is the formatted representation of a table of ALMI control blocks. Each ALMI represents a module that was loaded by Preinitialized Environments for Authorized Programs.

[3]User Managed Control Blocks

This section contains control blocks for all user managed environments. A user managed environment is initialized when the CELAAUTH macro is invoked with REQUEST=USERINIT.

[4]-[5]Control Blocks for one user managed environment

These sections are repeated for each user managed environment that was initialized.

[4]ALEI

Each ALEI control block represents one environment.

[5]Routine Control Blocks

This section is the formatted representation of a table of ALRI control blocks. Each ALRI in this section represents a routine that was called by the user managed environment. Each ALRI appears in the table twice, once for the routine name and once for the routine address.

[6]System Managed Control Blocks

This section contains control blocks for all system managed environments. A set of system managed environments is initialized when the CELAAUTH macro is invoked with REQUEST=MNGDINIT.

[7]-[11]Control Blocks for one set of system managed environments that was initialized

These sections are repeated for each set of system managed environments that was initialized.

[7]ALES

Each ALES represents a set of system managed environments.

[8]-[11]Control blocks for one environment definition entry

These sections are repeated for every environment definition entry (AEDE) that was specified when the set of system managed environments was initialized.

[8]ETINDEX and ALESETE

The ETINDEX is the environment definition entry index value and the ALESETE represents the environment definition entry.

[9]Routine Control Blocks

This section is the formatted representation of a table of ALRI control blocks. Each ALRI in this section represents a routine that was called in one of the environments associated with the ETINDEX and ALESETE above. Each ALRI appears in the table twice, once for the routine name and once for the routine address.

[10]-[11]Control blocks for one system managed environment

These sections are repeated for every environment associated with the ETINDEX and ALESETE above.

[10]ALEI

Each ALEI control block represents one environment. The ALEIs in this section represent system managed environments.

[10]ALRI

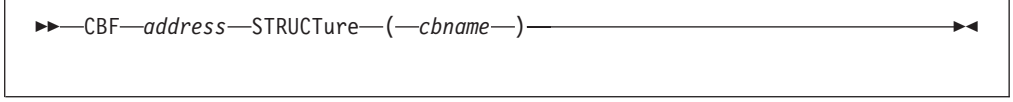
This section contains the ALRI control blocks for each routine that was called in the environment identified by the ALEI above. This section does not appear if the environment has not been used to call a routine.

Formatting individual control blocks

In addition to the full LEDATA output which contains many formatted control blocks, the IPCS Control block formatter can also format individual Language Environment control blocks.

The IPCS cbf command can be invoked from the ″IPCS Subcommand Entry″ screen, option 6 of the ″IPCS PRIMARY OPTION MENU″.

Syntax



address
The address of the control block in the dump. This is determined by browsing the dump or running the LEDATA Verbexit.

cbname
The name of the control block to be formatted. The control blocks that can be individually formatted are listed in Table 28 on page 463. In general, the name of each control block is similar to that used by the LEDATA Verbexit and is generally found in the control block's eyecatcher field. However, all control block

names are prefixed with CEE in order to uniquely define the Language Environment control block names to IPCS.

For an example of the display which is the result of the command, see Figure 151 :

```
CBF 15890 struct(CELCAA)
```

```
CEECAA:  00000001_00007B18
+000288  DLLF:00000000_00000000        INVAR:8000  FLAG0:00
+000304  TORC:00000000     FLAG2:30    LEVEL:15    _PM:04
+000368  DMC:00000000_00000000   CD:00000000       RS:00000000
+000378  ERR:00000001_082FBE00   DDSA:00000001_082FF760
+000388  EDB:00000001_00005340   PCB:00000001_00003CA0   EYEPTR:00000001_00007B00
+0003A0  CAA:00000001_00007B18   SHAB:00000000_00000000
+0003B0  PRGCK:00000000_00000000       URC:00000000      PICICB:00000000_00000000
+0003C8  SIGSCTR:00000000        SIGSFLG:08000000        THDID:253E0190_00000000
+0003D8  RCB:00000001_00003A10   MEMBR:00000001_000084D0
+0003E8  SIGNAL_STATUS:00000000_00000008     HCOM_REG14:00000000_00000000
+0003F8  EDCHPXV:00000000_25546C78     THREADHEAPID:00000000_00000000
+000408  SYS_RTNCODE:00000000    SYS_RSNCODE:00000000    SIGNGPTR:00000001_00007F30
+000418  SIGNG:00000001    AB_STATUS:00      STACKDIRECTION:00
+000420  AB_GR0:00000000_00000000      AB_ICD1:00000000_00000000
+000430  AB_ABCC:00000000_00000000     AB_CRC:00000000_00000000
+000440  USERRTN:00000000_00000000     QINITDSA:00000001_082FF280
+0004E8  IFLAG:0008  TRMRSN:00   DEVH:00000000_00000000
+0004F8  PtatPtr:00000000_00000000     SQELADDR:00000000_257520A0
+000510  VBA:00000001_08913350   TCS:00000001_08FEC450
+000520  CONDWAITDSAREG:00000000_00000000    THDSTATUS:00000000_00000000
+000570  FBTOK:00000000 00000000 00000000 00000000       PTXLPTR:00000000_00000000
+000588  TICB_PTR:00000001_00006AB0    FWD_CHAIN:00000001_114013C8
+0005A0  BKWD_CHAIN:00000001_199013C8        TCB:007FF050
+0007EC  DIA:25752320      DLLFFLAG:00       MCBPTR:00000000_25773DA8
+000838  MAD:00000000_25773048   MFD:00000000_25752998
```

Figure 151. The CAA formatted by the CBFORMAT IPCS command

For more information on using the IPCS CBF command, see the ″CBFORMAT subcommand″ section in *z/OS MVS IPCS Commands*, SA22-7594.

Table 28. Language Environment control blocks which can be individually formatted

Control Block	Description
CELCIB	Condition Information Block
CELCIBH	Condition Information Block Header
CELDLLF	DLL Failure Control Block
CELDSA	Dynamic Storage Area
CELDSATR	XPLINK Transition Area
CELEDB	Enclave Data Block
CELENSQ	Enclave Level Storage Management
CELHNQ31	Heap Anchor Node 31-bit
CELHCOM	CEL Exception Manager Communications Area
CELHPCQ	Thread Level Heap Control Block
CELLAA	Library Anchor Area
CELLCA	Library Communication Area
CELPCB	Process Control Block
CELRCB	Region Control Block

Table 28. Language Environment control blocks which can be individually formatted (continued)

Control Block	Description
CELSANC	Storage Management Control Block
CELSTSB	Storage Report Statistics Block

Table 29. Preinitalized Environments for Authorized Programs control blocks which can be individually formatted

Control Block	Description
CELALEC	Anchor Block
CELALEI	Environment Information Block
CELALES	System Managed Environment Set Block
CELALMI	Module Information Block
CELALRI	Routine Information Block

Requesting a Language Environment trace for debugging

Language Environment provides an in-storage, wrapping trace facility that can reconstruct the events leading to the point where a dump is taken. Language Environment produces a trace table in its dump report when the TRACE run-time option is set to ON and:

- A thread ends abnormally because of an unhandled condition of severity 2 or greater and the TERMTHDACT run-time option is set to DUMP, UADUMP, TRACE, or UATRACE.
- An application terminates normally and the TRACE run-time option is set to DUMP (the default).

For more information about recording done by the TERMTHDACT run-time option or the TRACE run-time option, see *z/OS Language Environment Programming Reference*.

The TRACE run-time option activates Language Environment run-time library tracing and controls the size of the trace buffer, the type of trace events to record, and it determines whether a dump containing only the trace table should be unconditionally taken when the application (enclave) terminates. The trace table contents can be written out either upon demand or at the termination of an enclave.

The contents of the Language Environment dump depend on the values set in the TERMTHDACT run-time option. Under abnormal termination, the following dump contents are generated:

- TERMTHDACT(QUIET) generates a Language Environment dump containing the trace table only
- TERMTHDACT(MSG) generates a Language Environment dump containing the trace table only
- TERMTHDACT(TRACE) generates a Language Environment dump containing the trace table and the traceback
- TERMTHDACT(DUMP) generates a Language Environment dump containing thread/enclave/process storage and control blocks (the trace table is included as an enclave control block)
- TERMTHDACT(UAONLY) generates a system dump of the user address space

- TERMTHDACT(UATRACE) generates a Language Environment dump that contains traceback information, and a system dump of the user address space
- TERMTHDACT(UADUMP) generates a Language Environment dump containing thread/enclave/process storage and control blocks (the trace table is included as an enclave control block), and a user address space dump
- TERMTHDACT(UAIMM) generates a system dump of the user address space of the original abend or program interrupt that occurred prior to the Language Environment condition manager processing the condition.

  Note: TRAP(ON,NOSPIE) must be in effect. When TRAP(ON,SPIE) is in effect, UAIMM equals UAONLY results. For software raised conditions or signals, UAIMM is the same as UAONLY.

Under normal termination, with the TRACE run-time option set to DUMP, Language Environment generates a dump containing the trace table only, independent of the TERMTHDACT setting.

Language Environment quiesces all threads that are currently running except for the thread that issued the call to `cdump()`. When you call `cdump()` in a multithread environment, only the current thread is dumped. Enclave- and process-related storage could have changed from the time the dump request was issued.

Locating the trace dump

If your application is running under TSO or batch, and a CEEDUMP DD is not specified, Language Environment writes the CEEDUMP to the batch log (SYSOUT=* by default). You can change the SYSOUT class by specifying a CEEDUMP DD, or by setting the environment variable, *_CEE_DMPTARG=SYSOUT(x)*, where x is the preferred SYSOUT class.

If your application is running under z/OS UNIX and is either running in a child process, or if it is invoked by one of the `exec` family of functions, the dump is written to the z/OS UNIX file system. Language Environment writes the CEEDUMP to one of the following directories in the specified order:

1. The directory in environment variable *_CEE_DMPTARG*, if found
2. The current working directory, if the directory is not the root directory (/), the directory is writable, and the CEEDUMP path name does not exceed 1024 characters
3. The directory found in environment variable *TMPDIR* (an environment variable that indicates the location of a temporary directory if it is not /tmp)
4. The **/tmp** directory

The name of this file changes with each dump and uses the following format:

`/path/CEEDUMP.Date.Time.Pid`

path The path determined from the above algorithm.

Date The date the dump is taken, appearing in the format `YYYYMMDD` (such as 20040918 for September 18, 2004).

Time The time the dump is taken, appearing in the format `HHMMSS` (such as 175501 for 05:55:01 p.m.).

Pid The process ID the application is running in when the dump is taken.

Using the Language Environment trace table format in a dump report

The Language Environment trace table is established unconditionally at enclave initialization time if the TRACE run-time option is set to ON. All threads in the enclave share the trace table; there is no thread-specific table, nor can the table be dynamically extended or enlarged.

Understanding the trace table entry (TTE)

Each trace table entry is a fixed-length record consisting of a fixed-format portion (containing such items as the timestamp, thread ID, and member ID) and a member-specific portion. The member-specific portion has a fixed length, of which some (or all) can be unused. For information about how participating products use the trace table entry, see the product-specific documentation. The format of the trace table entry is as follows:

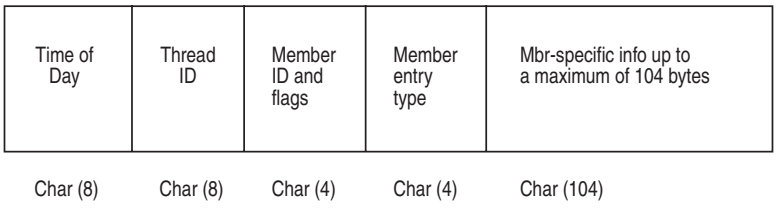


Figure 152. Format of the trace table entry

Following is a definition of each field:

Time The 64-bit value obtained from a store clock (STCK).

Thread ID The 8-byte thread ID of the thread that is adding the trace table entry.

Member ID and Flags
Contains 2 fields:

Member ID The 1-byte member ID of the member making the trace table entry, as follows:

ID	Name
01	CEL
03	C/C++
08	DCE
12	Sockets

Flags 24 flags reserved for internal use.

Member Entry Type
A number that indicates the type of the member-specific trace information that follows the field.

To uniquely identify the information contained in a specific TTE, you must consider Member ID as well as Member Entry Type.

Member-Specific Information
Based on the member ID and the member entry type, this field contains the specific information for the entry, up to 104 bytes.

For C/C++, the entry type of 1 is a record that records an invocation of a base C run-time library function. The entry consists of the name of the invoking function and the name of the invoked

function. Entry type 2 is a record that records the return from the base library function. It contains the returned value and the value of errno.

Member-specific information in the trace table entry

Global tracing is activated by using the LE=n suboption of the TRACE run-time option. This requests all Language Environment members to generate trace records in the trace table.

The settings for the global trace events are:

Level	Description
0	No global trace
1	Trace all run-time library (RTL) function entry and exits
2	Trace all RTL mutex init/destroy and lock/unlock
3	Trace all RTL function entry and exits, and all mutex init/destroy and lock/unlock
8	Trace all RTL storage allocation/deallocation

When LE=1 is specified: The following C/C++ records may be generated.

Table 30. LE=1 entry records

Member ID	Record Type	Description
03	00000001	Base C Library function Entry
03	00000002	Base C Library function Exit
03	00000003	Posix C Library function Entry
03	00000004	Posix C Library function Exit
03	00000005	XPLINK Base or Posix C Library function Entry
03	00000006	XPLINK Base or Posix C Library function Exit

For a detailed description of these records, see “C/C++ contents of the Language Environment trace tables” on page 498.

When LE=2 is specified: The following Language Environment records may be generated.

Table 31. LE=2 entry records

Member ID	Record Type	Class	Event	Description
01	00000101	LT	A	Latch Acquire
01	00000102	LT	R	Latch Release
01	00000103	LT	W	Latch Wait
01	00000104	LT	AW	Latch Acquire after Wait
01	00000106	LT	I	Latch Increment (Recursive)
01	00000107	LT	D	Latch Decrement (Recursive)
01	000002FC	LE	EUO	Latch unowned (not released)
01	000002FD	LE	EO	Latch already owned (not acquired)
01	00000301	MX	A	Mutex acquire
01	00000302	MX	R	Mutex release
01	00000303	MX	W	Mutex wait

Table 31. LE=2 entry records (continued)

Member ID	Record Type	Class	Event	Description
01	00000304	MX	AW	Mutex acquire after wait
01	00000305	MX	B	Mutex busy (Trylock failed)
01	00000306	MX	I	Mutex increment (recursive)
01	00000307	MX	D	Mutex decrement (recursive)
01	00000315	MX	IN	Mutex initialize
01	00000316	MX	DS	Mutex destroy
01	0000031D	MX	BI	Shared memory lock init
01	0000031E	MX	BD	Shared memory lock destroy
01	0000031F	MX	BO	shared memory lock obtain
01	00000320	MX	BC	Shared memory lock obtain on condition
01	00000321	MX	BR	Shared memory lock release
01	00000324	MX	CIN	Call to SMC_INIT
01	00000325	MX	CSD	Call to SMC_DESTROY
01	00000326	MX	CSO	Shared resource obtain
01	00000327	MX	CSR	Shared resource release
01	00000328	MX	CST	Call to SMC_SetupToWait
01	00000329	MX	CSP	Call to SMC_POST
01	000004CC	ME	FFR	Error - Forced release (shared mutex)
01	000004CD	ME	FFD	Error - Forced decrement (shared mutex)
01	000004CE	ME	FBD	Error - BPX_SMC(DESTROY) error return
01	000004CF	ME	FBU	Error - BPX_SMC(fail) returns EBUSY
01	000004D0	ME	FIV	Error - BPX_SMC(fail) returns EINVAL
01	000004D4	ME	FDU	Error - Destroy failed (uninitialized) (shared mutex/CV)
01	000004D5	ME	FP	Error - Program check (shared mutex/CV)
01	000004DB	ME	ESC	Error - BPX1SMC error return
01	000004DE	ME	EDL	Shared memory lock returns deadlock
01	000004DF	ME	EIV	Shared memory lock returns invalid
01	000004E0	ME	EPM	Shared memory lock returns eperm
01	000004E1	ME	EAG	Shared memory lock returns eagain
01	000004E2	ME	EBU	Shared memory lock returns ebusy
01	000004E3	ME	ENM	Shared memory lock returns enomem
01	000004E4	ME	EBR	Shared memory lock release error
01	000004E5	ME	EBC	Shared memory lock obtain condition error
01	000004E6	ME	EBO	Shared memory lock obtain error
01	000004E7	ME	EBD	Shared memory lock destroy error
01	000004E8	ME	EBI	Shared memory lock initialize error
01	000004E9	ME	EFR	Mutex forced release
01	000004EA	ME	EFD	Mutex forced decrement

Table 31. LE=2 entry records (continued)

Member ID	Record Type	Class	Event	Description
01	000004EB	ME	EDD	Mutex destroy failed (damage)
01	000004EC	ME	EDB	Mutex destroy failed (busy)
01	000004ED	ME	EIA	Mutex initialize failed (attribute)
01	000004EE	ME	EIS	Mutex initialize failed (storage)
01	000004EF	ME	EF	Mutex release (forced by quiesce)
01	000004F0	ME	EP	Mutex program check
01	000004FA	ME	EDU	Mutex destroy failed (uninitialized)
01	000004FB	ME	EUI	Mutex uninitialized
01	000004FC	ME	EUO	Mutex unowned (not released)
01	000004FD	E	EO	Mutex already owned (not acquired)
01	000004FE	ME	EIN	Mutex initialization failed (duplicate)
01	00000508	CV	MR	CV release mutex
01	00000509	CV	MA	CV reacquire mutex
01	0000050A	CV	MW	CV mutex wait
01	0000050B	CV	MAW	CV reacquire mutex after wait
01	0000050C	CV	CW	CV condition wait
01	0000050D	CV	CTW	CV condition timeout
01	0000050E	CV	CWP	CV wait posted
01	0000050F	CV	CWI	CV wait interrupted
01	00000510	CV	CTO	CV wait timeout
01	00000511	CV	CSS	CV condition signal success
01	00000512	CV	CSM	CV condition signal miss
01	00000513	CV	CBS	CV condition broadcast success
01	00000514	CV	CBM	CV condition broadcast miss
01	00000515	CV	IN	CV initialize
01	00000516	CV	DS	CV destroy
01	00000522	CV	CIN	Call to SMC_INIT
01	00000523	CV	CSD	Call to SMC_DESTROY
01	00000529	CV	CSP	Call to SMC_POST
01	0000052A	CV	CSB	Call to SMC_POSTALL
01	0000052B	CV	CSW	Call to SMC_WAIT
01	0000052C	CV	DBM	Shared condition broadcast - miss
01	0000052D	CV	DBS	Shared condition broadcast - success
01	0000052E	CV	DDS	Destroy (shared mutex/CV)
01	0000052F	CV	DIN	Initialize (shared mutex/CV)
01	00000530	CV	DSM	Condition signal - miss (shared CV)
01	00000531	CV	DSS	Condition signal - success (shared CV)
01	00000532	CV	DWI	Wait interrupted (shared CV)
01	00000533	CV	DTO	Wait timeout (shared CV)

Table 31. LE=2 entry records (continued)

Member ID	Record Type	Class	Event	Description
01	00000534	CV	DWP	Wait posted (shared CV)
01	000006CB	CE	FBT	Error - Invalid system TOD (shared)
01	000006D1	CE	FRM	Error - Recursive mutex (shared)
01	000006D2	CE	FUO	Error - Shared mutex unowned
01	000006D3	CE	FDB	Error - Destroy failed (busy) (shared mutex/CV)
01	000006D4	CE	FDU	Error - Destroy failed (unitialized) (shared mutex/CV)
01	000006D5	CE	FP	Error - Program check (shared mutex/CV)
01	000006D6	CE	FUI	Error - Shared mutex or CV unitialized
01	000006D7	CE	ENV	Error - BPX1SMC(fail) returns EINVAL
01	000006D8	CE	EPE	Error - BPX1SMC(fail) returns EPERM
01	000006D9	CE	EAN	Error - BPX1SMC(fail) returns EAGAIN
01	000006DA	CE	EIB	Error - BPX1SMC failed (EBUSY)
01	000006DB	CE	ESC	Error - BPX1SMC failed
01	000006EB	CE	EDD	CV destroy failed (damage)
01	000006EC	CE	EDB	CV destroy failed (busy)
01	000006ED	CE	EIA	CV initialization failed (attribute)
01	000006EE	CE	EIS	CV initialization failed (storage)
01	000006EF	CE	EF	CV forced by quiesce
01	000006F0	CE	EP	CV program check
01	000006F1	CE	EBT	CV invalid system TOD
01	000006F2	CE	EBN	CV invalid timespec (nanoseconds)
01	000006F3	CE	EBS	CV invalid timespec (seconds)
01	000006F4	CE	EPO	CV condition post callable service fail
01	000006F5	CE	ETW	CV condition timed wait callable service fail
01	000006F6	CE	EWA	CV condition wait callable service fail
01	000006F7	CE	ESE	CV condition setup callable service fail
01	000006F8	CE	ERM	CV recursive mutex
01	000006F9	CE	EWM	CV wrong mutex
01	000006FA	CE	EDU	CV destroy failed (uninitialized)
01	000006FB	CE	EUI	CV mutex or CV uninitialized
01	000006FC	CE	EUO	CV mutex unowned
01	000006FE	CE	EIN	CV initialization failed (duplicate)
01	00000702	RW	R	Release
01	00000704	RW	AW	Acquire after wait
01	00000706	RW	I	Increment (recursive)
01	00000707	RW	D	Decrement (recursive)
01	00000715	RW	IN	Initialize
01	00000716	RW	DS	Destroy

Table 31. LE=2 entry records (continued)

Member ID	Record Type	Class	Event	Description
01	00000717	RW	RA	Read acquire
01	00000718	RW	WA	Write acquire
01	00000719	RW	RB	Read busy (tryread failed)
01	0000071A	RW	WB	Write busy (trywrite failed)
01	0000071B	RW	RW	Read wait
01	0000071C	RW	WW	Write wait
01	0000071D	RW	BI	Call to SLK_INIT
01	0000071E	RW	BD	Call to SLK_DESTROY
01	0000071F	RW	BO	Call to SLK_OBTAIN
01	00000720	RW	BC	Call to SLK_OBTAIN_COND
01	00000721	RW	BR	Call to SLK_RELEASE
01	000008DC	RE	EOW	Error - Already owned for write (not acquired)
01	000008DD	RE	EOR	Error - Already owned for read (not acquired)
01	000008DE	RE	EDL	Error - BPX1SLK(fail) returns EDEADLK
01	000008DF	RE	EIV	Error - BPX1SLK(fail) returns EINVAL
01	000008E0	RE	EPM	Error - BPX1SLK(fail) returns EPERM
01	000008E1	RE	EAG	Error - BPX1SLK(fail) returns EAGAIN
01	000008E2	RE	EBS	Error - BPX1SLK(fail) returns EBUSY
01	000008E3	RE	ENM	Error - BPX1SLK(fail) returns ENOMEM
01	000008E4	RE	EBR	Error - BPX1SLK(RELEASE) error return
01	000008E5	RE	EBC	Error - BPX1SLK(OBTAIN_COND) error return
01	000008E6	RE	EBO	Error - BPX1SLK(OBTAIN) error return
01	000008E7	RE	EBD	Error - BPX1SLK(DESTROY) error return
01	000008E8	RE	EBI	Error - BPX1SLK(INIT) error return
01	000008E9	RE	EFR	Error - Forced release
01	000008EA	RE	EFD	Error - Forced decrement
01	000008ED	RE	EIA	Error - Initialization failed (attribute)
01	000008EE	RE	EIS	Error - Initialization failed (storage)
01	000008EF	RE	EF	Error - Forced by quiesce
01	000008F0	RE	EP	Error - Program check
01	000008FB	RE	EUI	Error - Uninitialized
01	000008FC	RE	EUO	Error - Unowned (not released)
01	000008FD	RE	EO	Error - Already owned (not acquired)
01	000008FE	RE	EIN	Error - Initialization failed (duplicate)

The format for the Mutex – Condition Variable – Latch entries in the trace table is:

Table 32. Format of the mutex/CV/latch records

Class	Source		Event		Object Addr	Name1	Name2
unused							

Where each field represents:

Class Two character EBCDIC representation of the trace class.

- **LT** Latch
- **LE** Latch Exception
- **MX** Mutex
- **ME** Mutex Exception
- **CV** Condition Variable
- **CE** Condition Variable Exception

Source
One character EBCDIC representation of the event.

- **C** C/C++

Blank Blank character

Event Two character EBCDIC representation of the event. See Table 31 on page 467.

Object address
Fullword address of the mutex object.

Name 1
Optional eight character field containing the name of the function or object to be recorded.

Name 2
Optional eight character field containing the name of the function or object to be recorded.

When LE=3 is specified: The trace table will include the records generated by both LE=1 and LE=2.

When LE=8 is specified: The trace table will contain only storage allocation records. Currently this is only supported by C/C++.

Table 33. LE=8 entry records

Member ID	Record Type	Description
03	00000005	Storage allocation entry
03	00000006	Storage allocation exit

For a detailed description of these records, see “C/C++ contents of the Language Environment trace tables” on page 498.

Sample dump for the trace table entry

The following is an example of a dump of the trace table when you specify the LE=1 suboption (the library call/return trace):

```
Language Environment Trace Table:
  Most recent trace entry is at displacement: 002080
      Displacement                    Trace Entry in Hexadecimal                          Trace Entry in EBCDIC
      ------------ ------------------------------------------------------------------  --------------------------------
        +000000    Time 22.02.30.389659    Date 2004.04.08    Thread ID... 2548146000000001
        +000010    Member ID.... 03    Flags..... 000000    Entry Type..... 00000005
        +000018    94818995 40404040 40404040 40404040  40404040 40404040 40404040 40404040  |main                            |
        +000038    60606E4D F0F0F6C6 5D409799 8995A386  4D5D4040 40404040 40404040 40404040  |-->(006F) printf()              |
        +000058    40404040 40404040 40404040 40404040  40404040 40404040 40404040 40404040  |                                |
        +000078    40404040 40404040                                                        |                                |

        +000080    Time 22.02.30.389724    Date 2004.04.08    Thread ID... 2548146000000001
        +000090    Member ID.... 03    Flags..... 000000    Entry Type..... 00000006
        +000098    4C60604D F0F0F6C6 5D40D9F1 7EF0F0F0  F0F0F0F0 F0F0F0F0 F0F0F0F0 F040D9F2  |<--(006F) R1=0000000000000000 R2|
        +0000B8    7EF0F0F0 F0F0F0F0 F0F2F5F4 C2F2F8C5  F040D9F3 7EF0F0F0 F0F0F0F0 F0F0F0F0  |=00000000254B28E0 R3=00000000000|
        +0000D8    F0F0F0F0 C340C5D9 D9D5D67E F0F0F0F0  F0F0F0F0 40C5D9D9 D5D6F27E F0F0F0F0  |0000C ERRNO=00000000 ERRNO2=0000|
        +0000F8    F0F0F0F0 00000000                                                        |0000....                        |

        +000100    Time 22.02.30.389725    Date 2004.04.08    Thread ID... 2548146000000001
        +000110    Member ID.... 03    Flags..... 000000    Entry Type..... 00000005
        +000118    94818995 40404040 40404040 40404040  40404040 40404040 40404040 40404040  |main                            |
        +000138    60606E4D F0F1F7F0 5D408493 93939681  844D5D40 40404040 40404040 40404040  |-->(0170) dllload()             |
        +000158    40404040 40404040 40404040 40404040  40404040 40404040 40404040 40404040  |                                |
        +000178    40404040 40404040                                                        |                                |

        +000180    Time 22.02.30.409904    Date 2004.04.08    Thread ID... 2548146000000001
        +000190    Member ID.... 03    Flags..... 000000    Entry Type..... 00000006
        +000198    4C60604D F0F1F7F0 5D40D9F1 7EF0F0F0  F0F0F0F0 F1F0F8F2 C6C6F4F6 F040D9F2  |<--(0170) R1=00000001082FF460 R2|
        +0001B8    7EF0F0F0 F0F0F0F0 F0F2F5F4 C2F2F8C5  F040D9F3 7EF0F0F0 F0F0F0F0 F1F0F8F9  |=00000000254B28E0 R3=00000001089|
        +0001D8    F4F8C6F1 F040C5D9 D9D5D67E F0F0F0F0  F0F0F0F0 40C5D9D9 D5D6F27E F0F0F0F0  |48F10 ERRNO=00000000 ERRNO2=0000|
        +0001F8    F0F0F0F0 00000000                                                        |0000....                        |

        +000200    Time 22.02.30.409906    Date 2004.04.08    Thread ID... 2548146000000001
        +000210    Member ID.... 03    Flags..... 000000    Entry Type..... 00000005
        +000218    94818995 40404040 40404040 40404040  40404040 40404040 40404040 40404040  |main                            |
        +000238    60606E4D F0F0F6C6 5D409799 8995A386  4D5D4040 40404040 40404040 40404040  |-->(006F) printf()              |
        +000258    40404040 40404040 40404040 40404040  40404040 40404040 40404040 40404040  |                                |
        +000278    40404040 40404040                                                        |                                |

        +000280    Time 22.02.30.409938    Date 2004.04.08    Thread ID... 2548146000000001
        +000290    Member ID.... 03    Flags..... 000000    Entry Type..... 00000006
        +000298    4C60604D F0F0F6C6 5D40D9F1 7EF0F0F0  F0F0F0F0 F0F0F0F0 F0F0F0F0 F040D9F2  |<--(006F) R1=0000000000000000 R2|
        +0002B8    7EF0F0F0 F0F0F0F0 F0F2F5F4 C2F2F8C5  F040D9F3 7EF0F0F0 F0F0F0F0 F0F0F0F0  |=00000000254B28E0 R3=00000000000|
        +0002D8    F0F0F0F0 C440C5D9 D9D5D67E F0F0F0F0  F0F0F0F0 40C5D9D9 D5D6F27E F0F0F0F0  |0000D ERRNO=00000000 ERRNO2=0000|
        +0002F8    F0F0F0F0 00000000                                                        |0000....                        |

        +000300    Time 22.02.30.409939    Date 2004.04.08    Thread ID... 2548146000000001
        +000310    Member ID.... 03    Flags..... 000000    Entry Type..... 00000005
        +000318    94818995 40404040 40404040 40404040  40404040 40404040 40404040 40404040  |main                            |
        +000338    60606E4D F0F1F6C4 5D408493 9398A485  99A88695 4D5D4040 40404040 40404040  |-->(016D) dllqueryfn()          |
        +000358    40404040 40404040 40404040 40404040  40404040 40404040 40404040 40404040  |                                |
        +000378    40404040 40404040                                                        |                                |
```

Figure 153. Trace table in dump output

Requesting a UNIX System Services syscall trace for debugging

Signal SIGTRACE can be sent to a process or process group to start or stop a trace of the z/OS UNIX System Services syscalls made by the application. The signal is implemented as a toggle. With the trace turned on, the z/OS UNIX System Services kernel gathers the syscall trace records for the targeted processes. A system dump of the user address space can be generated by sending signal SIGDUMP to the same processes in order to capture the trace output. See *z/OS UNIX System Services Command Reference* for more information about the SIGTRACE signal.

Chapter 13. Debugging AMODE 64 C/C++ routines

This chapter provides specific information to help you debug AMODE 64 applications that contain one or more C/C++ routines. It includes the following topics:

- Debugging C/C++ I/O routines
- Using XL C/C++ compiler listings
- Generating a Language Environment dump of a C/C++ routine
- Finding C/C++ information in a Language Environment dump
- Debugging example of C/C++ routines

There are several debugging features that are unique to C/C++ routines. Before examining the C/C++ techniques to find errors, you might want to consider the following areas of potential problems:

- To prevent errors which may result from differences in LP64 default argument types, you should include function prototypes for all C/C++ function calls. For C/C++ run-time library functions, see *z/OS XL C/C++ Run-Time Library Reference*.

  Note: `malloc()` is an example of a RTL function which needs this prototype to work correctly in LP64 applications.
- If you are using the `fetch()` function, see *z/OS XL C/C++ Programming Guide* to ensure that you are creating the fetchable module correctly.
- If you are using `DLL`s, see *z/OS XL C/C++ Programming Guide* to ensure that you are using the DLL correctly.
- Ensure that the entry point of the load module is CELQSTRT.
- If you suspect that you are using uninitialized storage, you may want to use the `STORAGE` run-time option.
- You should avoid:
  - Incorrect casting
  - Referencing an array element with a subscript outside the declared bounds
  - Copying a string to a target with a shorter length than the source string
  - Declaring but not initializing a pointer variable, or using a pointer to allocated storage that has already been freed

  If a routine exception occurred and you need more information than the condition handler provided, run your routine with the following run-time options, TRAP(ON, NOSPIE) and TERMTHDACT(UAIMM). Setting these run-time options generates a system dump of the user address space of the original abend or program interrupt prior to the Language Environment condition manager processing the condition. After the system dump is taken by the operating system the Language Environment condition manager continues processing.

Debugging C/C++ programs

You can use C/C++ conventions such as `__amrc` and `perror()` when you debug C/C++ programs.

Using the __amrc and __amrc2 structures to debug input/output

`__amrc`, a structure defined in **stdio.h**, can help you determine the cause of errors resulting from an I/O operation, because it contains diagnostic information (for example, the return code from a failed VSAM operation).

© Copyright IBM Corp. 1991, 2009

There are two structures:
- `__amrc` (defined by type `__amrc_type`
- `__amrc2` (defined by type `__amrc2_type`)

The `__amrc2_type` structure contains secondary information that C can provide.

Because any I/O function calls, such as `printf()`, can change the value of `__amrc` or `__amrc2`, make sure you save the contents into temporary structures of `__amrc_type` and `__amrc2_type` respectively, before dumping them.

Figure 154 on page 477 shows the structure as it appears in **stdio.h**.

```
    typedef struct __amrctype {

[1]     union {

[2]        int      __error;
           struct {
             unsigned short __syscode,
                            __rc;
[3]        } __abend;
           struct {
              unsigned char __fdbk_fill,
                            __rc,
                            __ftncd,
                            __fdbk;
[4]        } __feedback;
           struct {
              unsigned short __svc99_info,
                             __svc99_error;
[5]        } __alloc;
[1]     } __code;
[6]     unsigned int      __RBA;
[7]     unsigned int      __last_op;
        struct {
         unsigned int   __len_fill; /* __len + 4       */
         unsigned int   __len;
         char           __str[120];
         unsigned int   __parmr0;
         unsigned int   __parmr1;
         unsigned int   __fill2[2];
         char           __str2[64];
[8]     } __msg;
         #if __EDC_TARGET >= 0x22080000
[9]      unsigned char        __rplfdbwd[4];  /*  rpl feedback word */
 #endif                        /*  __EDC_TARGET >= 0x22080000  */
 #if __EDC_TARGET >= 0x41080000
[10] #ifdef  __LP64
   unsigned long         __XRBA; /* 8 byte RBA                */
 #elif defined(__LL)
   unsigned long long    __XRBA; /* 8 byte RBA                */
 #else
   unsigned int          __XRBA1;/* high half of 8 byte RBA    */
   unsigned int          __XRBA2;/* low half of 8 byte RBA     */
 #endif
                               /* QSAM to BSAM switch reason  */
[11]   unsigned char        __amrc_noseek_to_seek;
                           /* padding to make amrc 256 bytes */
   char                  __amrc_pad[23];
    } __amrc_type;
```

Figure 154. __amrc structure

Figure 155 shows the __amrc2 structure as it appears in **stdio.h**.

```
    struct {
[12]       int        __error2;
                             char       __pad__error2[4];
[13]       FILE      *__fileptr;
[14]       int        __reserved{6};
    }
```

Figure 155. __amrc2 structure

[1] union { ... } __code
The error or warning value from an I/O operation is in __error, __abend, __feedback, or __alloc. Look at __last_op to determine how to interpret the __code union.

[2] __error A structure that contains error codes for certain macros or services your application uses. Look at __last_op to determine the error codes. __syscode is the system abend code.

[3] __abend A structure that contains the abend code when errno is set to indicate a recoverable I/O abend. __rc is the return code. For more information on abend codes, see *z/OS MVS System Codes*.

[4] __feedback A structure that is used for VSAM only. The __rc stores the VSAM register 15, __fdbk stores the VSAM error code or reason code, and __RBA stores the RBA after some operations.

[5] __alloc A structure that contains errors during fopen or freopen calls when defining files to the system using SVC 99.

[6] __RBA The RBA value returned by VSAM after an ESDS or KSDS record is written out. For an RRDS, it is the calculated value from the record number. In AMODE 64 applications, you can no longer use the address of _amrc._ RBA as the first argument to flocate(). Instead, _amrc._RBA must be placed into an unsigned long in order to make it 8 bytes wide, since flocate() is updated to indicate that size of (unsigned long) must be specified as the key length (second argument).

[7] __last_op A field containing a value that indicates the last I/O operation being performed by C/C++ at the time the error occurred. These values are shown in Table 34 on page 479.

[8] __msg May contain the system error messages from read or write operations emitted from the DFSMS/MVS SYNADAF macro instruction. Because the message can start with a hexadecimal address followed by a short integer, it is advisable to start printing at MSG+6 or greater so the message can be printed as a string. Because the message is not null-terminated, a maximum of 114 characters should be printed. This can be accomplished by specifying a printf format specifier as %.114s.

[9] __rplfdbwd This field contains feedback information related to a VSAM RLS failure. This is the feedback code from the IFGRPL control block.

[10]__XRBA This is the 8 byte relative byte address returned by VSAM after an ESDS or KSDS record is written out. For an RRDS, it is the calculated value from the record number. It may be used in subsequent calls to flocate().

[11] __amrc_noseek_to_seek
This field contains the reason for the switch from QSAM (noseek) to BSAM with NOTE and POINT macros requested (seek) by the XL C/C++ Run-Time Library. This field is set when system-level I/O macro processing triggers an ABEND condition. The macro name values (defined in stdio.h) for this field are as follows:

Macro	Definition
__AM_BSAM_NOSWITCH	No switch was made.
__AM_BSAM_UPDATE	The data set is open for update

Macro	Definition
__AM_BSAM_BSAMWRITE	The data set is already open for write (or update) in the same C process.
__AM_BSAM_FBS_APPEND	The data set is recfm=FBS and open for append
__AM_BSAM_LRECLX	The data set is recfm=LRECLX (used for VBS data sets where records span the largest blocksize allowed on the device)
__AM_BSAM_PARTITIONED_DIRECTORY	The data set is the directory for a regular or extended partitioned data set
__AM_BSAM_PARTITIONED_INDIRECT	The data set is a member of a partitioned data set, and the member name was not specified at allocation

[12] __error2 A secondary error code. For example, an unsuccessful rename or remove operation places its reason code here.

[13] __fileptr A pointer to the file that caused a SIGIOERR to be raised. Use an `fldata()` call to get the actual name of the file.

[14] __reserved
Reserved for future use.

__last_op values

The `__last_op` field is the most important of the `__amrc` fields. It defines the last I/O operation C/C++ was performing at the time of the I/O error. You should note that the structure is neither cleared nor set by non-I/O operations, so querying this field outside of a `SIGIOERR` handler should only be done immediately after I/O operations. Table 34 lists `__last_op` values you could receive and where to look for further information.

Table 34. __last_op values and diagnosis information

Value	Further Information
__IO_INIT	Will never be seen by SIGIOERR exit value given at initialization.
__BSAM_OPEN	Sets __error with return code from OS OPEN macro.
__BSAM_CLOSE	Sets __error with return code from OS CLOSE macro.
__BSAM_READ	No return code (either __abend (errno == 92) or __msg (errno == 66) filled in).
__BSAM_NOTE	NOTE returned 0 unexpectedly, no return code.
__BSAM_POINT	This will not appear as an error lastop.
__BSAM_WRITE	No return code (either __abend (errno == 92) or __msg (errno == 65) filled in).
__BSAM_CLOSE_T	Sets __error with return code from OS CLOSE TYPE=T.
__BSAM_BLDL	Sets __error with return code from OS BLDL macro.
__BSAM_STOW	Sets __error with return code from OS STOW macro.
__TGET_READ	Sets __error with return code from TSO TGET macro.
__TPUT_WRITE	Sets __error with return code from TSO TPUT macro.
__IO_DEVTYPE	Sets __error with return code from I/O DEVTYPE macro.
__IO_RDJFCB	Sets __error with return code from I/O RDJFCB macro.
__IO_TRKCALC	Sets __error with return code from I/O TRKCALC macro.

Table 34. __last_op values and diagnosis information (continued)

Value	Further Information
__IO_OBTAIN	Sets __error with return code from I/O CAMLST OBTAIN.
__IO_LOCATE	Sets __error with return code from I/O CAMLST LOCATE.
__IO_CATALOG	Sets __error with return code from I/O CAMLST CAT. The associated macro is CATALOG.
__IO_UNCATALOG	Sets __error with return code from I/O CAMLST UNCAT. The associated macro is CATALOG.
__IO_RENAME	Sets __error with return code from I/O CAMLST RENAME.
__SVC99_ALLOC	Sets __alloc structure with info and error codes from SVC 99 allocation.
__SVC99_ALLOC_NEW	Sets __alloc structure with info and error codes from SVC 99 allocation of NEW file.
__SVC99_UNALLOC	Sets __unalloc structure with info and error codes from SVC 99 unallocation.
__C_TRUNCATE	Set when C or C++ truncates output data. Usually this is data written to a text file with no newline such that the record fills up to capacity and subsequent characters cannot be written. For a record I/O file this refers to an `fwrite()` writing more data than the record can hold. Truncation is always rightmost data. There is no return code.
__C_FCBCHECK	Set when C or C++ FCB is corrupted. This is due to a pointer corruption somewhere. File cannot be used after this.
__C_DBCS_TRUNCATE	This occurs when writing DBCS data to a text file and there is no room left in a physical record for anymore double byte characters. A new-line is not acceptable at this point. Truncation will continue to occur until an SI is written or the file position is moved. Cannot happen if MB_CUR_MAX is 1.
__C_DBCS_SO_TRUNCATE	This occurs when there is not enough room in a record to start any DBCS string or else when a redundant SO is written to the file before an SI. Cannot happen if MB_CUR_MAX is 1.
__C_DBCS_SI_TRUNCATE	This occurs only when there was not enough room to start a DBCS string and data was written anyways, with an SI to end it. Cannot happen if MB_CUR_MAX is 1.
__C_DBCS_UNEVEN	This occurs when an SI is written before the last double byte character is completed, thereby forcing C or C++ to fill in the last byte of the DBCS string with a padding byte X'FE'. Cannot happen if MB_CUR_MAX is 1.
__C_CANNOT_EXTEND	This occurs when an attempt is made to extend a file that allows writing, but cannot be extended. Typically this is a member of a partitioned data set being opened for update.
__VSAM_OPEN_FAIL	Set when a low level VSAM OPEN fails, sets __rc and __fdbk fields in the __amrc struct.
__VSAM_OPEN_ESDS	Does not indicate an error; set when the low level VSAM OPEN succeeds, and the file type is ESDS.
__VSAM_OPEN_RRDS	Does not indicate an error; set when the low level VSAM OPEN succeeds, and the file type is ESDS.
__VSAM_OPEN_KSDS	Does not indicate an error; set when the low level VSAM OPEN succeeds, and the file type is ESDS.
__VSAM_OPEN_ESDS_PATH	Does not indicate an error; set when the low level VSAM OPEN succeeds, and the file type is ESDS.

Table 34. __last_op values and diagnosis information (continued)

Value	Further Information
__VSAM_OPEN_KSDS_PATH	Does not indicate an error; set when the low level VSAM OPEN succeeds, and the file type is ESDS.
__VSAM_MODCB	Set when a low level VSAM MODCB macro fails, sets __rc and __fdbk fields in the __amrc struct.
__VSAM_TESTCB	Set when a low level VSAM TESTCB macro fails, sets __rc and __fdbk fields in the __amrc struct.
__VSAM_SHOWCB	Set when a low level VSAM SHOWCB macro fails, sets __rc and __fdbk fields in the __amrc struct.
__VSAM_GENCB	Set when a low level VSAM GENCB macro fails, sets __rc and __fdbk fields in the __amrc struct.
__VSAM_GET	Set when the last op was a low level VSAM GET; if the GET fails, sets __rc and __fdbk in the __amrc struct.
__VSAM_PUT	Set when the last op was a low level VSAM PUT; if the PUT fails, sets __rc and __fdbk in the __amrc struct.
__VSAM_POINT	Set when the last op was a low level VSAM POINT; if the POINT fails, sets __rc and __fdbk in the __amrc struct.
__VSAM_ERASE	Set when the last op was a low level VSAM ERASE; if the ERASE fails, sets __rc and __fdbk in the __amrc struct.
__VSAM_ENDREQ	Set when the last op was a low level VSAM ENDREQ; if the ENDREQ fails, sets __rc and __fdbk in the __amrc struct.
__VSAM_CLOSE	Set when the last op was a low level VSAM CLOSE; if the CLOSE fails, sets __rc and __fdbk in the __amrc struct.
__QSAM_GET	__error is not set (if abend (errno == 92), __abend is set, otherwise if read error (errno == 66), look at __msg.
__QSAM_PUT	__error is not set (if abend (errno == 92), __abend is set, otherwise if write error (errno == 65), look at __msg.
__QSAM_TRUNC	This is an intermediate operation. You will only see this if an I/O abend occurred.
__QSAM_FREEPOOL	This is an intermediate operation. You will only see this if an I/O abend occurred.
__QSAM_CLOSE	Sets __error to result of OS CLOSE macro.
__QSAM_OPEN	Sets __error to result of OS OPEN macro.
__CMS_OPEN	Sets __error to result of FSOPEN.
__CMS_CLOSE	Sets __error to result of FSCLOSE.
__CMS_READ	Sets __error to result of FSREAD.
__CMS_WRITE	Sets __error to result of FSWRITE.
__CMS_STATE	Sets __error to result of FSSTATE.
__CMS_ERASE	Sets __error to result of FSERASE.
__CMS_RENAME	Sets __error to result of CMS RENAME command.
__CMS_EXTRACT	Sets __error to result of DMS EXTRACT call.
__CMS_LINERD	Sets __error to result of LINERD macro.
__CMS_LINEWRT	Sets __error to result of LINEWRT macro.
__CMS_QUERY	__error is not set.

Table 34. __last_op values and diagnosis information (continued)

Value	Further Information
__HSP_CREATE	Indicates last op was a DSPSERV CREATE to create a hiperspace for a hiperspace memory file. If CREATE fails, stores abend code in __amrc__code__abend__syscode, reason code in __amrc__code__abend__rc.
__HSP_DELETE	Indicates last op was a DSPSERV DELETE to delete a hiperspace for a hiperspace memory file during termination. If DELETE fails, stores abend code in __amrc__code__abend__syscode, reason code in __amrc__code__abend__rc.
__HSP_READ	Indicates last op was a HSPSERV READ from a hiperspace. If READ fails, stores abend code in __amrc__code__abend__syscode, reason code in __amrc__code__abend__rc.
__HSP_WRITE	Indicates last op was a HSPSERV WRITE to a hiperspace. If WRITE fails, stores abend code in __amrc__code__abend__syscode, reason code in __amrc__code__abend__rc.
__HSP_EXTEND	Indicates last op was a HSPSERV EXTEND during a write to a hiperspace. If EXTEND fails, stores abend code in __amrc__code__abend__syscode, reason code in __amrc__code__abend__rc.
__LFS_OPEN	Sets __error with reason code from HFS services. Reason code from HFS services must be broken up. The low order 2 bytes can be looked up in *z/OS UNIX System Services Programming: Assembler Callable Services Reference*.
__LFS_CLOSE	Sets __error with reason code from HFS services. Reason code from HFS services must be broken up. The low order 2 bytes can be looked up in *z/OS UNIX System Services Programming: Assembler Callable Services Reference*.
__LFS_READ	Sets __error with reason code from HFS services. Reason code from HFS services must be broken up. The low order 2 bytes can be looked up in *z/OS UNIX System Services Programming: Assembler Callable Services Reference*.
__LFS_WRITE	Sets __error with reason code from HFS services. Reason code from HFS services must be broken up. The low order 2 bytes can be looked up in *z/OS UNIX System Services Programming: Assembler Callable Services Reference*.
__LFS_LSEEK	Sets __error with reason code from HFS services. Reason code from HFS services must be broken up. The low order 2 bytes can be looked up in *z/OS UNIX System Services Programming: Assembler Callable Services Reference*.
__LFS_FSTAT	Sets __error with reason code from HFS services. Reason code from HFS services must be broken up. The low order 2 bytes can be looked up in *z/OS UNIX System Services Programming: Assembler Callable Services Reference*.

Using file I/O tracing to debug C/C++ file I/O problems

You can use file I/O tracing to debug C/C++ file I/O problems. For more information, see Debugging I/O programs in *z/OS XL C/C++ Programming Guide*.

Displaying an error message with the perror() function

To find a failing routine, check the return code of all function calls. After you have found the failing routine, use the `perror()` function after the routine to display the error message. `perror()` displays the string that you pass to it and an error message corresponding to the value of `errno`. `perror()` writes to the standard error stream (`stderr`). By default, the errno2 value will be appended to the end of the perror() string.

If you do not want the errno2 value appended to the `perror()` string, set the _EDC_ADD_ERRNO2 environment variable to 0.

Figure 156 is an example of a routine using `perror()`.

```
#include <stdio.h>
int main(void){
   FILE *fp;

   fp = fopen("myfile.dat", "w");
   if (fp == NULL)
      perror("fopen error");
}
```

Figure 156. Example of a routine using perror()

Using __errno2() to diagnose application problems

Use the __errno2() function when diagnosing problems in an application program. This function enables z/OS XL C/C++ application programs to access additional diagnostic information, `errno2` (`errnojr`), associated with `errno`. The `__errno2` may be set by the z/OS XL C/C++ run-time library, z/OS UNIX callable services, or other callable services. The `errno2` is intended for diagnostic display purposes only and is not a programming interface.

Note: Not all functions set `errno2` when `errno` is set. In the cases where `errno2` is not set, the __errno2() function may return a residual value. You may use the __err2ad() function to clear `errno2` to reduce the possibility of a residual value being returned.

Figure 157 on page 484 is an example of a routine using __errno2() and Figure 158 on page 484 shows the sample output from that routine.

```
#pragma runopts(posix(on))
#define _EXT
#include <stdio.h>
#include <errno.h>

int main(void) {
  FILE *f;
  f = fopen("testfile.dat", "r")
  if (f==NULL) {
      perror("fopen() failed");
      printf("__errno2 = %08x\n", __errno2());
   }
   return 0;
}
```

Figure 157. Example of a routine using __errno2()

```
fopen() failed: EDC5129I No such file or directory. (errno2=0x05620062)
__errno2 = 05620062
```

Figure 158. Sample output of routine using __errno2()

Figure 159 is an example of a routine using the environment variable _EDC_ADD_ERRNO2 and Figure 160 shows the sample output from that routine.

```
#pragma runopts(posix(on))
#define _EXT
#include <stdio.h>
#include <errno.h>
#include <stdlib.h>

int main(void) {
  FILE *fp;
  /* do NOT add errno2 to perror message */
  setenv("_EDC_ADD_ERRNO2", "0", 1);
  fp = fopen("testfile.dat", "r");
  if (fp == NULL)
      perror("fopen() failed");
  return 0;
}
```

Figure 159. Example of a routine using _EDC_ADD_ERRNO2

```
fopen() failed: EDC5129I No such file or directory.
```

Figure 160. Sample output of a routine using _EDC_ADD_ERRNO2

Figure 161 on page 485 is an example of a routine using __err2ad() in combination with __errno2() and Figure 162 on page 485 shows the sample output from that routine.

```
#pragma runopts(posix(on))
#define _EXT
#include <stdio.h>
#include <errno.h>
#include <stdlib.h>

int main(void) {
  FILE *f;
  setenv("_EDC_ADD_ERRNO2", "0", 1);
  f = fopen("testfile.dat", "r");
  if (f == NULL) {
    perror("fopen() failed");
    printf("__errno2 = %08x\n", __errno2());
  }
  /* reset errno2 to zero */
  *__err2ad() = 0x0;
  printf("__errno2 = %08x\n", __errno2());
  f = fopen(*testfile.dat", "r");

  if (fp == NULL) {
    perror("fopen() failed");
    printf(*__errno2 = %08x\n", __errno2());
  }
  return 0;
}
```

Figure 161. Example of a routine using __err2ad() in combination with __errno2()

```
fopen() failed: EDC5129I  No such file or directory.
__errno2 = 05620062
__errno2 = 00000000
fopen() failed: EDC5129I  No such file or directory.
__errno2 = 05620062
```

Figure 162. Sample output of routine using __err2ad() in combination with __errno2()

For more information about _EDC_ADD_ERRNO2, see *z/OS XL C/C++ Programming Guide*.

For more information about __errno2() and __err2ad(), see *z/OS XL C/C++ Run-Time Library Reference*.

Using C/C++ listings

For a detailed description of available listings, see *z/OS XL C/C++ User's Guide*.

Finding variables

You can determine the value of a variable in the routine at the point of interrupt by using the compiled code listing as a guide to its address, then finding this address in the Language Environment dump or system dump. The method you use depends on the storage class of variable.

It is possible for the routine to be interrupted before the value of the variable is placed in the location provided for it. This can explain unexpected values in the dump.

Steps for finding automatic variables

Perform the following steps to find automatic variables in the Language Environment dump or system dump:

1. Determine the name of the automatic variable and the function it is defined in. As an example, we will find the variable **aa** in the function **main** from the program **cdivzero** shown in Figure 59 on page 214.
2. From the compiler listing, locate the variable in the storage offset listing:

```
aa                  5823-0:10       Class = automatic,          Location = 2248(r4),         Length = 4
```

   The location is specified as decimal offset (base register). So variable **aa** is located at register 4 + 2248 (X'8C8').

3. From the Traceback (in the Language Environment dump or in the formatted output from the IPCS VERBEXIT LEDATA CEEDUMP subcommand for a system dump) locate the function:

```
DSA       Entry       E  Offset  Load Mod  Program Unit  Service  Status
00000004  main        +00000016  CDIVZERO                        Call

DSA       DSA Addr          E  Addr             PU Addr           PU Offset  Comp Date Attributes
00000004  00000001082FF180  000000002510000C0   0000000000000000  ********   20040408  XPLINK  EBCDIC  IEEE
```

   If the base register is r4, the register 4 value is always the DSA address for the function.

   If the base register is not r4, the register value must be located from saved registers.

   If the Status field indicates Exception, use the saved registers from when the condition occurred. In the Language Environment dump, the saved registers can be found in the Condition information associated with the DSA address in the Condition Information for Active Routines section. In the formatted output from the IPCS VERBEXIT LEDATA CM subcommand for a system dump, the saved registers can be found in the CIBH that has the DSA address as the value for the SV1 field.

   If the Status field indicates Call, use the saved registers from the DSA address that appears on the line above the function in the Traceback. In the Language Environment dump, the DSAs can be found in the ″Control Blocks for Active Routines″ section. In the formatted output from the IPCS VERBEXIT LEDATA 'STACK' subcommand for a system dump, the DSAs can be found in the ″DSA backchain″ section.

   Note: Some functions do not save all registers.

4. Add the register value to the offset of the variable to obtain the address of the variable. In the Language Environment dump, the contents of the variable can be read in the DSA Frame section corresponding to the function the variable is contained in. For a system dump, use the IPCS LIST subcommand to display the storage where the variable is located.

   The address for variable **aa** is X'1082FF080' + X'980' = X'1082FFA00'.

Restriction: The parameter value might never be stored, since the first few parameters might be passed in registers and there might be no need to save them.

Steps for finding C/C++ parameters

The C/C++ parameter list is always located in the caller's DSA at offset 2176 (X'880'). Parameters that are passed in registers are not always stored in the parameter list. The compiler option XPLINK(STOREARGS) can be used to ensure that all parameters are stored in the parameter list.

Perform the following steps to find parameters in the Language Environment dump or system dump:

1. Determine the name of the parameter and the function it is for. As an example, we will find the parameter **pp** for the function **funcb** from the program **cdivzero** shown in Figure 53. C routine with a divide-by-zero error.
2. From the compiler listing, locate the parameter in the storage offset listing:

```
pp                5828-0:15       Class = parameter,          Location = 2432(r4),          Length = 8
```

3. From the Traceback (in the Language Environment dump or in the formatted output from the IPCS VERBEXIT LEDATA 'CEEDUMP' subcommand for a system dump) locate the function:

```
    DSA       Entry       E  Offset  Load Mod  Program Unit  Service  Status
    00000003  funcb       +0000002E  CDIVZERO                        Exception

    DSA       DSA Addr          E  Addr             PU Addr           PU Offset  Comp Date Attributes
    00000003  00000001082FF080  0000000025100108    0000000000000000  ********   20040408  XPLINK  EBCDIC  IEEE
```

   If the base register is r4, the register 4 value is always the DSA address for the function.

   If the base register is not r4, the register value must be located from saved registers.

   If the Status field indicates Exception, use the saved registers from when the condition occurred. In the Language Environment dump, the saved registers can be found in the Condition information associated with the DSA address in the ″Condition Information for Active Routines″ section. In the formatted output from the IPCS VERBEXIT LEDATA 'CM' subcommand for a system dump, the saved registers can be found in the CIBH that has the DSA address as the value for the SV1 field.

   If the Status field indicates Call, use the saved registers from the DSA address that appears on the line above the function in the Traceback. In the Language Environment dump, the DSAs can be found in the ″Control Blocks for Active Routines″ section. In the formatted output from the IPCS VERBEXIT LEDATA 'STACK' subcommand for a system dump, the DSAs can be found in the ″DSA backchain″ section.

   Note: Some functions do not save all registers.

4. Add the register value to the offset of the parameter to obtain the address of the parameter. In the Language Environment dump, the contents of the parameter can be read in the DSA Frame section corresponding to the function that passed the parameter. For a system dump, use the IPCS LIST subcommand to display the storage where the parameter is located.

   The address for parameter **pp** is X'1082FF080' + X'980' = X'1082FFA00'.

Steps for finding members of aggregates

You can define aggregates in any of the storage classes or pass them as parameters to a called function. The first step is to find the start of the aggregate. You can compute the start of the aggregate as described in previous sections, depending on the type of aggregate used.

The aggregate map provided for each declaration in a routine can further assist in finding the offset of a specific variable within an aggregate. Structure maps are generated using the AGGREGATE compiler option. Figure 163 on page 488 shows an example of an aggregate.

```
typedef struct {
     int asid;
     void *addr;
     asfAmodeType amode;
  } asfTargetRef;
  asfTargetRef  tempTargetRef;
```

Figure 163. Example code for structure variables

Figure 164 shows an example of aggregate map.

```
================================================================================
| Aggregate map for: struct with no tag #68            Total size: 24 bytes    |
|..............................................................................|
asfTargetRef
================================================================================
|      Offset       |       Length      | Member Name                          |
|    Bytes(Bits)    |     Bytes(Bits)   |                                      |
|===================|===================|======================================|
|       0           |        4          |  asid                                |
|       4           |        4          |  ***PADDING***                       |
|       8           |        8          |  addr                                |
|      16           |        1          |  amode                               |
|      17           |        7          |  ***PADDING***                       |
================================================================================
```

Figure 164. Example of aggregate map

To find the value of variable **tempTargetRef.addr**:

1. Locate the automatic variable **tempTargetRef** in the storage offset listing:

```
tempTargetRef       209-0:209       Class = automatic,          Location = 2264(r4),          Length = 24
```

   The variable **tempTargetRef** is located at register 4 + 2264 (X'8D8'). For this example, assume that the register 4 value is X'1082FD3E0'. The result is X'1082FDCB8'(X'1082FD3E0' + X'8D8'). This is the address of the value of the automatic variable **tempTargetRef** in the dump

2. Find the offset of addr in the Aggregate Map, shown in Figure Figure 164. The offset is 8. Add the offset from the Aggregate Map to the address of the **tempTargetRef** variable.

   The result is X'1082FDCC0' (X'1082FDCB8' + X'8'). This is the address of the value of **tempTargetRef.addr** in the dump

Generating a Language Environment dump of a C/C++ routine

You can use the `cdump()`, `csnap()`, and `ctrace()` C/C++ functions to generate a Language Environment dump of C/C++ routines.

cdump()

If your routine is running under z/OS, you can generate useful diagnostic information by using the `cdump()` function. `cdump()` produces a main storage dump with the activation stack.

When `cdump()` is invoked from a user routine, the C/C++ library issues an OS IEATDUMP macro to obtain a dump of virtual storage. You can use the Interactive Problem Control System (IPCS) to format and analyze IEATDUMP dumps.

The DD definition for CEESNAP must include the desired data set name and DCB information:

```
LRECL=4160,  BLKSIZE=4160, and RECFM=FBS
```

If the data set is not defined, or is not usable for any reason, `cdump()` returns a failure code of 1. This occurs even if the call to CEE3DMP is successful.

Because `cdump()` returns a code of 0 only if the IEATDUMP was successful or 1 if it was unsuccessful, you cannot distinguish whether a failure of `cdump()` occurred in the call to CEE3DMP or IEATDUMP. A return code of 0 is issued only if both IEATDUMP and CEE3DMP are successful.

Support for IEATDUMP dumps using the `_cdump` function is provided only under z/OS. In addition to a IEATDUMP dump, a Language Environment formatted dump is also taken.

csnap()

The `csnap()` function produces a condensed storage dump.

To use these functions, you must add `#include <ctest.h>` to your C/C++ code. The dump is directed to output *dumpname*, which is specified in a `//CEEDUMP DD` statement in JCL.

See the *z/OS XL C/C++ Run-Time Library Reference* for more details about the syntax of these functions.

ctrace()

The `ctrace()` function produces a traceback and includes the offset addresses from which the calls were made.

Sample C routine that calls cdump()

Figure 165 on page 490 shows a sample C routine that uses the `cdump` function to generate a dump.

Figure 170 on page 493 shows the dump output.

```
#include <stdio.h>
#include <signal.h>
#include <stdlib.h>

void hsigfpe(int);
void hsigterm(int);
void atf1(void);

typedef int (*FuncPtr_T)(void);

int st1    =  99;
int st2    = 255;
int xcount =   0;

int main(void) {
  /*
   * 1) Open multiple files
   * 2) Register 2 signals
   * 3) Register 1 atexit function
   * 4) Fetch and execute a module
   */

  FuncPtr_T fetchPtr;
  FILE*     fp1;
  FILE*     fp2;
  int       rc;
  fp1 = fopen("myfile.data", "w");
  if (!fp1) {
    perror("Could not open myfile.data for write");
    exit(101);
  }

  fprintf(fp1, "record 1\n");
  fprintf(fp1, "record 2\n");
  fprintf(fp1, "record 3\n");

  fp2 = fopen("memory.data", "wb,type=memory");
  if (!fp2) {
    perror("Could not open memory.data for write");
    exit(102);
  }
  fprintf(fp2, "some data");
  fprintf(fp2, "some more data");
  fprintf(fp2, "even more data");

  signal(SIGFPE , hsigfpe);
  signal(SIGTERM, hsigterm);

  rc = atexit(atf1);
  if (rc) {
    fprintf(stderr, "Failed on registration of atexit function atf1\n");
    exit(103);
  }
```

Figure 165. Example C routine using cdump() to generate a dump (Part 1 of 2)

```
  fetchPtr = (FuncPtr_T) fetch("MODULE1");
  if (!fetchPtr) {
    fprintf(stderr, "Failed to fetch MODULE1\n");
    exit(104);
  }
  fetchPtr();
  return(0);
}

void hsigfpe(int sig) {
  ++st1;
  return;
}

void hsigterm(int sig) {
  ++st2;
  return;
}

void atf1() {
  ++xcount;
}
```

Figure 165. Example C routine using cdump() to generate a dump (Part 2 of 2)

Figure 166 shows a fetched C module:

```
#include <ctest.h>

#pragma linkage(func1, fetchable)
int func1(void) {
  __cdump("This is a sample dump");
  return(0);
}
```

Figure 166. Fetched module for C routine

Sample C++ routine that generates a Language Environment dump

Figure 167 shows a sample C++ routine that uses a protection exception to generate a dump.

```
#include <iostream.h>
#include <ctest.h>
#include "stack.h"

int main() {
  cout << "Program starting:\n";
  cerr << "Error report:\n";

  Stack<int> x;
  x.push(1);
  cout << "Top value on stack : " << x.pop() << '\n';
  cout << "Next value on stack: " << x.pop() << '\n';
  return(0);
}
```

Figure 167. Example C++ routine with protection exception generating a dump

Figure 168 shows the template file stack.c

```
#ifndef __STACK__
  #include "stack.h"
#endif

template <class T> T Stack<T>::pop() {
  T value = head->value;
  head = head->next;

  return(value);
}
template <class T> void Stack<T>::push(T value) {
  Node* newNode  = new Node;
  newNode->value = value;
  newNode->next  = head;
  head = newNode;
}
```

Figure 168. Template file STACK.C

Figure 169 shows the header file **stack.h**.

```
#ifndef __STACK_
  #define __STACK__
  template <class T> class Stack {
    public:
      Stack() {
        char* badPtr = 0; badPtr -= (0x01010101);
        head = (Node*) badPtr; /* head initialized to 0xFEFEFEFF */
      }
      T pop();
      void push(T);
    private:
      struct Node {
        T value;
        struct Node* next;
      }* head;
  };
#endif
```

Figure 169. Header file STACK.H

Sample Language Environment dump with C/C++-specific information

This sample dump was produced by compiling the routines shown in Figure 165 on page 490 and Figure 166 on page 491. They were both compiled using options LP64 and GONUM to produce statement numbers in the CEEDUMP. Notice the sequence of calls in the traceback section - CELQINIT is the Language Environment module that invokes the main entry. `main` calls `fetchPtr()` at statement number 60, which in turn, through @@FECBMODULE1 fetches the user-defined function `func1` shown in Figure 166 on page 491. `func1` calls the library routine `__cdump()` in statement number 5. The complete program unit names for `main` and `func1` are shown in the Fully Qualified Names section along with its load module name.

```
1CEE3DMP V1 R8.0: This is a sample dump                                  Wed Feb 22 21:31:53 2006            Page:    1

 Information for enclave main

   Information for thread 25AC528000000000

   Traceback:
     DSA       Entry       E  Offset  Statement   Load Mod            Program Unit                  Service  Status
     00000001  __cdump     +00000000              CELQLIB                                           HLE7730  Call
     00000002  func1       +00000020  5           MODULE1             func1.c                                Call
     00000003  @@FECBMODULE1
                           -005F601C                                  ** NoName **                           Call
     00000004  main        +00000284  60          CSAMPLE             FIG142                                 Call
     00000005  CELQINIT    +0000134C              CELQLIB             CELQINIT                      HLE7730  Call

     DSA       DSA Addr          E  Addr             PU Addr           PU Offset   Comp Date Attributes
     00000001  00000001082FEDC0  0000000025C1FFE0    0000000000000000  ********    20060111  XPLINK  EBCDIC  POSIX  IEEE
     00000002  00000001082FEF00  0000000025D8A0D0    0000000000000000  ********    20060222  XPLINK  EBCDIC  POSIX  IEEE
     00000003  00000001082FF000  0000000025D8D058    0000000025D8D048  005F600C              XPLINK  EBCDIC  POSIX  Floating Point
     00000004  00000001082FF180  00000000257000D0    0000000000000000  ********    20060222  XPLINK  EBCDIC  POSIX  IEEE
     00000005  00000001082FF280  0000000025703010    0000000025703010  0000134C    20060111  XPLINK  EBCDIC  POSIX  Floating Point

     Fully Qualified Names
     DSA       Entry       Program Unit                                        Load Module
     00000002  func1       AQMVSOE:/u/alfcar/tools/func1.c                     MODULE1
     00000004  main        PLPSC://'POSIX.CRTL.C(FIG142)'                      CSAMPLE

   Control Blocks for Active Routines:
     DSA for __cdump: 00000001082FF5C0
       +000000  R4....... 00000001082FEF00          R5....... 0000000025D77E10          R6....... 0000000025C1FFE0
       +000018  R7....... 0000000025D8A0F2          R8....... 0000000025796F40          R9....... 0000000025D8A110
       +000030  R10...... 00000001082FF880          R11...... 0000000000000000          R12...... 0000000100007AC0
       +000048  R13...... 00000001082FF180          R14...... 000000010000B238          R15...... 0000000025D8D048
       +000060  reserved. 0000000025AA5FD6          reserved. 0000000000000000          HPTRAN... 0000000025D71580
       +000078  reserved. 0000000100007AC0
     DSA for func1: 00000001082FF700
       +000000  R4....... 00000001082FF000          R5....... 00000001083012E0          R6....... 0000000025D8A0D0
       +000018  R7....... 000000002579703E          R8....... 0000000025796F40          R9....... 00000001082FF800
       +000030  R10...... 00000001082FF880          R11...... 0000000000000000          R12...... 0000000100007AC0
       +000048  R13...... 00000001082FF180          R14...... 000000010000B238          R15...... 0000000025D8D048
       +000060  reserved. 00000000180F58FF          reserved. 001007FF00000000          HPTRAN... 00000001082FF920
       +000078  reserved. 0000000000000000
     DSA for @@FECBMODULE1 : 00000001082FF800
       +000000  R4....... 00000001082FF180          R5....... C0F0FFFFE7AC07FF          R6....... 0000000025D8D058
       +000018  R7....... 0000000025700356          R8....... 0000000000006FE8          R9....... 0000000025700410
       +000030  R10...... 0000000025700620          R11...... 0000000108415310          R12...... 0000000100005300
       +000048  R13...... 0000000000006F50          R14...... 0000000025753360          R15...... 000000000000001F
       +000060  reserved. 0000000700006FE8          reserved. 0000000025700410          HPTRAN... 0000000100002000
       +000078  reserved. 0000000108415310
     DSA for main: 00000001082FF980
       +000000  R4....... 00000001082FF280          R5....... 0000000108300090          R6....... 00000000257000D0
       +000018  R7....... 000000002570435E          R8....... 0000000000006FE8          R9....... 0000000025701548
       +000030  R10...... 0000000025700620          R11...... 0000000108415310          R12...... 0000000100005300
       +000048  R13...... 0000000000006F50          R14...... 0000000025753360          R15...... 000000000000001F
       +000060  reserved. 0000000000000000          reserved. 0000000000000000          HPTRAN... 0000000000000000
       +000078  reserved. 0000000000000000
     DSA for CELQINIT: 00000001082FFA80
       +000000  R4....... 00000001082FF760          R5....... 0000000000000000          R6....... 0000000025703010
       +000018  R7....... 00000000257044F8          R8....... 0000000000000000          R9....... 0000000000000000
       +000030  R10...... 0000000000000000          R11...... 0000000000000000          R12...... 0000000000000000
       +000048  R13...... 0000000000000000          R14...... 0000000000000000          R15...... 0000000000000000
       +000060  reserved. 0000000000000000          reserved. 0000000000000000          HPTRAN... 0000000000000000
       +000078  reserved. 0000000000000000

   Storage for Active Routines:

     DSA frame(00000001082FEDC0)
       +0800 00000001082FF5C0  00000001 082FEF00 00000000 25D77E10  |............P=.|
       +0810 00000001082FF5D0  00000000 25C1FFE0 00000000 25D8A0F2  |.....A.......Q.2|
       +0820 00000001082FF5E0  00000000 25796F40 00000000 25D8A110  |......? .....Q..|
       +0830 00000001082FF5F0  00000001 082FF880 00000000 00000000  |......8.........|
       +0840 00000001082FF600  00000001 00007AC0 00000001 082FF180  |......:.......1.|
       +0850 00000001082FF610  00000001 0000B238 00000000 25D8D048  |.............Q..|
       +0860 00000001082FF620  00000000 25AA5FD6 00000000 00000000  |......^O........|
       +0870 00000001082FF630  00000000 25D71580 00000001 00007AC0  |.....P........:.|
       +0880 00000001082FF640  00000001 082FF6A0 00000000 25C20719  |......6......B..|
       +0890 00000001082FF650  00000001 082FF690 00000000 00000000  |......6.........|
```

Figure 170. Example dump from sample C routine (Part 1 of 4)

```
  +08A0 00000001082FF660  00000000 00000000 00000000 00000000  |................|
  +08B0 00000001082FF670  00000000 00000000 00000001 082FF75C  |.............7*|
  +08C0 00000001082FF680  00000000 25D8D0E0 00000000 25D8D0C8  |.....Q.......Q.H|
  +08D0 00000001082FF690  00010C7B 49C3C5C5 00000000 00000000  |...#.CEE........|
  +08E0 00000001082FF6A0  E38889A2 4089A240 8140A281 94979385  |This is a sample|
  +08F0 00000001082FF6B0  4084A494 97404040 40404040 40404040  | dump           |
  +0900 00000001082FF6C0  40404040 40404040 40404040 40404040  |                |
  +0910 00000001082FF6D0 - +00092F 00000001082FF6EF            same as above
  +0930 00000001082FF6F0  00000001 083012D0 00000000 00000020  |................|

DSA frame(00000001082FEF00)
  +0800 00000001082FF700  00000001 082FF000 00000001 083012E0  |......0.........|
  +0810 00000001082FF710  00000000 25D8A0D0 00000000 2579703E  |.....Q..........|
  +0820 00000001082FF720  00000000 25796F40 00000001 082FF800  |......? .....8..|
  +0830 00000001082FF730  00000001 082FF880 00000000 00000000  |......8.........|
  +0840 00000001082FF740  00000001 00007AC0 00000001 082FF180  |......:.......1.|
  +0850 00000001082FF750  00000001 0000B238 00000000 25D8D048  |.............Q..|
  +0860 00000001082FF760  00000000 180F58FF 001007FF 00000000  |................|
  +0870 00000001082FF770  00000001 082FF920 00000000 00000000  |......9.........|
  +0880 00000001082FF780  00000000 25D8A110 00000001 00007AC0  |.....Q........:.|
  +0890 00000001082FF790  00000001 00007AC0 00000001 082FF85C  |......:.......8*|
  +08A0 00000001082FF7A0  00000001 082FF8E0 00000001 082FF8E8  |......8.......8Y|
  +08B0 00000001082FF7B0  00000001 082FF8F0 00000000 25D67E10  |......80.....O=.|
  +08C0 00000001082FF7C0  00000001 08300070 00000001 0000A5E8  |.............vY|
  +08D0 00000001082FF7D0  00000000 25753360 00000000 0000001F  |.......-........|
  +08E0 00000001082FF7E0  40404040 40404040 00000000 00000001  |        ........|
  +08F0 00000001082FF7F0  00000000 00000000 00000001 00000000  |................|

DSA frame(00000001082FF000)
  +0800 00000001082FF800  00000001 082FF180 C0F0FFFF E7AC07FF  |......1..0..X...|
  +0810 00000001082FF810  00000000 25D8D058 00000000 25700356  |.....Q..........|
  +0820 00000001082FF820  00000000 00006FE8 00000000 25700410  |......?Y........|
  +0830 00000001082FF830  00000000 25700620 00000001 08415310  |................|
  +0840 00000001082FF840  00000001 00005300 00000000 00006F50  |.............?&|
  +0850 00000001082FF850  00000000 25753360 00000000 0000001F  |.......-........|
  +0860 00000001082FF860  00000007 00006FE8 00000000 25700410  |......?Y........|
  +0870 00000001082FF870  00000001 00002000 00000001 08415310  |................|
  +0880 00000001082FF880  00000001 082FF180 00000000 25D67E10  |......1......O=.|
  +0890 00000001082FF890  00000000 25940F18 00000000 00000019  |.....m..........|
  +08A0 00000001082FF8A0  00000000 00006FE8 00000000 25700410  |......?Y........|
  +08B0 00000001082FF8B0  00000000 25700620 00000000 25D8A000  |.............Q..|
  +08C0 00000001082FF8C0  00000001 08415378 00000000 25D8A000  |.............Q..|
  +08D0 00000001082FF8D0  00000000 25D8A000 00000001 082FF89C  |.....Q.......8.|
  +08E0 00000001082FF8E0  00000001 083012D0 00000000 25D8D048  |.............Q..|
  +08F0 00000001082FF8F0  00000000 00000000 00000000 00000000  |................|
  +0900 00000001082FF900  00000000 257003F0 00000000 00000000  |.......0........|
  +0910 00000001082FF910  00000000 00000000 58F0C2B8 58F0FFA4  |.........0B..0.u|
  +0920 00000001082FF920  00000001 08300080 00000000 00000000  |................|
  +0930 00000001082FF930  D4D6C4E4 D3C5F140 00000000 00002000  |MODULE1 ........|
  +0940 00000001082FF940  00000000 00000000 00000000 00000000  |................|
  +0950 00000001082FF950 - +00095F 00000001082FF95F            same as above
  +0960 00000001082FF960  00000000 00000008 00000000 00000000  |................|
  +0970 00000001082FF970  00000000 00000000 00000001 00000000  |................|

DSA frame(00000001082FF180)
  +0800 00000001082FF980  00000001 082FF280 00000001 08300090  |......2.........|
  +0810 00000001082FF990  00000000 257000D0 00000000 2570435E  |.............;|
  +0820 00000001082FF9A0  00000000 00006FE8 00000000 25701548  |......?Y........|
  +0830 00000001082FF9B0  00000000 25700620 00000001 08415310  |................|
  +0840 00000001082FF9C0  00000001 00005300 00000000 00006F50  |.............?&|
  +0850 00000001082FF9D0  00000000 25753360 00000000 0000001F  |.......-........|
  +0860 00000001082FF9E0  00000000 00000000 00000000 00000000  |................|
  +0870 00000001082FF9F0 - +00087F 00000001082FF9FF            same as above
  +0880 00000001082FFA00  00000000 25D8D170 00000000 00000020  |.....QJ.........|
  +0890 00000001082FFA10  00000000 25D8D178 00000000 00000000  |.....QJ.........|
  +08A0 00000001082FFA20  00000000 00000000 00000000 00000000  |................|
  +08B0 00000001082FFA30 - +0008BF 00000001082FFA3F            same as above
  +08C0 00000001082FFA40  00000000 25D8D178 00000000 25D873D8  |.....QJ......Q.Q|
  +08D0 00000001082FFA50  00000000 25D88750 00000000 00000000  |.....Qg&........|
  +08E0 00000001082FFA60  00000000 00000000 00000000 00000000  |................|
  +08F0 00000001082FFA70 - +0008FF 00000001082FFA7F            same as above
```

Figure 170. Example dump from sample C routine (Part 2 of 4)

```
   DSA frame(00000001082FF280)
     +0800 00000001082FFA80  00000001 082FF760 00000000 00000000  |......7-........|
     +0810 00000001082FFA90  00000000 25703010 00000000 257044F8  |............8|
     +0820 00000001082FFAA0  00000000 00000000 00000000 00000000  |................|
     +0830 00000001082FFAB0 - +00087F 00000001082FFAFF             same as above
     +0880 00000001082FFB00  00000001 082FFD08 00000001 082FF760  |..............7-|
     +0890 00000001082FFB10  00000001 00007AC0 00000000 00000000  |......:.........|
     +08A0 00000001082FFB20  00000000 00000000 00000000 00000000  |................|
     +08B0 00000001082FFB30 - +0009FF 00000001082FFC7F             same as above
     +0A00 00000001082FFC80  00000000 00000000 00000001 082FFD08  |................|
     +0A10 00000001082FFC90  00000000 00000000 00000000 00000000  |................|
     +0A20 00000001082FFCA0 - +000A7F 00000001082FFCFF             same as above
     +0A80 00000001082FFD00  00000000 00000000 00000001 00000000  |................|
     +0A90 00000001082FFD10  00000000 00000000 00000000 00000000  |................|
     +0AA0 00000001082FFD20 - +000ADF 00000001082FFD5F             same as above
     +0AE0 00000001082FFD60  00000001 00003C60 00000001 00005300  |.......-........|
     +0AF0 00000001082FFD70  00000001 00007AC0 00000000 00000000  |......:.........|
     +0B00 00000001082FFD80  00000000 00000000 00000000 00000000  |................|
     +0B10 00000001082FFD90 - +000B4F 00000001082FFDCF             same as above
     +0B50 00000001082FFDD0  00000000 00000000 00000001 08300090  |................|
     +0B60 00000001082FFDE0  00000000 00000000 00000000 00000000  |................|
     +0B70 00000001082FFDF0 - +000BAF 00000001082FFE2F             same as above
     +0BB0 00000001082FFE30  00000000 00000000 00000001 08300090  |................|
     +0BC0 00000001082FFE40  00000000 00000001 00000001 08415320  |..............|
     +0BD0 00000001082FFE50  00000001 08413430 00000001 082FF280  |..............2.|
     +0BE0 00000001082FFE60  00000000 25704444 00000000 257000D0  |................|
     +0BF0 00000001082FFE70  00000000 00000098 00000000 00000000  |.......q........|
     +0C00 00000001082FFE80  00000000 00000000 00000000 00000000  |................|
     +0C10 00000001082FFE90 - +000CDF 00000001082FFF5F             same as above

 Control Blocks Associated with the Thread:
   CAA(0000000100007AC0)
     +0000 0000000100007AC0  00000000 00000000 00000000 00000000  |................|
     +0010 0000000100007AD0 - +0002AF 0000000100007D6F             same as above
     +02B0 0000000100007D70  00008000 00000000 00000000 00000000  |................|
     +02C0 0000000100007D80  00000000 00000000 00000000 00000000  |................|
     +02D0 0000000100007D90 - +00030F 0000000100007DCF             same as above
     +0310 0000000100007DD0  00000001 0000B918 00000000 00000000  |................|
     +0320 0000000100007DE0  00000001 00005558 00000000 00000000  |................|
     +0330 0000000100007DF0  00000001 00008E58 00000000 25D8D048  |............Q..|
     +0340 0000000100007E00  00000001 00008630 00000001 0000A498  |......f.......uq|
     +0350 0000000100007E10  00000000 00000000 00000001 00008828  |..............h.|
     +0360 0000000100007E20  03030210 15040000 00000000 257D2FC6  |............'.F|
     +0370 0000000100007E30  00000000 00000000 00000001 00007668  |................|
     +0380 0000000100007E40  00000001 082FF760 00000001 00005300  |......7-........|
     +0390 0000000100007E50  00000001 00003C60 00000001 00007AA8  |.......-......:y|
     +03A0 0000000100007E60  00000001 00007AC0 00000000 00000000  |......:.........|
     +03B0 0000000100007E70  00000000 00000004 00000000 00000000  |................|
     +03C0 0000000100007E80  00000000 00000000 00000000 00000000  |................|
     +03D0 0000000100007E90  25AC5280 00000000 00000001 000039D0  |................|
     +03E0 0000000100007EA0  00000001 00008478 00000000 00000000  |......d.........|
     +03F0 0000000100007EB0  00000000 00000000 00000000 25770FE0  |................|
     +0400 0000000100007EC0  00000000 00000000 00000000 00000000  |................|
     +0410 0000000100007ED0  00000001 00007ED8 00000001 00000000  |......=Q........|
     +0420 0000000100007EE0  00000000 00000000 00000000 00000000  |................|
     +0430 0000000100007EF0 - +0004BF 0000000100007F7F             same as above
   MATH PARAMETERS:(0000000025D82AD0)
     +0000 0000000025D82AD0  00000000 00000000 00000000 00000000  |................|
     +0010 0000000025D82AE0 - +00001F 0000000025D82AEF             same as above
   Thread Synchronization Queue Element (SQEL)(0000000025D820A0)
     +0000 0000000025D820A0  00000000 00000000 00000000 00000000  |................|
     +0010 0000000025D820B0 - +00002F 0000000025D820CF             same as above
     +0030 0000000025D820D0  00000000 00000000 00000001 00007AC0  |..............:.|
     +0040 0000000025D820E0  00000000 00000000 00000000 00000000  |................|
     +0050 0000000025D820F0 - +00006F 0000000025D8210F             same as above
   DUMMY DSA: 00000001082FFF60
     +000000  R4....... 0000000000000000           R5....... 0000000000000000           R6....... 0000000000000000
     +000018  R7....... 1111111111111111           R8....... 0000000000000000           R9....... 0000000000000000
     +000030  R10...... 0000000000000000           R11...... 0000000000000000           R12...... 0000000000000000
     +000048  R13...... 0000000000000000           R14...... 0000000000000000           R15...... 0000000000000000
     +000060  reserved. 0000000000000000           reserved. 0000000000000000           HPTRAN... 0000000000000000
     +000078  reserved. 0000000000000000
  CEE3DMP called by program unit  (entry point __cdump) at offset +000000000.

  Registers on Entry to CEE3DMP:
    PM....... 0100
    GPR0..... ****************  GPR1..... ****************  GPR2..... ****************  GPR3..... ****************
    GPR4..... 00000001082FEDC0  GPR5..... 00000000257D07CC  GPR6..... 00000000257CCB80  GPR7..... 0000000025C20124
    GPR8..... 0000000025D77E10  GPR9..... 00000001082FF6A0  GPR10.... 0000000025D8A110  GPR11.... 0000000000000001
    GPR12.... 0000000100007AC0  GPR13.... 00000001082FF180  GPR14.... 000000010000B238  GPR15.... 0000000025D8D048
    GPREG STORAGE:
      Storage around GPR0  is invalid.
```

Figure 170. Example dump from sample C routine (Part 3 of 4)

```
Storage around GPR1  is invalid.
Storage around GPR2  is invalid.
Storage around GPR3  is invalid.

Storage around GPR4 (00000001082FEDC0)
  +0800 00000001082FF5C0  00000001 082FEF00 00000000 25D77E10  |............P=.|
  +0810 00000001082FF5D0  00000000 25C1FFE0 00000000 25D8A0F2  |.....A.......Q.2|
  +0820 00000001082FF5E0  00000000 25796F40 00000000 25D8A110  |......? .....Q..|
  +0830 00000001082FF5F0  00000001 082FF880 00000000 00000000  |......8.........|
  +0840 00000001082FF600  00000001 00007AC0 00000001 082FF180  |......:.......1.|
  +0850 00000001082FF610  00000001 0000B238 00000000 25D8D048  |............Q..|
Storage around GPR5 (00000000257D07CC)
  -0020 00000000257D07AC  00000000 00000000 00000000 00000000  |................|
  -0010 00000000257D07BC - +FFFFFF 00000000257D07CB             same as above
  +0000 00000000257D07CC  257CCB80 00000F38 00000F38 00000000  |.@..............|
  +0010 00000000257D07DC  257D0880 00000000 257D0874 00000000  |.'.......'......|
  +0020 00000000257D07EC  257D0850 00000000 257D0850 00000000  |.'.&.....'.&....|
  +0030 00000000257D07FC - +00003F 00000000257D080B             same as above
Storage around GPR6 (00000000257CCB80)
  -0020 00000000257CCB60  F0F9F0F0 0005C4F1 F9F0F200 00000000  |0900..D1902.....|
  -0010 00000000257CCB70  00C300C5 00C500F1 00003DE8 00000740  |.C.E.E.1...Y...  |
  +0000 00000000257CCB80  EB134880 0024B904 0004A74B F8C0EB5F  |..........x.8..^|
  +0010 00000000257CCB90  48080024 E3040800 00244190 4FFFEB13  |....T.......|...|
  +0020 00000000257CCBA0  49800024 E38004B8 0017E380 80580004  |....T.....T.....|
  +0030 00000000257CCBB0  E3C08008 0004A788 00504080 4C6C1F88  |T.....xh.& .<%.h|
Storage around GPR7 (0000000025C20124)
  -0020 0000000025C20104  C0600000 024E4470 6060C070 00000249  |.-...+..--......|
  -0010 0000000025C20114  EB568000 00044130 48D04120 71790D76  |.............   |
  +0000 0000000025C20124  07004800 48D0B914 0000A70E 0003A784  |.........x...xd|
  +0010 0000000025C20134  FF75A70E 0005A784 FF7112BB A774FF6E  |..x...xd....x..>|
  +0020 0000000025C20144  A7390000 EB4B4800 000447F0 70020000  |x.........0....|
  +0030 0000000025C20154  00000000 00C300C5 00C500F1 00000838  |.....C.E.E.1....|

Storage around GPR8 (0000000025D77E10)
  -0020 0000000025D77DF0  00000000 25D78EB0 00000000 25C2ED28  |.....P.......B..|
  -0010 0000000025D77E00  00000000 25D76E20 00000000 25BBADC8  |.....P>........H|
  +0000 0000000025D77E10  00000000 257D07CC 00000000 257CCB80  |.....'.......@..|
  +0010 0000000025D77E20  00000000 25BB7E98 00000000 25BB7E98  |......=q......=q|
  +0020 0000000025D77E30  00000000 257D69BC 00000000 257D6560  |.....'.......'.-|
  +0030 0000000025D77E40  0001018F 49C3C5C5 00000000 00000000  |.....CEE........|
Storage around GPR9 (00000001082FF6A0)
  -0020 00000001082FF680  00000000 25D8D0E0 00000000 25D8D0C8  |.....Q.......Q.H|
  -0010 00000001082FF690  00010C7B 49C3C5C5 00000000 00000000  |...#.CEE........|
  +0000 00000001082FF6A0  E38889A2 4089A240 8140A281 94979385  |This is a sample|
  +0010 00000001082FF6B0  4084A494 97404040 40404040 40404040  | dump           |
  +0020 00000001082FF6C0  40404040 40404040 40404040 40404040  |                |
  +0030 00000001082FF6D0 - +00003F 00000001082FF6DF             same as above
Storage around GPR10(0000000025D8A110)
  -0020 0000000025D8A0F0  0D760700 A7390000 E3704818 0004EB89  |....x...T......i|
  -0010 0000000025D8A100  48200004 41404100 47F07002 00000000  |..... ...0......|
  +0000 0000000025D8A110  E38889A2 4089A240 8140A281 94979385  |This is a sample|
  +0010 0000000025D8A120  4084A494 97000000 02CE07C0 00000068  | dump...........|
  +0020 0000000025D8A130  80800281 00000503 0000003C 01000000  |...a...........|
  +0030 0000000025D8A140  000586A4 9583F140 FFFFFF98 00000000  |..func1 ...q....|
Storage around GPR11(0000000000000001)
  -0001 0000000000000000  Inaccessible storage.
  +000F 0000000000000010  Inaccessible storage.
  +001F 0000000000000020  Inaccessible storage.
  +002F 0000000000000030  Inaccessible storage.
  +003F 0000000000000040  Inaccessible storage.
  +004F 0000000000000050  Inaccessible storage.
Storage around GPR12(0000000100007AC0)
  -0020 0000000100007AA0  00000000 00000000 C3C5C5C3 C1C14040  |........CEECAA  |
  -0010 0000000100007AB0  00000000 00000000 00000000 00000000  |................|
  +0000 0000000100007AC0 - +00003F 0000000100007AFF             same as above
Storage around GPR13(00000001082FF180)
  -0020 00000001082FF160  00000001 00000000 00000000 25853F8C  |............e..|
  -0010 00000001082FF170  00000000 25D88AC0 00000000 25C20719  |.....Q.......B..|
  +0000 00000001082FF180  084134F0 25D82118 082FE740 25853F44  |...0.Q....X .e..|
  +0010 00000001082FF190  08413550 00000020 000044E8 25D8218C  |...&.......Y.Q..|
  +0020 00000001082FF1A0  25D8A000 00007AC0 082FF8C8 00000000  |.Q....:...8H....|
  +0030 00000001082FF1B0  00000000 00000000 00000000 00000D90  |................|
Storage around GPR14(000000010000B238)
  -0020 0000000010000B218  00000000 00000000 00000000 00000000  |................|
  -0010 0000000010000B228 - +00003F 0000000010000B277             same as above
Storage around GPR15(0000000025D8D048)
  -0020 0000000025D8D028  00008000 00007E78 00000000 00000000  |......=.........|
  -0010 0000000025D8D038  00000000 00000000 25D8D000 00000128  |.........Q......|
  +0000 0000000025D8D048  00C300C5 00C500F1 00000038 00000184  |.C.E.E.1.......d|
  +0010 0000000025D8D058  EB134880 0024B904 0014EB4F 46800024  |..........|....|
  +0020 0000000025D8D068  A74BFE80 41940800 B90400F6 A7FBFFF0  |x....m.....6x..0|
  +0030 0000000025D8D078  E3806100 001707F8 02CE0FFF 00000024  |T./....8........|
```

Figure 170. Example dump from sample C routine (Part 4 of 4)

C/C++ contents of the Language Environment trace tables

Language Environment provides four C/C++ trace table entry types that contain character data:

- Trace entry 5 occurs when a C library function is called.
- Trace entry 6 occurs when a C library function returns.

The format for trace table entry 5 is:

```
NameOfCallingFunction
-->(xxxx) NameOfCalledFunction<(input_parameters)>
```

or, for called functions calloc, free, malloc, and realloc:

```
NameOfCallingFunction
—->(xxx) NameOfCalledFunction<(input_parameters)>
```

In addition, when the call is due to one of these C++ operators:

```
-new,
-new[],
-delete,
-delete[]
```

then the C++ operator will appear and the format becomes:

```
NameOfCallingFunction
—->(xxx) NameOfCalledFunction<(input_parameters)>

NameOfC++Operator
```

The `input_parameters` and `NameOfC++Operator` only appear for the appropriate functions. The angle brackets (<>) indicate that this information does not always appear.

The format for trace table entry 6 is:

```
    <--(xxxx)
R1=xxxxxxxxxxxxxxxx R2=xxxxxxxxxxxxxxxx R3=xxxxxxxxxxxxxxxx
ERRNO=xxxxxxxx ERRNO2=xxxxxxxx
```

In the entry types, `(xxx)` and `(xxxx)` are numbers associated with the called library function and are used to associate a specific entry record with its corresponding return record.

For entry types 5 and 6, the number will be the same as the number of the function as seen in the C run-time library definition side-deck, SCEELIB dataset member CELQS003, on the IMPORT statement for that function.

Figure 171 on page 499 shows an XPLINK trace which has examples of the trace entries 5 and 6.

```
Language Environment Trace Table:

   Most recent trace entry is at displacement: 000680

     Displacement                    Trace Entry in Hexadecimal                          Trace Entry in EBCDIC
     ------------ ------------------------------------------------------------------  --------------------------------
       +000000    Time 21.58.20.255215    Date 2004.04.20    Thread ID... 8000000000000000
       +000010    Member ID.... 03    Flags..... 000000    Entry Type..... 00000005
       +000018    86899385 82A4867A 7A96A585 99869396  A64D8995 A35D4040 40404040 40404040  |filebuf::overflow(int)          |
       +000038    60606E4D F0F1F5F6 5D406D6D 85999995  964D5D40 40404040 40404040 40404040  |-->(0156) __errno()             |
       +000058    40404040 40404040 40404040 40404040  40404040 40404040 40404040 40404040  |                                |
       +000078    40404040 40404040                                                        |                                |

       +000080    Time 21.58.20.255216    Date 2004.04.20    Thread ID... 8000000000000000
       +000090    Member ID.... 03    Flags..... 000000    Entry Type..... 00000006
       +000098    4C60604D F0F1F5F6 5D40D9F1 7EF0F0F0  F0F0F0F0 F1F0F8F7 F1C1C6F8 F040D9F2  |<--(0156) R1=0000000010871AF80 R2|
       +0000B8    7EF0F0F0 F0F0F0F0 F0F2F5F5 F2C2F8C2  F840D9F3 7EF0F0F0 F0F0F0F0 F1F0F0F0  |=0000000002552B8B8 R3=00000001000|
       +0000D8    F0F7F5F5 F840C5D9 D9D5D67E F0F0F0F0  F0F0F0F0 40C5D9D9 D5D6F27E F0F0F0F0  |07558 ERRNO=00000000 ERRNO2=0000|
       +0000F8    F0F0F0F0 00000000                                                        |0000....                        |

       +000100    Time 21.58.20.255216    Date 2004.04.20    Thread ID... 8000000000000000
       +000110    Member ID.... 03    Flags..... 000000    Entry Type..... 00000005
       +000118    86899385 82A4867A 7A96A585 99869396  A64D8995 A35D4040 40404040 40404040  |filebuf::overflow(int)          |
       +000138    60606E4D F0F1F5F6 5D406D6D 85999995  964D5D40 40404040 40404040 40404040  |-->(0156) __errno()             |
       +000158    40404040 40404040 40404040 40404040  40404040 40404040 40404040 40404040  |                                |
       +000178    40404040 40404040                                                        |                                |

       +000180    Time 21.58.20.255217    Date 2004.04.20    Thread ID... 8000000000000000
       +000190    Member ID.... 03    Flags..... 000000    Entry Type..... 00000006
       +000198    4C60604D F0F1F5F6 5D40D9F1 7EF0F0F0  F0F0F0F0 F1F0F8F7 F1C1C6F8 F040D9F2  |<--(0156) R1=0000000010871AF80 R2|
       +0001B8    7EF0F0F0 F0F0F0F0 F0F2F5F5 F2C2F8C2  F840D9F3 7EF0F0F0 F0F0F0F0 F1F0F0F0  |=0000000002552B8B8 R3=00000001000|
       +0001D8    F0F7F5F5 F840C5D9 D9D5D67E F0F0F0F0  F0F0F0F0 40C5D9D9 D5D6F27E F0F0F0F0  |07558 ERRNO=00000000 ERRNO2=0000|
       +0001F8    F0F0F0F0 00000000                                                        |0000....                        |

       +000200    Time 21.58.20.255218    Date 2004.04.20    Thread ID... 8000000000000000
       +000210    Member ID.... 03    Flags..... 000000    Entry Type..... 00000005
       +000218    86899385 82A4867A 7A96A585 99869396  A64D8995 A35D4040 40404040 40404040  |filebuf::overflow(int)          |
       +000238    60606E4D F0F0F7C5 5D4086A6 9989A385  4D5D4040 40404040 40404040 40404040  |-->(007E) fwrite()              |
       +000258    40404040 40404040 40404040 40404040  40404040 40404040 40404040 40404040  |                                |
       +000278    40404040 40404040                                                        |                                |

       +000280    Time 21.58.20.255242    Date 2004.04.20    Thread ID... 8000000000000000
       +000290    Member ID.... 03    Flags..... 000000    Entry Type..... 00000006
       +000298    4C60604D F0F0F7C5 5D40D9F1 7EF0F0F0  F0F0F0F0 F1F0F0F0 F0F8C2F3 F040D9F2  |<--(007E) R1=0000000100008B30 R2|
       +0002B8    7EF0F0F0 F0F0F0F0 F0F2F5F5 F2C2F8C2  F840D9F3 7EF0F0F0 F0F0F0F0 F0F0F0F0  |=0000000002552B8B8 R3=00000000000|
       +0002D8    F0F0F0F0 C540C5D9 D9D5D67E F0F0F0F0  F0F0F0F0 40C5D9D9 D5D6F27E F0F0F0F0  |0000E ERRNO=00000000 ERRNO2=0000|
       +0002F8    F0F0F0F0 00000000                                                        |0000....                        |

       +000300    Time 21.58.20.255243    Date 2004.04.20    Thread ID... 8000000000000000
       +000310    Member ID.... 03    Flags..... 000000    Entry Type..... 00000005
       +000318    86899385 82A4867A 7A96A585 99869396  A64D8995 A35D4040 40404040 40404040  |filebuf::overflow(int)          |
       +000338    60606E4D F0F0F6F8 5D408686 93A4A288  4D5D4040 40404040 40404040 40404040  |-->(0068) fflush()              |
       +000358    40404040 40404040 40404040 40404040  40404040 40404040 40404040 40404040  |                                |
       +000378    40404040 40404040                                                        |                                |

       +000380    Time 21.58.20.255244    Date 2004.04.20    Thread ID... 8000000000000000
       +000390    Member ID.... 03    Flags..... 000000    Entry Type..... 00000006
       +000398    4C60604D F0F0F6F8 5D40D9F1 7EF0F0F0  F0F0F0F0 F1F0F0F0 F0F8F4F8 F040D9F2  |<--(0068) R1=0000000100008480 R2|
       +0003B8    7EF0F0F0 F0F0F0F0 F0F2F5F5 F2C2F8C2  F840D9F3 7EF0F0F0 F0F0F0F0 F0F0F0F0  |=0000000002552B8B8 R3=00000000000|
       +0003D8    F0F0F0F0 F040C5D9 D9D5D67E F0F0F0F0  F0F0F0F0 40C5D9D9 D5D6F27E F0F0F0F0  |00000 ERRNO=00000000 ERRNO2=0000|
       +0003F8    F0F0F0F0 00000000                                                        |0000....                        |

       +000400    Time 21.58.20.255245    Date 2004.04.20    Thread ID... 8000000000000000
       +000410    Member ID.... 03    Flags..... 000000    Entry Type..... 00000005
       +000418    86899385 82A4867A 7A96A585 99869396  A64D8995 A35D4040 40404040 40404040  |filebuf::overflow(int)          |
       +000438    60606E4D F0F1F5F6 5D406D6D 85999995  964D5D40 40404040 40404040 40404040  |-->(0156) __errno()             |
       +000458    40404040 40404040 40404040 40404040  40404040 40404040 40404040 40404040  |                                |
       +000478    40404040 40404040                                                        |                                |
```

Figure 171. Trace table with XPLINK trace table entries 5 and 6. (Part 1 of 2)

```
      +000480    Time 21.58.20.255245    Date 2004.04.20    Thread ID... 8000000000000000
      +000490    Member ID.... 03    Flags..... 000000    Entry Type..... 00000006
      +000498    4C60604D F0F1F5F6 5D40D9F1 7EF0F0F0  F0F0F0F0 F1F0F8F7 F1C1C6F8 F040D9F2  <--(0156) R1=000000010871AF80 R2
      +0004B8    7EF0F0F0 F0F0F0F0 F0F2F5F5 F2C2F8C2  F840D9F3 7EF0F0F0 F0F0F0F0 F1F0F0F0  =000000002552B8B8 R3=00000001000
      +0004D8    F0F7F5F5 F840C5D9 D9D5D67E F0F0F0F0  F0F0F0F0 40C5D9D9 D5D6F27E F0F0F0F0  07558 ERRNO=00000000 ERRNO2=0000
      +0004F8    F0F0F0F0 00000000                                                        0000....

      +000500    Time 21.58.20.255246    Date 2004.04.20    Thread ID... 8000000000000000
      +000510    Member ID.... 03    Flags..... 000000    Entry Type..... 00000005
      +000518    86899385 82A4867A 7A96A585 99869396  A64D8995 A35D4040 40404040 40404040  filebuf::overflow(int)
      +000538    60606E4D F0F1F5F6 5D406D6D 85999995  964D5D40 40404040 40404040 40404040  -->(0156) __errno()
      +000558    40404040 40404040 40404040 40404040  40404040 40404040 40404040 40404040
      +000578    40404040 40404040

      +000580    Time 21.58.20.255247    Date 2004.04.20    Thread ID... 8000000000000000
      +000590    Member ID.... 03    Flags..... 000000    Entry Type..... 00000006
      +000598    4C60604D F0F1F5F6 5D40D9F1 7EF0F0F0  F0F0F0F0 F1F0F8F7 F1C1C6F8 F040D9F2  <--(0156) R1=000000010871AF80 R2
      +0005B8    7EF0F0F0 F0F0F0F0 F0F2F5F5 F2C2F8C2  F840D9F3 7EF0F0F0 F0F0F0F0 F1F0F0F0  =000000002552B8B8 R3=00000001000
      +0005D8    F0F7F5F5 F840C5D9 D9D5D67E F0F0F0F0  F0F0F0F0 40C5D9D9 D5D6F27E F0F0F0F0  07558 ERRNO=00000000 ERRNO2=0000
      +0005F8    F0F0F0F0 00000000                                                        0000....

      +000600    Time 21.58.20.255252    Date 2004.04.20    Thread ID... 8000000000000000
      +000610    Member ID.... 03    Flags..... 000000    Entry Type..... 00000005
      +000618    E2A38183 924C8995 A36E7A7A 97A4A288  4D8995A3 5D404040 40404040 40404040  Stack<int>::push(int)
      +000638    60606E4D F0F0F5F6 5D409481 93939683  4DF1F65D 40404040 40404040 40404040  -->(0056) malloc(16)
      +000658    40404040 40404040 40404040 40404040  40404040 40404040 40404040 40404040
      +000678    9585A640 40404040                                                        new

  >>> +000680    Time 21.58.20.255253    Date 2004.04.20    Thread ID... 8000000000000000
      +000690    Member ID.... 03    Flags..... 000000    Entry Type..... 00000006
      +000698    4C60604D F0F0F5F6 5D40D9F1 7EF0F0F0  F0F0F0F0 F1F0F8F3 F0C5C1F5 F040D9F2  <--(0056) R1=000000010830EA50 R2
      +0006B8    7EF0F0F0 F0F0F0F0 F0F2F5F5 F2C2F8C2  F840D9F3 7EF0F0F0 F0F0F0F0 F1F0F8F3  =000000002552B8B8 R3=00000001083
      +0006D8    F0C5C1F5 F040C5D9 D9D5D67E F0F0F0F0  F0F0F0F0 40C5D9D9 D5D6F27E F0F0F0F0  0EA50 ERRNO=00000000 ERRNO2=0000
      +0006F8    F0F0F0F0 00000000                                                        0000....
```

Figure 171. Trace table with XPLINK trace table entries 5 and 6. (Part 2 of 2)

For more information about the Language Environment trace table format, see “Understanding the trace table entry (TTE)” on page 466.

Debugging examples of C/C++ routines

This section contains examples that demonstrate the debugging process for C/C++ routines. Important areas of the output are highlighted. Data unnecessary to the debugging examples has been replaced by ellipses.

Divide-by-zero error

Figure 172 on page 501 illustrates a C program that contains a divide-by-zero error. The code was compiled with `RENT` so static and external variables need to be calculated from the WSA field. The code was compiled with `LP64`, `GONUM` (`to produce statement numbers`) and `XREF`, `LIST` and `OFFSET` to generate a listing, which is used to calculate addresses of functions and data. The code was processed by the binder with `MAP` to generate a binder map, which is used to calculate the addresses of static and external variables. The program was created with the option TERMTHDACT(UADUMP) which produced both a Language environment dump and a system dump.

```
/* C Routine with a Divide-by-Zero Error */
#pragma options(noinline)
#include <stdio.h>
#include <stdlib.h>
#include <errno.h>
int statint = 73;
int fa;
int funcb(int *pp);
int main(void) {
  int aa, bb=1;
  aa = bb;
  aa = funcb(&aa);
  return(aa);
}
int funcb(int *pp) {
  int result;
  fa = *pp;
  result = fa/(statint-73);
  printf("Result = %d\n",result);
  return result;
}
```

Figure 172. C routine with a divide-by-zero error

To debug this routine, use the following steps:

1. Locate the Original Condition message in the Condition Information for Active Routines section of the dump. In this example, the message is `CEE3209S`. The system detected a fixed-point divide exception. This message indicates the error was caused by an attempt to divide by zero. For additional information about CEE3209S, see *z/OS Language Environment Run-Time Messages*.

   The traceback section of the dump indicates that the exception occurred at offset X'52' within function `funcb`. This information is used along with the compiler-generated Pseudo Assembly Listing to determine where the problem occurred.

   If the `GONUMBER` compiler option is specified, statement number information is in the dump. Figure 173 on page 502 shows the generated traceback from the dump.

```
CEE3DMP V1 R8.0: Condition processing resulted in the unhandled condition.         Tue Feb 21 16:50:50 2006            Page:    1

Information for enclave main

  Information for thread 25AC70A000000000

  Traceback:
    DSA       Entry       E  Offset  Statement   Load Mod             Program Unit                   Service  Status
    00000001  CEEHDSP     +00000000              CELQLIB              CEEHDSP                        HLE7730  Call
    00000002  CEEOSIGJ    +0000094E              CELQLIB              CEEOSIGJ                       HLE7730  Call
    00000003  CELQHROD    +0000024E              CELQLIB              CELQHROD                       HLE7730  Call
    00000004  CEEOSIGG    -1D58AE60              CELQLIB              CEEOSIGG                       HLE7730  Call
    00000005  CELQHROD    +0000024E              CELQLIB              CELQHROD                       HLE7730  Call
    00000006  funcb       +00000052  18          CDIVZERO             CDIVZERO                               Exception
    00000007  main        +00000026  12          CDIVZERO             CDIVZERO                               Call
    00000008  CELQINIT    +00001340              CELQLIB              CELQINIT                       HLE7730  Call

    DSA       DSA Addr          E  Addr             PU Addr           PU Offset   Comp Date Attributes
    00000001  00000001082FAAC0  0000000025793E88    0000000025793E88  00000000    20060109  XPLINK  EBCDIC  POSIX  Floating Point
    00000002  00000001082FD3E0  000000002588FE28    000000002588FE28  0000094E    20051214  XPLINK  EBCDIC  POSIX  Floating Point
    00000003  00000001082FDDE0  00000000257B50D8    00000000257B50D8  0000024E    20051214  XPLINK  EBCDIC  POSIX  Floating Point
    00000004  00000001082FE020  00000000258894E0    00000000258894E0  1D58AE60    20051214  XPLINK  EBCDIC  POSIX  Floating Point
    00000005  00000001082FEE40  00000000257B50D8    00000000257B50D8  0000024E    20051214  XPLINK  EBCDIC  POSIX  Floating Point
    00000006  00000001082FF080  0000000025708000    0000000000000000  ********    20060221  XPLINK  EBCDIC  POSIX  IEEE
    00000007  00000001082FF180  0000000025708170    0000000000000000  ********    20060221  XPLINK  EBCDIC  POSIX  IEEE
    00000008  00000001082FF280  000000002570B010    000000002570B010  00001340    20051214  XPLINK  EBCDIC  POSIX  Floating Point

    Fully Qualified Names
    DSA       Entry       Program Unit                                        Load Module
    00000006  funcb       PLPSC://'POSIX.CRTL.C(CDIVZERO)'                    /u/alfcar/tools/CDIVZERO
    00000007  main        PLPSC://'POSIX.CRTL.C(CDIVZERO)'                    /u/alfcar/tools/CDIVZERO

  Condition Information for Active Routines
    Condition Information for PLPSC://'POSIX.CRTL.C(CDIVZERO)' (DSA address 00000001082FF080)
      CIB Address: 00000001082FBE00
      Current Condition:
        CEE0198S The termination of a thread was signaled due to an unhandled condition.
      Original Condition:
        CEE3209S The system detected a fixed-point divide exception (System Completion Code=0C9).
      Location:
        Program Unit: PLPSC://'POSIX.CRTL.C(CDIVZERO)'
        Entry:        funcb Statement: 18 Offset: +00000052
      Machine State:
        ILC..... 0002    Interruption Code..... 0009
        PSW..... 0785240180000000 0000000025708124
        GPR0..... 0000000000000000  GPR1..... 00000001082FFA40  GPR2..... 0000000108414340  GPR3..... 0000000108413430
        GPR4..... 00000001082FF080  GPR5..... 0000000108300060  GPR6..... 0000000000000000  GPR7..... 0000000100000001
        GPR8..... 0000000025700CC8  GPR9..... 00000000257081B8  GPR10.... 0000000025708278  GPR11.... 0000000108414330
        GPR12.... 0000000100005300  GPR13.... 00000000000006F60  GPR14.... 00000000257BF218  GPR15.... 000000000000001F
        FPC...... 00000000
        FPR0..... 4327CCCA  93BCEEF1            FPR1..... 00000000  00000000
        FPR2..... 00000000  00000000            FPR3..... 00000000  00000000
        FPR4..... 3C100000  00000000            FPR5..... 00000000  00000000
        FPR6..... 34100000  00000000            FPR7..... 00000000  00000000
        FPR8..... 00000000  00000000            FPR9..... 00000000  00000000
        FPR10.... 00000000  00000000            FPR11.... 00000000  00000000
        FPR12.... 00000000  00000000            FPR13.... 00000000  00000000
        FPR14.... 00000000  00000000            FPR15.... 00000000  00000000
    Storage dump near condition, beginning at location(0000000025708112)
      +0000 0000000025708112  0004E300 70000014 A70BFFB7 8E600020  |..T.....x....-..|
      +0010 0000000025708122  1D60B904 00075000 48C0E320 48C00014  |.-....&...T.....|
```

Figure 173. Sections of the dump from example C/C++ routine (Part 1 of 2)

```
Parameters, Registers, and Variables for Active Routines:
  funcb (DSA address 00000001082FF080):
    DOWNSTACK DSA
    Saved Registers:
      GPR0..... ****************  GPR1..... ****************  GPR2..... ****************  GPR3..... ****************
      GPR4..... 00000001082FF080  GPR5..... BBBBBBBBBBBBBBBB  GPR6..... 00000000257B50D8  GPR7..... 0000000100000001
      GPR8..... 0000000025700CC8  GPR9..... 00000000257081B8  GPR10.... 0000000025708278  GPR11.... 0000000108414330
      GPR12.... 4040404040404040  GPR13.... 4040404040404040  GPR14.... 4040404040404040  GPR15.... 4040404040404040
  GPREG STORAGE:
    Storage around GPR0  is invalid.
    Storage around GPR1  is invalid.
    Storage around GPR2  is invalid.
    Storage around GPR3  is invalid.
    Storage around GPR4 (00000001082FF080)
      +0800 00000001082FF880  00000001 082FF180 00000001 08300060  |......1........-|
      +0810 00000001082FF890  00000000 25708170 00000000 2570819A  |......a.......a.|
      +0820 00000001082FF8A0  00000000 25700CC8 00000000 25709138  |.......H......j.|
      +0830 00000001082FF8B0  00000000 25708278 00000001 08414330  |......b.........|
      +0840 00000001082FF8C0  00000001 00005300 00000000 00006F60  |..............?-|
      +0850 00000001082FF8D0  00000000 257BF218 00000000 0000001F  |.....#2.........|
```

Figure 173. Sections of the dump from example C/C++ routine (Part 2 of 2)

2. In the traceback, statement number 12, corresponding to DSA 7, refers to line: `aa = funcb(&aa);` in the listing. This is were entry `funcb` is called. Similarly, statement number 18, corresponding to DSA 6, points to line: `result = fa/(statint-73);` in the listing. This line is where the divide by zero exception takes place.
3. Locate the instruction with the divide-by-zero error in the Pseudo Assembly Listing in Figure 174 on page 504.

   The offset (within `funcb`) of the exception from the traceback (X'52') reveals the divide instruction: `DR R6,R0` at that location. Instructions at offsets X'32' through X'58' refer to the `result = fa/(statint-73);` line of the C/C++ routine.

```
 OFFSET OBJECT CODE        LINE#  FILE#    P S E U D O   A S S E M B L Y   L I S T I N G

                           Timestamp and Version Information
 000010  F2F0  F0F6                                    =C'2006'           Compiled Year
 000014  F0F2  F2F1                                    =C'0221'           Compiled Date MMDD
 000018  F1F5  F3F3  F1F5                              =C'153315'         Compiled Time HHMMSS
 00001E  F0F1  F0F8  F0F0                              =C'010800'         Compiler Version
                           Timestamp and Version End

15694A01 V1.8 z/OS XL C                          'POSIX.CRTL.C(CDIVZERO)': funcb              02/21/06 15:33:15   Page   148

 OFFSET OBJECT CODE        LINE#  FILE#    P S E U D O   A S S E M B L Y   L I S T I N G

                           000015 |       *  int funcb(int *pp) {

 000028                                     @2L0     DS    0D
 000028  00C300C5                                    =F'12779717'       XPLink entrypoint marker
 00002C  00C500F1                                    =F'12910833'
 000030  00000108                                    =F'264'
 000034  00000100                                    =F'256'
 000000                    000015 |        funcb    DS    0D
 000000  EB59  4708  0024  000015 |                  STMG  r5,r9,1800(r4)
 000006  A74B  FF00        000015 |                  AGHI  r4,H'-256'
 00000A                    End of Prolog

 00000A  C090  0000  006F  000000 |                  LARL  r9,F'111'
 000010  E310  4980  0024  000015 |                  STG   r1,pp(,r4,2432)
                           000016 |       *    int result;
                           000017 |       *    fa = *pp;
 000016  E360  4980  0004  000017 |                  LG    r6,pp(,r4,2432)
 00001C  E300  6000  0014  000017 |                  LGF   r0,(*)int(,r6,0)
 000022  E360  4808  0004  000017 |                  LG    r6,#Save_ADA_Ptr_2(,r4,2056)
 000028  E360  6000  0004  000017 |                  LG    r6,=A(fa)(,r6,0)
 00002E  5000  6000        000017 |                  ST    r0,fa(,r6,0)
                           000018 |       *    result = fa/(statint-73);
 000032  E360  6000  0014  000018 |                  LGF   r6,fa(,r6,0)
 000038  E370  4808  0004  000018 |                  LG    r7,#Save_ADA_Ptr_2(,r4,2056)
 00003E  E370  7008  0004  000018 |                  LG    r7,=A(statint)(,r7,8)
 000044  E300  7000  0014  000018 |                  LGF   r0,statint(,r7,0)
 00004A  A70B  FFB7        000018 |                  AGHI  r0,H'-73'
 00004E  8E60  0020        000018 |                  SRDA  r6,32
 000052  1D60              000018 |                  DR    r6,r0
 000054  B904  0007        000018 |                  LGR   r0,r7
 000058  5000  48C0        000018 |                  ST    r0,result(,r4,2240)
                           000019 |       *    printf("Result = %d\n",result);
 00005C  E320  48C0  0014  000019 |                  LGF   r2,result(,r4,2240)
 000062  E360  4808  0004  000019 |                  LG    r6,#Save_ADA_Ptr_2(,r4,2056)
 000068  EB56  6010  0004  000019 |                  LMG   r5,r6,=A(printf)(r6,16)
 00006E  B904  0019        000019 |                  LGR   r1,r9
 000072  0D76              000019 |                  BASR  r7,r6
 000074  0700              000019 |                  NOPR  0
                           000020 |       *    return result;
 000076  E330  48C0  0014  000020 |                  LGF   r3,result(,r4,2240)
                           000021 |       *  }
 00007C                    000021 |        @2L3     DS    0H

 00007C                    Start of Epilog
 00007C  E370  4818  0004  000021 |                  LG    r7,2072(,r4)
 000082  EB89  4820  0004  000021 |                  LMG   r8,r9,2080(r4)
 000088  4140  4100        000021 |                  LA    r4,256(,r4)
 00008C  47F0  7002        000021 |                  B     2(,r7)
```

Figure 174. Pseudo assembly listing (Part 1 of 3)

```
                        ***   General purpose registers used: 1111011101000000
                        ***   Floating point  registers used: 1111111100000000
                        ***   Size of register spill area: 128(max) 0(used)
                        ***   Size of dynamic storage: 0
                        ***   Size of executable code: 144


                        000001 |       *  /* C Routine with a Divide-by-Zero Error from LE Debugging Guide */
                        000002 |       *  #pragma options(noinline)
                        000003 |       *  #include <stdio.h>
                        000004 |       *  #include <stdlib.h>
                        000005 |       *  #include <errno.h>
                        000006 |       *  int statint = 73;
                        000007 |       *  int fa;
                        000008 |       *  int funcb(int *pp);
                        000009 |       *  int main(void) {

0000C8                                   @1L0     DS    0D
0000C8  00C300C5                                  =F'12779717'       XPLink entrypoint marker
0000CC  00C500F1                                  =F'12910833'
0000D0  00000090                                  =F'144'
0000D4  00000100                                  =F'256'
000000                  000009 |         main     DS    0D
000000  EB57  4708  0024 000009 |                  STMG  r5,r7,1800(r4)
000006  A74B  FF00       000009 |                  AGHI  r4,H'-256'
00000A                  End of Prolog

                        000010 |       *    int aa, bb=1;
00000A  A709  0001       000010 |                  LGHI  r0,H'1'
00000E  5000  48C4       000010 |                  ST    r0,bb(,r4,2244)
                        000011 |       *    aa = bb;
000012  E300  48C4  0014 000011 |                  LGF   r0,bb(,r4,2244)
000018  5000  48C0       000011 |                  ST    r0,aa(,r4,2240)
                        000012 |       *    aa = funcb(á);
00001C  4110  48C0       000012 |                  LA    r1,aa(,r4,2240)
000020  E350  4808  0004 000012 |                  LG    r5,#Save_ADA_Ptr_1(,r4,2056)
000026  A775  FF9D       000012 |                  BRAS  r7,funcb
00002A  0701             000012 |                  NOPR  1
00002C  B904  0003       000012 |                  LGR   r0,r3
000030  5000  48C0       000012 |                  ST    r0,aa(,r4,2240)
                        000013 |       *    return(aa);
000034  E330  48C0  0014 000013 |                  LGF   r3,aa(,r4,2240)
                        000014 |       *  }
00003A                  000014 |        @1L2     DS    0H

00003A                  Start of Epilog
00003A  E370  4818  0004 000014 |                  LG    r7,2072(,r4)
000040  4140  4100       000014 |                  LA    r4,256(,r4)
000044  47F0  7002       000014 |                  B     2(,r7)

                        ***   General purpose registers used: 1111011100000000
                        ***   Floating point  registers used: 1111111100000000
                        ***   Size of register spill area: 128(max) 0(used)
                        ***   Size of dynamic storage: 0
                        ***   Size of executable code: 72

                        Constant Area
000000  D985A2A4 93A3407E 406C8415 00          |Result = %d..   |


                        PPA1: Entry Point Constants
000000  02                                       =AL1(2)            Version
000001  CE                                       =AL1(206)          CEL signature
000002  07C0                                     =H'1984'           GPR save mask
000004  00000090                                 =A(PPA2-PPA1)
000008  80800281                                 =F'-2139094399'    Flags
00000C  0002                                     =H'2'              Parm length/4
00000E  0503                                     =H'1283'           Prol len/2; alloca reg; R4 change offset/2
000010  00000090                                 =F'144'            Code length
000014  01000000                                 =F'16777216'       Interface mapping flags
000018  0005  ****                               AL2(5),C'funcb'
000020  FFFFFEF8                                 =F'-264'           Offset to Entry Point Marker
                        PPA1 End
```

Figure 174. Pseudo assembly listing (Part 2 of 3)

```
                        PPA1: Entry Point Constants
000000  02                                  =AL1(2)            Version
000001  CE                                  =AL1(206)          CEL signature
000002  0700                                =H'1792'           GPR save mask
000004  00000068                            =A(PPA2-PPA1)
000008  80800281                            =F'-2139094399'    Flags
00000C  0000                                =H'0'              Parm length/4
00000E  0503                                =H'1283'           Prol len/2; alloca reg; R4 change offset/2
000010  00000048                            =F'72'             Code length
000014  01000000                            =F'16777216'       Interface mapping flags
000018  0004  ****                          AL2(4),C'main'
000020  FFFFFF70                            =F'-144'           Offset to Entry Point Marker
                        PPA1 End


                        PPA4: Compile Unit Debug Block
000000  80000000                            =F'-2147483648'    Additional Flags
000004  84060238                            =F'-2079981000'    Flags
000008  0000000000000000                    =D'0'              R/O static Offset
000010  0000000000000000                    =D'0'              R/W static Offset
000018  0000000000000000                    =D'0'              Symbol Offset Table Offset
000020  FFFFFFFFFFFFFE80                    =D'-384'           CSECT Start Offset
000028  0000000000000000                    =D'0'              Code CSECT Size
000030  FFFFFFFFFFFFFE88                    =D'-376'           No program region
000038  00000000                            =F'0'              DWARF File Name
00003C  ****                                C''
                        PPA4 End

                        PPA2: Compile Unit Block
000000  0300  2204                          =F'50340356'       Flags
000004  FFFF  FE40                          =A(CELQSTRT-PPA2)
000008  FFFF  FFC0                          =A(PPA4-PPA2)
00000C  FFFF  FE50                          =A(TIMESTMP-PPA2)
000010  0000  0000                          =F'0'              No primary
000014  9140  0000                          =F'-1858076672'    Flags
                        PPA2 End
```

Figure 174. Pseudo assembly listing (Part 3 of 3)

4. Verify the value of the divisor `statint`. The procedure specified below is to be used for determining the value of static variables only. If the divisor is an automatic variable, there is a different procedure for finding the value of the variable.

   Because this routine was compiled with the RENT option, find the WSA address in the Enclave Control Blocks section of the dump. In this example, this address is X'108300050'. Figure 175 shows the WSA address.

```
Enclave Control Blocks:
  .
  .
  .
  DLL Information:
  WSA Addr          Module Addr          Thread ID         Use Count  Name
  0000000108300050                                         00000001   main
```

Figure 175. C/C++ CAA information in dump

5. Routines compiled with the RENT option must also be processed by the binder. The binder produces the Writable Static Map. Find the offset of `statint` in the Writable Static Map in Figure 176 on page 507. In this example, the offset is X'30'.

```
---------------
CLASS  C_WSA64          LENGTH =       38  ATTRIBUTES = MRG, DEFER , RMODE= 64
                        OFFSET =        0 IN SEGMENT 002       ALIGN = QDWORD
---------------

           CLASS
          OFFSET  NAME                TYPE    LENGTH   SECTION
               0  $PRIV000012      PART            10
              10  CDIVZERO#S       PART            20  CDIVZERO#C
              30  statint          PART             4  statint
              34  fa               PART             4  fa
```

Figure 176. Writable static map

6. Add the WSA address of X'108300050' to the offset of `statint`. The result is X'108300080'. This is the address of the variable `statint`, which is in the writable static area.
7. Use IPCS to display the writeable static area in the system dump. The value at location X'108300080' is X'49' (that is, `statint` is 73), and hence the fixed-point divide exception.

```
LIST 0000000108300050 LEN(X'00000100')

LIST 01_08300050. ASID(X'0015') LENGTH(X'0100') AREA
_8300050. C36DE6E2 C1F6F440 40404040 40404040 |C_WSA64         |
_8300060. 00000001 08300084 00000001 08300080 |.......d........|
_8300070. 00000000 000000C0 00000000 2548D200 |.......{......K.|
_8300080. 00000049 00000001 00000000 00000000 |................|
_8300090 LENGTH(X'10')==>All bytes contain X'00'
_83000A0. 00000001 08300000 00000000 00000220 |................|
_83000B0. 00000001 083002D0 00000001 083004B8 |.......}........|
_83000C0. 00000001 083004F5 00000001 08300532 |.......5........|
_83000D0. 00000001 0830056F 00000001 083005AC |.......?........|
_83000E0. 00000001 083005E9 00000001 08300626 |.......Z........|
_83000F0. 00000001 08300663 00000001 08300A70 |................|
_8300100. 00000001 08300AAD 00000000 00000000 |................|
_8300110 LENGTH(X'40')==>All bytes contain X'00'
```

Figure 177. IPCS storage display of the writeable static area

Calling a nonexistent function

Figure 178 on page 508 demonstrates the error of calling a nonexistent function. This routine was compiled with the compiler options LP64, GONUM, LIST, OFFSET, and RENT and was run with the option TERMTHDACT(UADUMP).

```
/* C/C++ Example of Calling a Nonexistent Subroutine     */
/*       from LE Debugging Guide                         */
#pragma options(noinline)
#include <stdio.h>
#include <stdlib.h>
#include <errno.h>
#include <signal.h>
void funca(int* aa);
int (*func_ptr)(void)=0;
int main(void) {
  int aa;
  funca(&aa);
  printf("result of funca = %d\n",aa);
  return;
}
void funca(int* aa) {
  *aa = func_ptr();
  return;
}
```

Figure 178. C/C++ example of calling a nonexistent subroutine

To debug this routine, use the following steps:

1. Locate the Original Condition message in the Condition Information for Active Routines section of the dump, shown in Figure 179 on page 509. In this example, the message is `CEE3201S The system detected an operation exception (System Completion Code=0C1).` This message suggests that the error was caused by an attempt to branch to an unknown address. For additional information about CEE3201S, see *z/OS Language Environment Run-Time Messages*.

   The Location section of the dump indicates that the exception occurred at offset X'-209000D0'' within function `funca` and that there may have been a bad branch from statement 17 offset X'+00000036'' within function `funca`. The negative offset indicates that the offset cannot be used to locate the instruction that caused the error. Another indication of bad data is the value of X'00000002' in the instruction address of the PSW shown in the Condition Information section. This address indicates that an instruction in the routine branched outside the bounds of the routine.

   In the traceback, the statement number displayed for entry 'main' points to line 12 in the source code shown in Figure 178. This line contains the statement ″funca(&aa); ″ in which entry 'funca' is called. As message CEE3841I explains, for entry 'funca' no statement number could be displayed. In this example, this problem is caused because 'funca' has an invalid offset. For further information about this message see*z/OS Language Environment Run-Time Messages*.

```
CEE3DMP V1 R9.0: Condition processing resulted in the unhandled condition.         Mon Jan 22 16:39:06 2007            Page:    1
ASID: 00CC   Job ID: JOB04367   Job name: QEXIST     Step name: STEP1      UserID: HEALY

CEE3845I CEEDUMP Processing started.

Information for enclave main

  Information for thread 8000000000000000

  Traceback:
    DSA   Entry       E  Offset  Statement   Load Mod             Program Unit                   Service  Status
    1     CEEHDSP     +00000000               CELQLIB              CEEHDSP                        D1908    Call
    2     CELQHROD    +0000024E               CELQLIB              CELQHROD                       D1908    Call
    3     funca       -209000D0               EXIST                                                        Exception
    CEE3841I A statement number is not available for this DSA. An internal routine failed with return code 08 and reason code 1C
    4     main        +00000034  12           EXIST                EXIST                                   Call
    5     CELQINIT    +0000134C               CELQLIB              CELQINIT                       D1908    Call

    DSA   DSA Addr          E  Addr             PU Addr           PU Offset   Comp Date Compile Attributes
    1     00000001082FC520  0000000020AB3680    0000000020AB3680  00000000    20061215  CEL       XPLINK  EBCDIC  HFP
    2     00000001082FEE40  0000000020AC6AA0    0000000020AC6AA0  0000024E    20061215  CEL       XPLINK  EBCDIC  HFP
    3     00000001082FF080  00000000209000D0    0000000000000000  ********    20070122  C/C++     XPLINK  EBCDIC  IEEE
    4     00000001082FF180  0000000020900138    0000000000000000  ********    20070122  C/C++     XPLINK  EBCDIC  IEEE
    5     00000001082FF280  0000000020903010    0000000020903010  0000134C    20061215  CEL       XPLINK  EBCDIC  HFP

    Fully Qualified Names
    DSA   Entry       Program Unit                                        Load Module
    4     main        PLPSC://'POSIX.CRTL.C(EXIST)'                       EXIST

  Condition Information for Active Routines
    Condition Information for  (DSA address 00000001082FF080)
      CIB Address: 00000001082FD860
      Current Condition:
        CEE0198S The termination of a thread was signaled due to an unhandled condition.
      Original Condition:
        CEE3201S The system detected an operation exception (System Completion Code=0C1).
      Location:
        Program Unit:  Entry: funca Statement:  Offset: -209000D0
        Possible Bad Branch:  Statement: 17  Offset: +00000036
      Machine State:
        ILC..... 0002    Interruption Code..... 0001
        PSW..... 0785240180000000 0000000000000002
        GPR0..... 0000000108300060  GPR1..... 00000001082FFA40  GPR2..... 0000000108401F60  GPR3..... 0000000108400070
        GPR4..... 00000001082FF080  GPR5..... 000A0000000130E1  GPR6..... 0000000000000000  GPR7..... 0000000020900108
        GPR8..... 00000000209000DC  GPR9..... 00000000209001A0  GPR10.... 00000000209002A8  GPR11.... 0000000108401F50
        GPR12.... 0000000100005340  GPR13.... 0000000000006F58  GPR14.... 0000000020B4E0A0  GPR15.... 000000000000001F

    Storage dump near condition, beginning at location(0000000000000000)
      +0000 0000000000000000  Inaccessible storage.
      +0010 0000000000000010  Inaccessible storage.
    GPREG STORAGE:
      Storage around GPR0 (0000000108300060)
        -0020 0000000108300040  00000001 08300000 00000000 00000060  |.............-|
        -0010 0000000108300050  C36DE6E2 C1F6F440 40404040 40404040  |C_WSA64         |
        +0000 0000000108300060  94818995 0086A495 83810000 00000000  |main.funca......|
        +0010 0000000108300070  00000001 08300090 00000000 209000D0  |.............. |
        +0020 0000000108300080  00000000 000000C0 00000000 20E71FF8  |............X.8 |
        +0030 0000000108300090  00000000 00000000 00000000 00000000  |..............|
```

Figure 179. Sections of the dump from example C routine (Part 1 of 3)

```
      Storage around GPR1 (00000001082FFA40)
        -0020 00000001082FFA20  00000000 00000000 00000000 00000000  |................|
        -0010 00000001082FFA30 - +FFFFFF 00000001082FFA3F             same as above
        +0000 00000001082FFA40  00000000 00000000 00000001 08300060  |...............-|
        +0010 00000001082FFA50  00000000 00000000 00000000 00000000  |................|
        +0020 00000001082FFA60 - +00003F 00000001082FFA7F             same as above
      Storage around GPR2 (0000000108401F60)
        -0020 0000000108401F40  00000001 08400000 00000000 00000040  |..... .........|
        -0010 0000000108401F50  00000001 00000020 00000001 08401F60  |............. .-|
        +0000 0000000108401F60  00000001 08401BF0 00000000 00000000  |..... .0........|
        +0010 0000000108401F70  00000000 00000000 00000000 00000000  |................|
        +0020 0000000108401F80  00000001 08400000 00000000 000014E0  |..... .........|
        +0030 0000000108401F90  C3C4D3C7 6DC8C4D9 00000001 08401FBC  |CDLG_HDR..... ..|
      Storage around GPR3 (0000000108400070)
        -0020 0000000108400050  6DC9C3D6 D5E56DD4 D6C4C57E D3000000  |_ICONV_MODE=L...|
        -0010 0000000108400060  00000001 08400000 00000000 000000C0  |..... .........|
        +0000 0000000108400070  00000001 084042B0 00000000 00000000  |..... .........|
        +0010 0000000108400080  00000000 00000000 00000000 20900000  |................|
        +0020 0000000108400090  00000000 00000000 00000001 08300050  |...............&|
        +0030 00000001084000A0  00000000 00000000 00000001 80C00000  |................|
      Storage around GPR4 (00000001082FF080)
        +0800 00000001082FF880  00000001 082FF180 00000001 08300060  |......1........-|
        +0810 00000001082FF890  00000000 209000D0 00000000 2090016E  |............... |
        +0820 00000001082FF8A0  00000000 20900144 00000000 209001A0  |................|
        +0830 00000001082FF8B0  00000000 209002A8 00000001 08401F50  |.......y..... .&|
        +0840 00000001082FF8C0  00000001 00005340 00000000 00006F58  |....... ......?.|
        +0850 00000001082FF8D0  00000000 20B4E0A0 00000000 0000001F  |................|
      Storage around GPR5 (000A0000000130E1)
        -0020 000A0000000130C1  Inaccessible storage.
        -0010 000A0000000130D1  Inaccessible storage.
        +0000 000A0000000130E1  Inaccessible storage.
        +0010 000A0000000130F1  Inaccessible storage.
        +0020 000A000000013101  Inaccessible storage.
        +0030 000A000000013111  Inaccessible storage.
      Storage around GPR6 (0000000000000000)
        +0000 0000000000000000  Inaccessible storage.
        +0010 0000000000000010  Inaccessible storage.
        +0020 0000000000000020  Inaccessible storage.
        +0030 0000000000000030  Inaccessible storage.
        +0040 0000000000000040  Inaccessible storage.
        +0050 0000000000000050  Inaccessible storage.
      Storage around GPR7 (0000000020900108)
        -0020 00000000209000E8  E3104980 0024E360 48080004 E3606010  |T.....T-....T--.|
        -0010 00000000209000F8  0004E360 60000004 EB566000 00040D76  |..T--.....-.....|
        +0000 0000000020900108  0700B904 0003E360 49800004 50006000  |......T-....&.-.|
        +0010 0000000020900118  47F08040 EB484800 000447F0 70020000  |.0. .......0....|
        +0020 0000000020900128  00C300C5 00C500F1 000000B0 00000100  |.C.E.E.1........|
        +0030 0000000020900138  EB494700 0024A74B FF000D80 C0900000  |......x.........|
⋮
  Enclave Control Blocks:
⋮

    DLL Information:
    WSA Addr          Module Addr          Thread ID         Use Count  Name
    0000000108300050                                        00000001   main
    0000000108301210  0000000002105B000     8000000000000000  00000002   CDAEQED
    0000000108306E10  00000000210D0000     8000000000000000  00000001   CDAEQDPI
    000000010830FE90  0000000021194000     8000000000000000  00000001   CELQDSNF
⋮
```

Figure 179. Sections of the dump from example C routine (Part 2 of 3)

```
 Run-Time Options Report:

  LAST WHERE SET                OPTION
  ------------------------------------------------------------------------------
  DD:CEEOPTS                      CEEDUMP(0,SYSOUT=*,FREE=END,SPIN=UNALLOC)
  DD:CEEOPTS                      DYNDUMP(POSIX.HEALY.ZOS19,DYNAMIC,TDUMP)
  Installation default            ENVAR("")
  DD:CEEOPTS                      ENVAR("_ICONV_MODE=L")
  Installation default            FILETAG(NOAUTOCVT,NOAUTOTAG)
  Installation default            HEAPCHK(OFF,1,0,0,0)
  Installation default            HEAPPOOLS64(OFF,8,4000,32,2000,128,700,256,350,1024,100,2048,50,3072,50,4096,50,8192,
                                    25,16384,10,32768,5,65536,5)
  Installation default            HEAP64(1M,1M,KEEP,32768,32768,KEEP,4096,4096,FREE)
  Installation default            INFOMSGFILTER(OFF,,,,)
  Installation default            IOHEAP64(1M,1M,FREE,12288,8192,FREE,4096,4096,FREE)
  Installation default            LIBHEAP64(1M,1M,FREE,16384,8192,FREE,8192,4096,FREE)
  Installation default            NATLANG(ENU)
  Installation default            POSIX(OFF)
  Installation default            PROFILE(OFF,"")
  Installation default            RPTOPTS(OFF)
  Installation default            RPTSTG(OFF)
  Installation default            STACK64(1M,1M,128M)
  Installation default            STORAGE(NONE,NONE,NONE,)
  DD:CEEOPTS                      TERMTHDACT(UADUMP,,96)
  Installation default           NOTEST(ALL,"*","PROMPT","INSPPREF")
  Installation default            THREADSTACK64(OFF,1M,1M,128M)
  Installation default            TRACE(OFF,4096,DUMP,LE=0)
  Installation default            TRAP(ON,SPIE)
 Process Control Blocks:

    PCB(0000000100003CA0)
      +0000 0000000100003CA0  C3C5C5D7 C3C24040 00000000 00000000  |CEEPCB  ........|
      +0010 0000000100003CB0  00000000 00000000 00000000 00000000  |................|
      +0020 0000000100003CC0 - +0000FF 0000000100003D9F             same as above
      +0100 0000000100003DA0  03030208 00000000 00000000 00000000  |................|
      +0110 0000000100003DB0  00000001 00004048 00000000 00000000  |...... .........|
      +0120 0000000100003DC0  00000000 00000000 00000000 00000000  |................|
      +0130 0000000100003DD0  00000000 00000000 00000001 00003A10  |................|
      +0140 0000000100003DE0  7F800000 00000000 00000000 00000000  |"...............|
      +0150 0000000100003DF0  00000000 00000000 00000000 00000000  |................|
      +0160 0000000100003E00 - +0001BF 0000000100003E5F             same as above
    MEML(0000000100004048)
      +0000 0000000100004048  00000000 00000000 00000000 00000000  |................|
      +0010 0000000100004058 - +00005F 00000001000040A7             same as above
      +0060 00000001000040A8  00000001 00008688 00000000 00000000  |......fh........|
      +0070 00000001000040B8  00000000 00000000 00000000 00000000  |................|
      +0080 00000001000040C8 - +0001AF 00000001000041F7             same as above
CEE3846I CEEDUMP Processing completed.
```

Figure 179. Sections of the dump from example C routine (Part 3 of 3)

2. Find the branch instructions for `funca` in the listing in Figure 180 on page 512. Notice the `BASR r7,r6` instruction at offset X'000036'. This branch is part of the instruction `aa=func_ptr();` in statement 17 in Figure 178 on page 508.

```
OFFSET OBJECT CODE        LINE#  FILE#    P S E U D O   A S S E M B L Y   L I S T I N G

                          Timestamp and Version Information
000010  F2F0  F0F7                                    =C'2007'           Compiled Year
000014  F0F1  F2F2                                    =C'0122'           Compiled Date MMDD
000018  F1F6  F2F5  F4F6                              =C'162546'         Compiled Time HHMMSS
00001E  F0F1  F0F9  F0F0                              =C'010900'         Compiler Version
                          Timestamp and Version End

OFFSET OBJECT CODE        LINE#  FILE#    P S E U D O   A S S E M B L Y   L I S T I N G

                          000016 |       *  void funca(int* aa) {

000028                                     @2L0     DS       0D
000028  00C300C5                                    =F'12779717'       XPLink entrypoint marker
00002C  00C500F1                                    =F'12910833'
000030  000000F8                                    =F'248'
000034  00000100                                    =F'256'
000000                    000016 |        funca    DS       0D
000000  EB48  4700  0024  000016 |                  STMG     r4,r8,1792(r4)
000006  A74B  FF00        000016 |                  AGHI     r4,H'-256'
00000A  0D80              000016 |                  BASR     r8,0
00000C                    End of Prolog

00000C  E350  4808  0024  000016 |                  STG      r5,#Save_ADA_Ptr_2(,r4,2056)
000012  E350  48C0  0024  000016 |                  STG      r5,#Save_WSA_Ptr_2(,r4,2240)
000018  E310  4980  0024  000016 |                  STG      r1,aa(,r4,2432)
                          000017 |       *    *aa = func_ptr();
00001E  E360  4808  0004  000017 |                  LG       r6,#Save_ADA_Ptr_2(,r4,2056)
000024  E360  6010  0004  000017 |                  LG       r6,=A(func_ptr)(,r6,16)
00002A  E360  6000  0004  000017 |                  LG       r6,func_ptr(,r6,0)
000030  EB56  6000  0004  000017 |                  LMG      r5,r6,&ADA_&EPA(r6,0)
000036  0D76              000017 |                  BASR     r7,r6
000038  0700              000017 |                  NOPR     0
00003A  B904  0003        000017 |                  LGR      r0,r3
00003E  E360  4980  0004  000017 |                  LG       r6,aa(,r4,2432)
000044  5000  6000        000017 |                  ST       r0,(*)int(,r6,0)
                          000018 |       *    return;
000048  47F0  8040        000018 |                  B        @2L3
                          000019 |       *  }
00004C                    000019 |        @2L3     DS       0H

00004C                    Start of Epilog
00004C  EB48  4800  0004  000019 |                  LMG      r4,r8,2048(r4)
000052  47F0  7002        000019 |                  B        2(,r7)

                          ***   General purpose registers used: 1111111110000000
                          ***   Floating point  registers used: 1111111100000000
                          ***   Size of register spill area: 256(max) 0(used)
                          ***   Size of dynamic storage: 0
                          ***   Size of executable code: 86
```

Figure 180. Pseudo assembly listing (Part 1 of 2)

```
OFFSET OBJECT CODE        LINE#  FILE#    P S E U D O   A S S E M B L Y   L I S T I N G

                          000001 |       *  /* C/C++ Example of Calling a Nonexistent Subroutine     */
                          000002 |       *  /*       from LE Debugging Guide                          */
                          000003 |       *  #pragma options(noinline)
                          000004 |       *  #include <stdio.h>
                          000005 |       *  #include <stdlib.h>
                          000006 |       *  #include <errno.h>
                          000007 |       *  #include <signal.h>
                          000008 |       *  void funca(int* aa);
                          000009 |       *  int (*func_ptr)(void)=0;
                          000010 |       *  int main(void) {

000090                                     @1L0     DS       0D
000090  00C300C5                                   =F'12779717'       XPLink entrypoint marker
000094  00C500F1                                   =F'12910833'
000098  000000B0                                   =F'176'
00009C  00000100                                   =F'256'
000000                    000010 |        main     DS       0D
000000  EB49  4700  0024  000010 |                 STMG     r4,r9,1792(r4)
000006  A74B  FF00        000010 |                 AGHI     r4,H'-256'
00000A  0D80              000010 |                 BASR     r8,0
00000C                    End of Prolog

00000C  C090  0000  002E  000000 |                 LARL     r9,F'46'
000012  E350  4808  0024  000010 |                 STG      r5,#Save_ADA_Ptr_1(,r4,2056)
000018  E350  48C8  0024  000010 |                 STG      r5,#Save_WSA_Ptr_1(,r4,2248)
                          000011 |       *    int aa;
                          000012 |       *    funca(&aa);
00001E  4110  48C0        000012 |                      LA       r1,aa(,r4,2240)
000022  E350  4808  0004  000012 |                      LG       r5,#Save_ADA_Ptr_1(,r4,2056)
000028  E360  4808  0004  000012 |                      LG       r6,#Save_ADA_Ptr_1(,r4,2056)
00002E  E360  6018  0004  000012 |                      LG       r6,=V(funca)(,r6,24)
000034  0D76              000012 |                      BASR     r7,r6
000036  0700              000012 |                      NOPR     0
                          000013 |       *    printf("result of funca = %d\n",aa);
000038  E320  48C0  0014  000013 |                      LGF      r2,aa(,r4,2240)
00003E  E360  4808  0004  000013 |                      LG       r6,#Save_ADA_Ptr_1(,r4,2056)
000044  EB56  6020  0004  000013 |                      LMG      r5,r6,=A(printf)(r6,32)
00004A  B904  0019        000013 |                      LGR      r1,r9
00004E  0D76              000013 |                      BASR     r7,r6
000050  0700              000013 |                      NOPR     0
                          000014 |       *    return;
000052  47F0  804A        000014 |                      B        @1L2
                          000015 |       *  }
000056                    000015 |        @1L2     DS       0H

000056                    Start of Epilog
000056  EB49  4800  0004  000015 |                 LMG      r4,r9,2048(r4)
00005C  B909  0033        000015 |                 SGR      r3,r3
000060  47F0  7002        000015 |                 B        2(,r7)

                          ***   General purpose registers used: 1111111111000000
                          ***   Floating point  registers used: 1111111100000000
                          ***   Size of register spill area: 256(max) 0(used)
                          ***   Size of dynamic storage: 0
                          ***   Size of executable code: 100

OFFSET OBJECT CODE        LINE#  FILE#    P S E U D O   A S S E M B L Y   L I S T I N G

000104  0000  0000

                          Constant Area
000000  9985A2A4 93A34096 864086A4 95838140    |result of funca |
000010  7E406C84 1500                          |= %d..          |
```

Figure 180. Pseudo assembly listing (Part 2 of 2)

3. Find the offset of `func_ptr` in the Writable Static Map, shown in Figure 181 on page 514.

```
---------------
CLASS  C_WSA64           LENGTH =       48  ATTRIBUTES = MRG, DEFER , RMODE= 64
                         OFFSET =        0 IN SEGMENT 002       ALIGN = QDWORD
---------------

           CLASS
          OFFSET  NAME                TYPE    LENGTH   SECTION
               0  $PRIV000012      PART            10
              10  EXIST#S          PART            30  EXIST#C
              40  func_ptr         PART             8  func_ptr
```

Figure 181. Writable static map

4. Add the offset of `func_ptr` (X'40') to the address of WSA (X'108300050') (the WSA address was obtained from the dump report in Figure 180 on page 512). The result (X'108300090') is the address of the function pointer `func_ptr` in the writable static storage area. This value is 0, indicating the variable is uninitialized.

   Figure 182 shows the sections of the dump.

```
 LIST 01_08300050. ASID(X'00CC') LENGTH(X'0100') AREA
 _8300050. C36DE6E2 C1F6F440 40404040 40404040 |C_WSA64          |
 _8300060. 94818995 0086A495 83810000 00000000 |main.funca......|
 _8300070. 00000001 08300090 00000000 209000D0 |..............}|
 _8300080. 00000000 000000C0 00000000 20E71FF8 |.......{.....X.8|
 _8300090 LENGTH(X'10')==>All bytes contain X'00'
 _83000A0. 00000001 08300000 00000000 00000220 |................|
 _83000B0. 00000001 083002D0 00000001 083004B8 |.......}........|
 _83000C0. 00000001 083004F5 00000001 08300532 |.......5........|
 _83000D0. 00000001 0830056F 00000001 083005AC |.......?........|
 _83000E0. 00000001 083005E9 00000001 08300626 |.......Z........|
 _83000F0. 00000001 08300663 00000001 08300A70 |................|
 _8300100. 00000001 08300AAD 00000000 00000000 |................|
 _8300110 LENGTH(X'40')==>All bytes contain X'00'
```

Figure 182. IPCS storage display of the writeable static area

Handling dumps written to the z/OS UNIX file system

When a z/OS UNIX C/C++ application program is running in an address space created as a result of a call to `spawnp()`, `vfork()`, or one of the `exec` family of functions, the SYSMDUMP DD allocation information is not inherited. Even though the SYSMDUMP allocation is not inherited, a SYSMDUMP allocation must exist in the parent in order to obtain a HFS storage dump. If the program terminates abnormally while running in this new address space, the kernel causes an unformatted storage dump to be written to an HFS file in the user's working directory. The file is placed in the current working directory or into /tmp if the current working directory is not defined. The file name has the following format:

```
/directory/coredump.pid
```

where directory is the current working directory or tmp, and pid is the hexadecimal process ID (PID) for the process that terminated. For details on how to generate the system dump, see "Steps for generating a system dump in a z/OS UNIX shell" on page 396.

To debug the dump, use the Interactive Problem Control System (IPCS). If the dump was written to an HFS file, you must allocate a data set that is large enough and has the correct attributes for receiving a copy of the HFS file. For example, from the ISPF DATA SET UTILITY panel you can specify a volume serial and data set name to allocate. Doing so brings up the DATA SET INFORMATION panel for specifying characteristics of the data set to be allocated. The following filled-in panel

shows the characteristics defined for the URCOMP.JRUSL.COREDUMP dump data set:

```
-------------------------  DATA SET INFORMATION  ----------------------
Command ===>

Data Set Name  . . . : URCOMP.JRUSL.COREDUMP

General Data                          Current Allocation
 Management class . . : STANDARD       Allocated cylinders : 30
 Storage class  . . . : OS390          Allocated extents . : 1
  Volume serial . . . : DPXDU1
  Device type . . . . : 3380
 Data class . . . . . :
  Organization  . . . : PS            Current Utilization
  Record format . . . : FB             Used cylinders. . . : 0
  Record length . . . : 4160           Used extents  . . . : 0
  Block size  . . . . : 4160
  1st extent cylinders: 30
  Secondary cylinders : 10
  Data set name type  :

  Creation date . . . : 2001/08/30
  Expiration date . . : ***None***

F1=Help     F2=Split     F3=End       F4=Return    F5=Rfind     F6=Rchange
F7=Up       F8=Down      F9=Swap     F10=Left     F11=Right    F12=Cancel
```

Figure 183. IPCS panel for entering data set information

Fill in the information for your data set as shown, and estimate the number of cylinders required for the dump file you are going to copy.

Use the TSO/E OGET or OCOPY command with the BINARY keyword to copy the file into the data set. For example, to copy the HFS memory dump file `coredump.00060007` into the data set URCOMP.JRUSL.COREDUMP just allocated, a user with the user ID URCOMP enters the following command:

```
OGET '/u/urcomp/coredump.00060007' 'urcomp.jrusl.coredump' BINARY
```

For more information on using the copy commands, see *z/OS UNIX System Services User's Guide*.

After you have copied the memory dump file to the data set, you can use IPCS to analyze the dump. See "Formatting and analyzing system dumps" on page 397 for information about formatting Language Environment control blocks.

Multithreading consideration

Certain control blocks are locked while a dump is in progress. For example, a `csnap()` of the file control block would prevent another thread from using or dumping the same information. An attempt to do so causes the second thread to wait until the first one completes before it can continue.

Understanding C/C++ heap information in storage reports

Storage reports that contain specific C/C++ heap information can be generated in two ways:

- By setting the Language Environment RPTSTG(ON) run-time option for Language Environment created heaps
- By issuing a stand-alone call to the C function `__uheapreport()` for user–created heaps.

Details on how to request and interpret the reports are provided in the following sections.

Language Environment storage report with heap pools statistics

To request a Language Environment storage report set RPTSTG(ON). If the C/C++ application specified the HEAPPOOLS(ON) or HEAPPOOLS64(ON) run-time option, the storage report displays HeapPools statistics. For a sample storage report showing HeapPools statistics for a multithreaded C/C++ application, see Figure 139 on page 362.

The following describes the C/C++ specific heap pool information.

HEAPPOOLS64 storage statistics

The HEAPPOOLS64 run-time option controls usage of the heap pools storage algorithm at the enclave level. The heap pools algorithm allows for the definition of one to twelve heap pools, each consisting of a number of storage cells of a specified length.

Usage Note: The use of an alternative vendor heap manager (VHM) overrides the use of the HEAPPOOLS64 run-time option.

HEAPPOOLS64 statistics:

- Pool *p* size: *ssss* Get requests: *gggg*
  - *p* — the number of the pool. When there are multiple pools for a cell size, the pools are numbered using the format *aa.bbb*.
    - *aa* — the number for the cell size.
    - *bbb* — the number for the pool within the cell size.
  - *ssss* — the cell size specified for the pool.
  - *gggg* - the number of storage requests that were satisfied from this pool.
- Successful Get Heap requests: *xxxx-yyyy n*
  - *xxxx* — the low side of the 8 byte range
  - *yyyy* — the high side of the 8 byte range
  - *n* — the number of requests in the 8 byte range.
- Requests greater than the largest cell size — the number of storage requests that are not satisfied by heap pools.

Note: Values displayed in the HEAPPOOLS64 Statistics report are not serialized when collected, therefore the values are not necessarily exact.

HEAPPOOLS64 summary: The HEAPPOOLS64 Summary displays a report of the HEAPPOOLS64 Statistics and provides suggested cell sizes.

- Specified Cell Size — the size of the cell specified in the HEAPPOOLS64 run-time option
- Element Size — the size of the cell plus any additional storage needed for control information or to maintain alignment
- Cells Per Extent — the cell pool count specified by the HEAPPOOLS64 run-time option. When there is more than one pool for a cell size, the count is divided by the number of pools.
- Extents Allocated — the number of times that each pool allocated an extent in order to optimize storage usage. The extents allocated needs to be either one or two. If the number of extents allocated is too high, increase the cell count for the pool.
- Maximum Cells Used — the maximum number of cells used for each pool.

- Cells In Use — the number of cells that were never freed.

  Note: A large number in this field could indicate a storage leak.
- Suggested Cell Sizes — sizes that are calculated to optimally use storage (assuming that the application will __malloc/__free with the same frequency).

  Note: The suggested cell sizes are given with no cell counts because the usage of each new cell pool size is not known. If there are less than 12 cell sizes calculated, then the last pool size is set at 65536.

For more information about stack and heap storage for AMODE64 applications, see *z/OS Language Environment Programming Guide for 64-bit Virtual Addressing Mode*.

HEAPPOOLS storage statistics

The HEAPPOOLS run-time option controls usage of the heap pools storage algorithm at the enclave level. The heap pools algorithm allows for the definition of one to twelve heap pools, each consisting of a number of storage cells of a specified length. HEAPPOOLS run-time option can be used by AMODE 64 applications to manage user heap storage above the 16MB line and below the 2GB bar.

Usage Note: The use of an alternative Vendor Heap Manager (VHM) overrides the use of the HEAPPOOLS run-time option.

HEAPPOOLS statistics:

- Pool *p* size: *ssss* Get requests: *gggg*
  - *p* — the number of the pool. When there are multiple pools for a cell size, the pools are numbered using the format *aa.bbb*.
    - *aa* — the number for the cell size.
    - *bbb* — the number for the pool within the cell size.
  - *ssss* — the cell size specified for the pool.
  - *gggg* — the number of storage requests that were satisfied from this pool.
- Successful Get Heap requests: *xxxx-yyyy n*
  - *xxxx* — the low side of the 8 byte range
  - *yyyy* — the high side of the 8 byte range
  - *n* — the number of requests in the 8 byte range.
- Requests greater than the largest cell size — the number of storage requests that are not satisfied by heap pools.

Note: Values displayed in the HEAPPOOLS Statistics report are not serialized when collected, therefore the values are not necessarily exact.

HEAPPOOLS summary: The HEAPPOOLS Summary displays a report of the HeapPool Statistics and provides suggested percentages for current cell sizes as well as suggested cell sizes.

- Specified Cell Size — the size of the cell specified in the HEAPPOOLS run-time option
- Element Size — the size of the cell plus any additional storage needed for control information or to maintain alignment
- Extent Percent — the cell pool percent specified by the HEAPPOOLS run-time option
- Cells Per Extent — the number of cells per extent. This number is calculated using the following formula:

```
Initial Heap Size * (Extent Percent/100))/(Element Size)
```

with a minimum of four cells.

Note: Having a small number of cells per extent is not suggested because the pool can allocate many extents, which causes the HeapPool algorithm to perform inefficiently.

- Extents Allocated — the number of times that each pool allocated an extent.

  In order to optimize storage usage, the extents allocated need to be either one or two. If the number of extents allocated is too high, increase the percentage for the pool.
- Maximum Cells Used — the maximum number of cells used for each pool.
- Cells In Use — the number of cells that were never freed.

  Note: A large number in this field can indicate a storage leak.
- Suggested Percentages for current Cell Sizes — percentages calculated to find the optimal size of the cell pool extent. The calculation is based on the following formula:

  ```
  (Maximum Cells Used * (Element Size) * 100) / Initial Heap Size
  With a minimum of 1% and a maximum of 90%
  ```

  Make sure that your cell pool extents are neither too large nor too small. If your percentages are too large then additional, unreferenced virtual storage will be allocated, thereby causing the program to exhaust the region size. If the percentages are too small then the HEAPPOOLS algorithm will run inefficiently.
- Suggested Cell Sizes — sizes that are calculated to optimally use storage (assuming that the application will __malloc/__free with the same frequency).

  Note: The suggested cell sizes are given with no percentages because the usage of each new cell pool size is not known. If there are less than 12 cell sizes calculated and the last calculated cell size is smaller than the largest cell size currently in effect, the largest cell size currently in effect is used for the last suggested cell size.

For more information about stack and heap storage, see *z/OS Language Environment Programming Guide for 64-bit Virtual Addressing Mode*.

C function __uheapreport() storage report

To generate a user-created heap storage report use the C function, `__uheapreport()`. Use the information in the report to assist with tuning your application's use of the user-created heap.

User-created HeapPools statistics

- Pool *p* size: *ssss*
  - *p* — the number of the pool
  - *ssss* — the cell size specified for the pool.
- Successful Get Heap requests: *xxxx-yyyy n*
  - *xxxx* — the low side of the range
  - *yyyy* — the high side of the range
  - *n* — the number of requests in the range.
- Requests greater than the largest cell size — the number of storage requests that are not satisfied by heap pools.

Note: Values displayed in the HeapPools Statistics report are not serialized when collected, therefore the values are not necessarily exact.

HeapPools summary

The HeapPools Summary displays a report of the HeapPool Statistics and provides suggested percentages for current cell sizes as well as suggested cell sizes.

- Cell Size — the size of the cell specified on the __ucreate() call
- Cells Per Extent — the cell pool count specified on the __ucreate() call
- Extents Allocated — the number of times that each pool allocated an extent in order to optimize storage usage.
- Maximum Cells Used — the maximum number of cells used for each pool.
- Cells In Use — the number of cells that were never freed.

  Note: A large number in this field could indicate a storage leak.
- Suggested Cell Sizes — sizes that are calculated to optimally use storage (assuming that the application will __umalloc/__ufree with the same frequency).

  Note: The suggested cell sizes are given with no cell counts because the usage of each new cell pool size is not known. If there are less than 12 cell sizes calculated, then the last pool size is set at 65536.

For more information on the `__uheapreport()` function, see *z/OS XL C/C++ Run-Time Library Reference*. For tuning tips, see *z/OS Language Environment Programming Guide for 64-bit Virtual Addressing Mode*.

A sample storage report generated by `__uheapreport()` is shown in Figure 184 on page 520.

```
Storage Report for Enclave  Fri Dec 19 20:29:08 2008
Language Environment V01 R11.00

    HeapPools Statistics:
      Pool  1 size:    32
        Successful Get Heap requests:      -                        15
      Pool  2 size:   128
        Successful Get Heap requests:      -                        15
      Pool  3 size:   512
        Successful Get Heap requests:      -                        15
      Pool  4 size:  2048
        Successful Get Heap requests:      -                        15
      Pool  5 size:  8192
        Successful Get Heap requests:      -                        15
      Pool  6 size: 16384
        Successful Get Heap requests:      -                        15
      Requests greater than the largest cell size:                 0
    HeapPools Summary:
      Cell     Cells Per   Extents    Maximum        Cells In
      Size     Extent      Allocated  Cells Used     Use
      ------------------------------------------------------------
         32           15           1           1           15
        128           15           1           1           15
        512           15           1           1           15
       2048           15           1           1           15
       8192           15           1           1           15
      16384           15           1           1           15
      ------------------------------------------------------------
      Suggested Cell Sizes:
        ,32,,128,,512,,2048,,8192,,16384,,0)
End of Storage Report
```

Figure 184. Storage report generated by __uheapreport()

Appendix A. Diagnosing problems with Language Environment

This appendix provides information for diagnosing problems in the Language Environment product. It helps you determine if a correction for a product failure similar to yours has been previously documented. If the problem has not been previously reported, it tells you how to open a problem management record (PMR) to report the problem to IBM, and if the problem is with an IBM product, what documentation you need for an Authorized Program Analysis Report (APAR).

Diagnosis checklist

Step through each of the items in the diagnosis checklist below to see if they apply to your problem. The checklist is designed to either solve your problem or help you gather the diagnostic information required for determining the source of the error. It can also help you confirm that the suspected failure is not a user error; that is, it was not caused by incorrect usage of the Language Environment product or by an error in the logic of the routine.

1. If your failing application contains programs that were changed since they last ran successfully, review the output of the compile or assembly (listings) for any unresolved errors.
2. If there have not been any changes in your applications, check the output (job or console logs, CICS transient (CESE) queues) for any messages from the failing run.
3. Check the message prefix to identify the system or subsystem that issued the message. This can help you determine the cause of the problem. Following are some of the prefixes and their respective origins.

   EDC The prefix for C/C++ messages. The following series of messages are from the C/C++ run-time component of Language Environment: 5000 (except for 5500, which are from the DSECT utility), 6000, and 7000.

   IGZ The prefix for messages from the COBOL run-time component of Language Environment.

   FOR The prefix for messages from the Fortran run-time component of Language Environment.

   IBM The prefix for messages from the PL/I run-time component of Language Environment.

   CEE The prefix for messages from the common run-time component of Language Environment.
4. For any messages received, check for recommendations in the “Programmer Response” sections of the messages in this information.
5. Verify that abends are caused by product failures and not by program errors. See the appropriate chapters in this manual for a list of Language Environment-related abend codes.
6. Your installation may have received an IBM Program Temporary Fix (PTF) for the problem. Verify that you have received all issued PTFs and have installed them, so that your installation is at the most current maintenance level.

© Copyright IBM Corp. 1991, 2009

7. The preventive service planning (PSP) bucket, an online database available to IBM customers through IBM service channels, gives information about product installation problems and other problems. Check to see whether it contains information related to your problem.
8. Narrow the source of the error.
   - If a Language Environment dump is available, locate the traceback in the Language Environment dump for the source of the problem.
   - For AMODE 64 applications, IBM recommends that you use the IPCS Verbexit IEDATA with the CEEDUMP option to format the traceback. Check the traceback for the source of the problem. For information on how to generate and use a Language Environment or system dump to isolate the cause of the error, see Chapter 3, "Using Language Environment debugging facilities," on page 35 or Chapter 12, "Using Language Environment AMODE 64 debugging facilities," on page 375.
   - Alternatively, in a non-XPLINK environment, you can follow the save area chain to find out the name of the failing module and whether IBM owns it. For information on finding the routine name, see "Locating the name of the failing routine for a non-XPLINK application."
9. After you identify the failure, consider writing a small test case that re-creates the problem. The test case could help you determine whether the error is in a user routine or in the Language Environment product. Do not make the test case larger than 75 lines of code. The test case is not required, but it could expedite the process of finding the problem.

   If the error is not a Language Environment failure, see the diagnosis procedures for the product that failed.
10. Record the conditions and options in effect at the time the problem occurred. Compile your program with the appropriate options to obtain an assembler listing and data map. If possible, obtain the binder or linkage editor output listing. Note any changes from the previous successful compilation or run. For an explanation of compiler options, see the compiler-specific programming guide.
11. If you are experiencing a no-response problem, try to force a dump. For example, CANCEL the program with the dump option.
12. Record the sequence of events that led to the error condition and any related programs or files. It is also helpful to record the service level of the compiler associated with the failing program.

Locating the name of the failing routine for a non-XPLINK application

If a system dump is taken, follow the save area chain to find out the name of the failing routine and whether IBM owns it. Following are the procedures for locating the name of the failing routine, which is the primary entry point name.

1. Find the entry point associated with the current save area. The entry point address (EPA), located in the previous save area at displacement X'10', decimal 16, points to it.
2. Determine the entry point type, of which there are four:

Entry point type is...	If...
Language Environment conforming	The entry point plus 4 is X'00C3C5C5'.
Language Environment conforming OPLINK	The entry point plus 4 is X'01C3C5C5'. OPLINK linkage conventions are used.
C/C++	The entry point plus 5 is X'CE'.

Entry point type is...	If...
Nonconforming	The entry point is none of the above. Nonconforming entry points are for routines that follow the linking convention in which the name is at the beginning of the routine. X'47F0Fxxx' is the instruction to branch around the routine name.

For routines with Language Environment-conforming and C/C++ entry points, Language Environment provides program prolog areas (PPAs). PPA1 contains the entry point name and the address of the PPA2; PPA2 contains pointers to the timestamp, where release level keyword information is found, and to the PPA1 associated with the primary entry point of the routine.

If the entry point type of the failing routine is Language Environment-conforming, go to step 3.

If the entry point type is C/C++, go to step 5.

If the entry point type is nonconforming, go to step 6 on page 524.

3. If the entry point type is Language Environment-conforming, find the entry point name for the Language Environment or COBOL program.
   a. Use an offset of X'C' from the entry point to locate the address of the PPA1.
   b. In the PPA1, locate the offset to the length of the name. If OPLINK, then multiply the offset by 2 to locate the actual offset to the length of the name.
   c. Add this offset to the PPA1 address to find the halfword containing the length of the name, followed by the entry point name.

      The entry point name appears in EBCDIC, with the translated version in the right-hand margin of the system dump.
4. Find the Language Environment or COBOL program name.
   a. Find the address of the PPA2 at X'04' from the start of the PPA1.
   b. Find the address of the compilation unit's primary entry point at X'10' in the PPA2.
   c. Find the entry point name associated with the primary entry point as described above. The primary entry point name is the routine name.

   See *z/OS Language Environment Vendor Interfaces* for illustrations and details of:
   - the non-XPLINK Language Environment-conforming PPA1 and PPA2.
   - the XPLINK Language Environment-conforming PPA1, and the XPLINK PPA1 optional area fields.
   - the non-XPLINK Language Environment PPA2.
   - the Language Environment PPA2: Compile Unit Block for XPLINK.
   - the PPA2 timestamp and version information.
5. If the entry point type is C/C++, find the C/C++ routine name.
   a. Use the entry point plus 4 to locate the offset to the entry point name in the PPA1.
   b. Use this offset to find the length-of-name byte followed by the routine name.

      The routine name appears in EBCDIC, with the translated version in the right-hand margin.

   Figure 185 on page 524 illustrates the C PPA1.

C Routine Layout Entry and PPA1

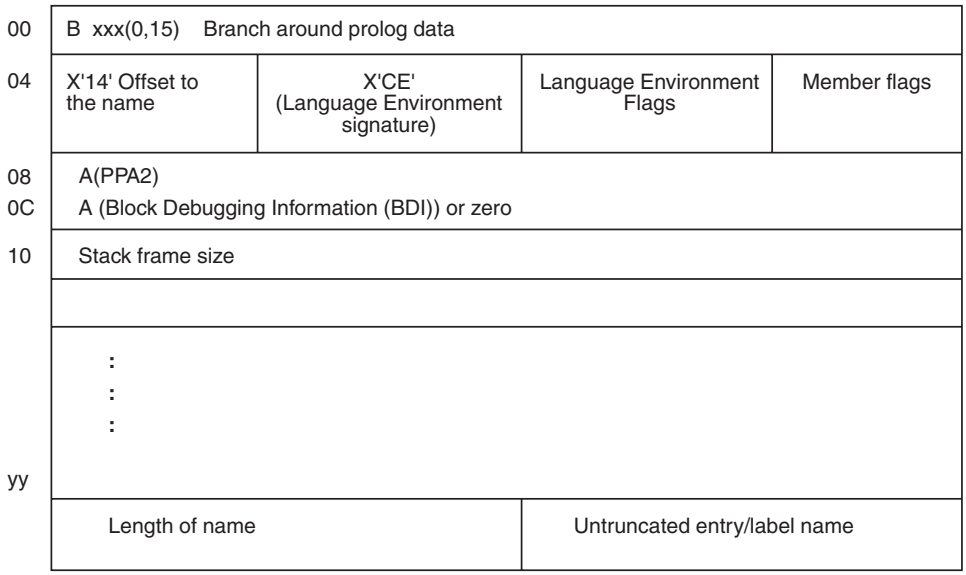


Figure 185. C PPA1

6. If the entry point type is nonconforming, find the PL/I routine name.
   a. Find the one byte length immediately preceding the entry point. This is the length of the routine name.
   b. Go back the number of bytes specified in the name length. This is the beginning of the routine name.
7. If the entry point type is nonconforming, find the name of the routine other than PL/I.
   a. Use the entry point plus 4 as the location of the entry point name.
   b. Use the next byte as the length of the name. The name directly follows the length of name byte. The entry point name appears in EBCDIC with the translated version in the right-hand margin.

   Figure 186 illustrates a nonconforming entry point type.

   Nonconforming entry points that can appear do not necessarily follow this linking convention. The location of data in these save areas can be unpredictable.

```
020000  =  47F0F00C  06D3C9E2  E3C9E300  90ECD00C  E0B |.00..LISTIT.....|
020010  =  18CF41B0  C29850BD  000850DB  000418DB      |....Bq&...&.....|
020020  =  4510C052  E3E8D7D3  C9D54040  01020034      |....TYPLIN  ....|
020030  =  C200001E  C5D5E3C5  D940D5E4  D4C2C5D9      |B...ENTER NUMBER|
020040  =  40D6C640  D9C5C3D6  D9C4E240  D6D940C1      | OF RECORDS OR A|
020050  =  D3D30ACA  00020058  4510C06C  E6C1C9E3      |LL.........%WAIT|
020060  =  D9C44040  010202F0  E4000000  0ACA0002      |RD  ...0U.......|
```

Figure 186. Nonconforming entry point type with sample dump

Searching the IBM Software Support Database

Failures in the Language Environment product can be described through the use of keywords. A keyword is a descriptive word or abbreviation assigned to describe one aspect of a product failure. A set of keywords, called a keyword string, describes the failure in detail. You can use a keyword or keyword string as a search argument against an IBM software support database, such as the Service Information Search (SIS). The database contains keyword and text information describing all current problems reported through APARs and associated PTFs. IBM Support Center personnel have access to the software support database and are responsible for storing and retrieving the information. Using keywords or a keyword string, they will search the database to retrieve records that describe similar known problems.

If you have IBMLink™ or some other connection to the IBM databases, you can do your own search for previously recorded product failures before calling the IBM Support Center.

If your keyword or keyword string matches an entry in the software support database, the search may yield a more complete description of the problem and possibly identify a correction or circumvention. Such a search may yield several matches to previously reported problems. Review each error description carefully to determine if the problem description in the database matches the failure.

If a match is not found, go to “Preparing documentation for an Authorized Program Analysis Report (APAR).”

Preparing documentation for an Authorized Program Analysis Report (APAR)

See http://techsupport.services.ibm.com/guides/handbook.html for detailed information.

Prepare documentation for an APAR only after you have done the following:

- Eliminated user errors as a possible cause of the problem.
- Followed the diagnostic procedures.
- You or your local IBM Support Center has been unsuccessful with the keyword search.

Having met these criteria, follow the instructions below.

1. Report the problem to IBM.

   If you have not already done so, report the problem to IBM by opening a problem management record (PMR).

   If you have IBMLink or some other connection to IBM databases, you can open a PMR yourself. Or, the IBM Software Support Center can open the PMR after consulting with you on the phone. The PMR is used to document your problem and to record the work that the Support Center does on the problem. Be prepared to supply the following information:

   - Customer number
   - PMR number
   - Operating system
   - Operating system release level
   - Your current Language Environment maintenance level (PTF list and list of APAR fixes applied)

- Keyword strings you used to search the IBM software support database
- Processor number (model and serial)
- A description of how reproducible the error is. Can it be reproduced each time? Can it be reproduced only sometimes? Have you been unable to reproduce it? Supply source files, test cases, macros, subroutines, and input files required to re-create the problem. Test cases are not required, but can often speed the response time for your problem.

If the IBM Support Center concludes that the problem described in the PMR is a problem with the Language Environment product, they will work with you to open an APAR, so the problem can be fixed.

2. Provide APAR documentation. When you submit an APAR, you will need to supply information that describes the failure. Table 35 describes how to produce documentation required for submission with the APAR.

Table 35. Problem resolution documentation requirements

Item	Materials Required	How to Obtain Materials
1	Machine-readable source program, including macros, subroutines, input files, and any other data that might help to reproduce the problem.	IBM-supplied system utility program
2	Compiler listings: • Source listing • Object listing • Storage map • Traceback • Cross-reference listing • JCL listing and linkage editor listing • Assembler-language expansion	Use appropriate compiler options
3	Dumps • Language Environment dump • System dump	See instructions in Chapter 3, “Using Language Environment debugging facilities,” on page 35 (as directed by IBM support personnel).
4	Partition/region size/virtual storage size	
5	List of applied PTFs	System programmer
6	Operating instructions or console log	Application programmer
7	JCL statements used to invoke and run the routine, including all run-time options, in machine-readable form	Application programmer
8	System output associated with the MSGFILE run-time option.	Specify MSGFILE(SYSOUT)
9	Contents of the applicable catalog	
10	A hardcopy log of the events leading up to the failure.	Print out each display.

3. Submit the APAR documentation.

   When submitting material for an APAR to IBM, carefully pack and clearly identify any media containing source programs, job stream data, interactive environment information, data sets, or libraries.

   All magnetic media submitted must have the following information attached and visible:

- The APAR number assigned by IBM.
- A list of data sets on the tape (such as source program, JCL, data).
- A description of how the tape was made, including:
  - The exact JCL listing or the list of commands used to produce the machine-readable source. Include the block size, LRECL, and format of each file. If the file was unloaded from a partitioned data set, include the block size, LRECL, and number of directory blocks in the original data set.
  - Labeling information used for the volume and its data sets.
  - The recording mode and density.
  - The name of the utility program that created each data set.
  - The record format and block size used for each data set.

  Any printed materials must show the corresponding APAR number.

  The IBM service personnel will inform you of the mailing address of the service center nearest you.

  If an electronic link with IBM Service is available, use this link to send diagnostic information to IBM Service.

After the APAR is opened and the fix is produced, the description of the problem and the fix will be in the software support database in SIS, accessible through ServiceLink.

Appendix B. Accessibility

Accessibility features help a user who has a physical disability, such as restricted mobility or limited vision, to use software products successfully. The major accessibility features in z/OS enable users to:

- Use assistive technologies such as screen readers and screen magnifier software
- Operate specific or equivalent features using only the keyboard
- Customize display attributes such as color, contrast, and font size

Using assistive technologies

Assistive technology products, such as screen readers, function with the user interfaces found in z/OS. Consult the assistive technology documentation for specific information when using such products to access z/OS interfaces.

Keyboard navigation of the user interface

Users can access z/OS user interfaces using TSO/E or ISPF. Refer to *z/OS TSO/E Primer*, *z/OS TSO/E User's Guide*, and *z/OS ISPF User's Guide Vol I* for information about accessing TSO/E and ISPF interfaces. These guides describe how to use TSO/E and ISPF, including the use of keyboard shortcuts or function keys (PF keys). Each guide includes the default settings for the PF keys and explains how to modify their functions.

z/OS information

z/OS information is accessible using screen readers with the BookServer/Library Server versions of z/OS books in the Internet library at:

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

© Copyright IBM Corp. 1991, 2009

Notices

This information was developed for products and services offered in the U.S.A.

IBM may not offer the products, services, or features discussed in this document in other countries. Consult your local IBM representative for information on the products and services currently available in your area. Any reference to an IBM product, program, or service is not intended to state or imply that only that IBM product, program, or service may be used. Any functionally equivalent product, program, or service that does not infringe any IBM intellectual property right may be used instead. However, it is the user's responsibility to evaluate and verify the operation of any non-IBM product, program, or service.

IBM may have patents or pending patent applications covering subject matter described in this document. The furnishing of this document does not give you any license to these patents. You can send license inquiries, in writing, to:

IBM Director of Licensing
IBM Corporation
North Castle Drive
Armonk, NY 10504-1785
USA

For license inquiries regarding double-byte (DBCS) information, contact the IBM Intellectual Property Department in your country or send inquiries, in writing, to:

IBM World Trade Asia Corporation
Licensing
2-31 Roppongi 3-chome, Minato-ku
Tokyo 106, Japan

The following paragraph does not apply to the United Kingdom or any other country where such provisions are inconsistent with local law:
INTERNATIONAL BUSINESS MACHINES CORPORATION PROVIDES THIS PUBLICATION "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF NON-INFRINGEMENT, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Some states do not allow disclaimer of express or implied warranties in certain transactions, therefore, this statement may not apply to you.

This information could include technical inaccuracies or typographical errors. Changes are periodically made to the information herein; these changes will be incorporated in new editions of the publication. IBM may make improvements and/or changes in the product(s) and/or the program(s) described in this publication at any time without notice.

Any references in this information to non-IBM Web sites are provided for convenience only and do not in any manner serve as an endorsement of those Web sites. The materials at those Web sites are not part of the materials for this IBM product and use of those Web sites is at your own risk.

IBM may use or distribute any of the information you supply in any way it believes appropriate without incurring any obligation to you.

Licensees of this program who wish to have information about it for the purpose of enabling: (i) the exchange of information between independently created programs

© Copyright IBM Corp. 1991, 2009

and other programs (including this one) and (ii) the mutual use of the information which has been exchanged, should contact:

IBM Corporation
Mail Station P300
2455 South Road
Poughkeepsie, NY 12601-5400
USA

Such information may be available, subject to appropriate terms and conditions, including in some cases, payment of a fee.

The licensed program described in this information and all licensed material available for it are provided by IBM under terms of the IBM Customer Agreement, IBM International Program License Agreement, or any equivalent agreement between us.

Any performance data contained herein was determined in a controlled environment. Therefore, the results obtained in other operating environments may vary significantly. Some measurements may have been made on development-level systems and there is no guarantee that these measurements will be the same on generally available systems. Furthermore, some measurement may have been estimated through extrapolation. Actual results may vary. Users of this document should verify the applicable data for their specific environment.

Information concerning non-IBM products was obtained from the suppliers of those products, their published announcements or other publicly available sources. IBM has not tested those products and cannot confirm the accuracy of performance compatibility or any other claims related to non-IBM products. Questions on the capabilities of non-IBM products should be addressed to the suppliers of those products.

All statements regarding IBM's future direction or intent are subject to change without notice, and represent goals and objectives only.

This information contains examples of data and reports used in daily business operations. To illustrate them as completely as possible, the examples include the names of individuals, companies, brands, and products. All of these names are fictitious and any similarity to the names and addresses used by an actual business enterprise is entirely coincidental.

COPYRIGHT LICENSE:

This information contains sample application programs in source language, which illustrates programming techniques on various operating platforms. You may copy, modify, and distribute these sample programs in any form without payment to IBM, for the purposes of developing, using, marketing or distributing application programs conforming to the application programming interface for the operating platform for which the sample programs are written. These examples have not been thoroughly tested under all conditions. IBM, therefore, cannot guarantee or imply reliability, serviceability, or function of these programs. You may copy, modify, and distribute these sample programs in any form without payment to IBM for the purposes of developing, using, marketing, or distributing application programs conforming to IBM's application programming interfaces.

If you are viewing this information softcopy, the photographs and color illustrations may not appear.

Policy for unsupported hardware

Various z/OS elements, such as DFSMS™, HCD, JES2, JES3, and MVS, contain code that supports specific hardware servers or devices. In some cases, this device-related element support remains in the product even after the hardware devices pass their announced End of Service date. z/OS may continue to service element code; however, it will not provide service related to unsupported hardware devices. Software problems related to these devices will not be accepted for service, and current service activity will cease if a problem is determined to be associated with out-of-support devices. In such cases, fixes will not be issued.

Programming Interface Information

This publication documents information NOT intended to be used as a Programming Interface of Language Environment in z/OS.

Trademarks

IBM, the IBM logo, and ibm.com are trademarks or registered trademarks of International Business Machines Corp., registered in many jurisdictions worldwide. Other product and service names might be trademarks of IBM or other companies. A current list of IBM trademarks is available on the Web at "Copyright and trademark information" at http://www.ibm.com/legal/copytrade.shtml.

IEEE is a trademark of the Institute of Electrical and Electronics Engineers, Inc. in the United States and other countries.

UNIX is a registered trademark of The Open Group in the United States and other countries.

Java and all Java-based trademarks and logos are trademarks of Sun Microsystems, Inc. in the United States and other countries.

Other company, product, and service names may be trademarks or service marks of others.

Bibliography

This section lists the books in the Language Environment library and other publications that may be helpful when using Language Environment.

Language Products Publications

z/OS Language Environment
- *z/OS Language Environment Concepts Guide*, SA22-7567
- *z/OS Language Environment Programming Guide*, SA22-7561
- *z/OS Language Environment Programming Reference*, SA22-7562
- *z/OS Language Environment Customization*, SA22-7564
- *z/OS Language Environment Debugging Guide*, GA22-7560
- *z/OS Language Environment Run-Time Application Migration Guide*, GA22-7565
- *z/OS Language Environment Writing Interlanguage Communication Applications*, SA22-7563
- *z/OS Language Environment Run-Time Messages*, SA22-7566
- *z/OS Language Environment Vendor Interfaces*, SA22-7568
- *z/OS Language Environment Programming Guide for 64-bit Virtual Addressing Mode*, SA22-7569

z/OS XL C/C++
- *z/OS XL C/C++ Language Reference*, SC09-4815
- *z/OS XL C/C++ Compiler and Run-Time Migration Guide for the Application Programmer*, GC09-4913
- *z/OS XL C/C++ Programming Guide*, SC09-4765
- *z/OS XL C/C++ User's Guide*, SC09-4767
- *z/OS XL C/C++ Run-Time Library Reference*, SA22-7821
- *z/OS XL C/C++ Messages*, GC09-4819
- *Standard C++ Library Reference*, SC09-4949

z/OS Metal C Runtime Library
- *z/OS Metal C Programming Guide and Reference*, SA23-2225

Enterprise COBOL for z/OS, V4R1
- *Enterprise COBOL for z/OS Licensed Program Specifications*, GI11-7871
- *Enterprise COBOL for z/OS Customization*, SC23-8526
- *Enterprise COBOL for z/OS Language Reference*, SC23-8528
- *Enterprise COBOL for z/OS Programming Guide*, SC23-8529
- *Enterprise COBOL for z/OS Migration Guide*, GC23-8527

Enterprise COBOL for z/OS, V3R4
- *Enterprise COBOL for z/OS Licensed Program Specifications*, GC27-1411
- *Enterprise COBOL for z/OS Customization*, GC27-1410
- *Enterprise COBOL for z/OS Language Reference*, SC27-1408
- *Enterprise COBOL for z/OS Programming Guide*, SC27-1412
- *Enterprise COBOL for z/OS Migration Guide*, GC27-1409

COBOL for OS/390 & VM
- *COBOL for OS/390 & VM Licensed Program Specifications*, GC26-9044
- *COBOL for OS/390 & VM Customization under OS/390*, GC26-9045
- *COBOL for OS/390 & VM Language Reference*, SC26-9046
- *COBOL for OS/390 & VM Programming Guide*, SC26-9049
- *COBOL for OS/390 & VM Compiler and Run-Time Migration Guide*, GC26-4764

© Copyright IBM Corp. 1991, 2009

Debug Tool
- Debug Tool documentation is available at: http://www.ibm.com/software/awdtools/debugtool/

VS FORTRAN Version 2
- *Language Environment for MVS & VM Fortran Run-Time Migration Guide*, SC26-8499
- *Language and Library Reference*, SC26-4221
- *Programming Guide for CMS and MVS*, SC26-4222

Enterprise PL/I for z/OS
- *Enterprise PL/I for z/OS Licensed Program Specifications*, GC27-1456
- *Enterprise PL/I for z/OS Programming Guide*, SC27-1457
- *Enterprise PL/I for z/OS Language Reference*, SC27-1460
- *Enterprise PL/I for z/OS Migration Guide*, GC27-1458
- *Enterprise PL/I for z/OS Messages and Codes*, SC27-1461

PL/I for MVS & VM
- *PL/I for MVS & VM Licensed Program Specifications*, GC26-3116
- *PL/I for MVS & VM Programming Guide*, SC26-3113
- *PL/I for MVS & VM Language Reference*, SC26-3114
- *PL/I for MVS & VM Reference Summary*, SX26-3821
- *PL/I for MVS & VM Compiler and Run-Time Migration Guide*, SC26-3118
- *PL/I for MVS & VM Installation and Customization under MVS*, SC26-3119
- *PL/I for MVS & VM Compile-Time Messages and Codes*, SC26-3229
- *PL/I for MVS & VM Diagnosis Guide*, SC26-3149

High Level Assembler for MVS & VM & VSE
- *Programmer's Guide, MVS & VM Edition*, SC26-4941

Related Publications

CICS
- *CICS Transaction Server for z/OS Installation Guide*, GC34-6224
- *CICS Operations and Utilities Guide*, SC34-6229
- *CICS Problem Determination Guide*, SC34-6239
- *CICS Resource Definition Guide*, SC34-6228
- *CICS Application Programming Guide*, SC34-6231
- *CICS Application Programming Reference*, SC34-6232
- *CICS System Definition Guide*, SC34-6226

DB2

Database 2 Application Programming and SQL Guide, SC26-4377

DFSMS/MVS

z/OS MVS Program Management: User's Guide and Reference, SA22-7643
z/OS DFSMS DFM Guide and Reference, SC26-7395

IPCS
- *z/OS MVS IPCS User's Guide*, SA22-7596
- *z/OS MVS IPCS Commands*, SA22-7594
- *z/OS MVS IPCS Customization*, SA22-7595

DFSORT

z/OS DFSORT Application Programming Guide, SC26-7523

IMS/ESA

IMS Version 8: Application Programming: Design Guide, SC27-1287
IMS Version 8: Application Programming: Database Manager, SC27-1286
IMS Version 8: Application Programming: Transaction Manager, SC27-1289
IMS Version 8: Application Programming: EXEC DLI Commands for CICS and IMS Version 8, SC27-1288

z/OS

- *z/OS Introduction and Release Guide*, GA22-7502
- *z/OS Program Directory*, GI10-0670
- *z/OS Planning for Installation*, GA22-7504
- *z/OS Information Roadmap*, SA22-7500
- *z/OS Hot Topics Newsletter*, GA22-7501
- *z/OS Licensed Program Specifications*, GA22-7503

z/OS ISPF

- *z/OS ISPF Dialog Tag Language Guide and Reference*, SC34-4824
- *z/OS ISPF Planning and Customizing*, GC34-4814
- *z/OS ISPF Dialog Developer's Guide and Reference*, SC34-4821

z/OS UNIX System Services

- *z/OS UNIX System Services User's Guide*, SA22-7801
- *z/OS UNIX System Services Command Reference*, SA22-7802
- *z/OS UNIX System Services Programming: Assembler Callable Services Reference*, SA22-7803
- *z/OS UNIX System Services Planning*, GA22-7800

z/OS TSO/E

- *z/OS TSO/E Customization*, SA22-7783
- *z/OS TSO/E Programming Services*, SA22-7789
- *z/OS TSO/E System Programming Command Reference*, SA22-7793

Index

Special characters

__abend 168, 476
__alloc 168, 476
__amrc 168, 476
__cabend() function 367, 374, 395
__code 168, 476
__error 168, 476
__feedback 168, 476
__last_op 168, 476
__le_cib_get() function 367
__le_message_get_and_and_write() function 360, 369
__le_message_get() function 369
__le_msg_write() function 360, 369
__msg 169, 478
__reset_exception_handler() function 367
__set_exception_handler() function 367, 368
_BPXK_MDUMP 83, 396
_EDC_ADD_ERRNO2 174, 484

Numerics

64-bit applications 359, 371, 375, 475

A

abend codes
  >= 4000 30, 372
  < 4000 30, 372
  4093 371
  passing to operating system 23
  system, example of 32, 373
  user-specified, example of 32, 373
  user, example of 32, 373, 374
  using 32, 373
abends
  internal, table of output 353
  Language Environment 32, 349, 373
  requested by assembler user exit 23
  system 32, 374
  under CICS 349
  user 32, 374
ABPERC run-time option
  function 8
  generating a system dump and 81
  modifying condition handling behavior and 21
ABTERMENC run-time option 8, 24
  using 24
accessibility 529
AGGREGATE compiler option 4, 6
AMODE 64 applications
  classifying errors 371
  debugging C/C++ 475
  preparing for debugging 359
  using debugging 375
anywhere heap
  statistics 18
APAR (Authorized Program Analysis Report) 525
APAR (Authorized Program Analysis Report) (continued)
  documentation 526
application program interfaces (API) 367, 369
application programs
  debugging
    handling a storage dump written to a BFS file 224, 514
    handling a storage dump written to an HFS file 224, 514
argument
  in dump 62
arguments, registers, and variables for active routines 60, 393
assembler language
  user exit 23, 24
    for CICS 353
    generating a system dump with 81, 395
    modifying condition handling behavior and 23
    using 23, 24
atexit
  information in dump 197
Authorized Program Analysis Report (APAR) 525
automatic variables
  locating in dump 297, 330

B

base locator
  for working storage 246
  in dump 246
below heap
  statistics 18
BLOCKS option of CEE3DMP callable service 37

C

C library function
  trace table entries for 498
C return codes to CICS 350
C-CAA (C-specific common anchor area)
  See C/C++, C-specific common anchor area (C-CAA)
C/C++
  __amrc
    example of structure 168, 476
    information in dump 199
  __msg 169, 478
  atexit
    information in dump 197
  C-specific common anchor area (C-CAA) 197
  cdump() function 185, 488
  compiler options 3
  debugging examples 214, 221, 500
  dump
    information in 198
    parameter in 181
    signal information in 197

© Copyright IBM Corp. 1991, 2009

C/C++ *(continued)*
structure variables, locating in 183
system, structures in 183
file
control block information 198
status and attributes in dump 198
functions
calling dump, example 185, 488
cdump() 43, 185, 377, 488
csnap() 43, 185, 186, 377, 488, 489
ctrace() 43, 185, 186, 377, 488, 489
fetch() 167, 475
fopen() 169, 478
perror() 167, 174, 475, 483
printf() 168, 476
to produce dump output 43, 377
memory file control block 198
stdio.h 168, 476
timestamp 185
CAA (common anchor area) 65, 393, 398, 399, 401, 415, 454
call chain 62
CALL statement
CDUMP/CPDUMP 267
DUMP/PDUMP 266
SDUMP 268
callable services 20
CEE3ABD—terminate enclave with an abend
See CEE3ABD—terminate enclave with an abend
CEE3DMP—generate dump
See CEE3DMP—generate dump
CEE3GRO—returns location offset
See CEE3GRO—returns location offset
CEE3SRP—set resume point
See CEE3SRP—set resume point
CEEDCOD—decompose a condition token
See CEEDCOD—decompose a condition token
CEEHDLR—register user condition handler
See CEEHDLR—register user condition handler
CEEMGET—get a message
See CEEMGET—get a message
CEEMOUT—dispatch a message
See CEEMOUT—dispatch a message
CEEMRCE—move resume cursor to a designated label
See CEEMRCE—move resume cursor to designated label
CEEMRCR—move resume cursor relative to handle cursor
See CEEMRCR—move resume cursor relative to handle cursor
CEEMSG—get, format, and dispatch a message
See CEEMSG—get, format, and dispatch a message
CEESGL—signal a condition
See CEESGL—signal a condition
case 1 condition token 26, 369
case 2 condition token 26, 369
cdump() function 185, 372, 488
CEE prefix 29, 31, 371, 373
CEE3ABD—terminate enclave with an abend 20, 32, 81
generating a dump and 81
handling user abends and 20, 32
modifying condition handling behavior and 20
CEE3DMP—generate dump 35, 62
See also Language Environment dump
generating a Language Environment dump with 35
options 36
relationship to PLIDUMP 289, 325
syntax 36
CEE3GRO—returns location offset 20
CEE3SRP—set resume point 20
CEEBXITA assembler user exit 23
CEECXITA assembler user exit 353
CEEDCOD—decompose a condition token 26
CEEDUMP—Language Environment Dump Service
See Language Environment dump
control blocks 103, 413
locating 153
CEEHDLR—register user condition handler 22
CEEHDLR—register user exception handler 368
CEEMGET—get a message 26
CEEMOUT—dispatch a message 24
CEEMRCE—move resume cursor to designated label 20
CEEMRCR—move resume cursor relative to handle cursor 20
CEEMSG—get, format, and dispatch a message 26
CEESGL—signal a condition 26
CEESTART 167
CEL prefix 371
CELQSTRT 475
character
data dump 267
CHECK run-time option
function 8
modifying condition handling behavior and 21
CHECKOUT compiler option 4
CICS
abends 349
application, from an EXEC CICS command 354
debugging for 347
debugging information, table of locations 347
destination control table (DCT) 347
example traceback in CESE transient data queue 347
examples of output 347
nonzero reason code returned, table of output 353
reason codes 349
register and program status word contents 349
return codes
Language Environment 350
run-time messages 347
transaction
dump 348
rollback 353
class test 238
classifying errors table 29, 371
CLLE (COBOL load list entry) 245
COBCOM control block 250

COBOL
  base locator for working storage 246
  compiler options 5
  debugging examples 250, 263
  dump
    external data in 246
    file information in 246
    linkage section in 246
    local variables in 243
    routine information in 243
    run unit storage in 248
    stack frames for active routines in 243
    working storage in 246
  errors 237
  listings 241
  memory file control block 197
  program class storage 246
  return codes to CICS 350
  routine
    calling Language Environment dump service 241
COBVEC control block 250
command
  syntax diagrams xix
COMMAREA (Communication Area) 349
compiler options
  C 3
  COBOL 5
  Fortran 5
  LP64 359, 475
  PL/I 6
condition
  information
    for active routines 60, 392
    in dump 60, 392
  POSIX 26
  unhandled 27, 370
condition handling
  behavior, modifying 20
  user-written condition handler 20, 22
condition information block (CIB) 62, 74
condition manager 27, 370
CONDITION option of CEE3DMP callable service 38, 62
condition token 25, 26, 368
  case 1 26, 369
  case 2 26, 369
  example of 27, 369
conditions, nested 27, 370
control block
  for active routines 61, 393
csnap() function 186, 489
ctrace() function 186, 372, 489

D

data
  map listing 241
  values 62
DCB (data control block) 245
DCT (destination control table) 347
DEBUG run-time option 8
debugging
  C, examples 214, 221, 500
  COBOL, examples 250, 263
  for CICS 347
  Fortran, examples 273, 279
  PL/I, examples 301, 307, 334, 342
  tool 35, 375
DEPTHCONDLMT run-time option
  function 8, 360
  modifying condition handling behavior and 21
  wait/loop error and 30
diagnosis checklist 521
disability 529
display
  errnojr_value 33
DISPLAY statement 25, 237
displays
  errnojr_value 33
divide-by-zero error 214, 256, 275, 307, 312, 342, 346, 500
DSA (dynamic save area) 63
  See stack, frame
dummy DSA 63
dump
  an area of storage 267
  date in 56, 390
  dynamically allocated storage in 62
  storage
    written to an HFS file 224, 514
  symbolic 268
DUMP suboption of TERMTHDACT run-time option 39, 375
DUMP/PDUMP routine 266
  format specifications 266
  output 266
  usage considerations 266

E

ECB (enclave control block) 61, 393
EDB (enclave data block) 61, 394
EDC prefix 29, 31, 371, 373
edcmtext shell command 33
EIB (exec interface block) 349
enclave
  identifier in dump 58, 390
  member list 61, 62, 394
  storage 62
  termination
    behavior, establishing 24
entry information 56, 389
ENTRY option of CEE3DMP callable service 38
entry point
  name of active routines in dump 391
ERRCOUNT run-time option
  function 8
  modifying condition handling behavior and 21
  wait/loop error and 30
errno 197
errnojr_value
  displaying 33

error
determining source of 521
message while Language Environment was handling another error 27, 370
unanticipated 29, 371
ESD compiler option 6
examples
application abends from 354
C routines 214, 221, 500
calling a nonexistent subroutine 253, 305, 338
COBOL routines 250, 263
divide-by-zero error 214, 256, 275, 307, 312, 342, 346, 500
Fortran routines 273, 279
output under CICS 347
PL/I routines 301, 307, 334, 342
SUBSCRIPTRANGE error 250, 301, 334
exception handling
behavior, modifying 367
user-written exception handler 367
EXEC CICS DUMP statements 349
external data
for COBOL programs in dump 246

F

fetch
fetch information in dump 198
fetch() function 167, 475
fetchable module 167, 475
file
for COBOL, in dump 246
status key 238
file control block (FCB) 198
FILES option of CEE3DMP callable service 37
FLAG compiler option 4
floating point registers
in dump 57
fopen() function 169, 478
FOR prefix 29, 31
Fortran
compiler options 5
debugging examples 273, 279
dump services 265
errors, determining the source of 263
listings 265

G

general purpose registers 57
GMAREA 245
GONUMBER compiler option 4

H

HANDLE ABEND EXEC CICS command 347
header files, C
ctest.h 185, 488
errno.h 214, 500
stdio.h 168, 476
stdlib.h 214, 500
heap storage
created by CEECRHP callable service 19
in LEDATA Output 107, 418
reports 111, 427
storage in dump 62
user 17
HEAP64 run-time option 361
HEAPCHK run-time option
function 8, 112, 360, 428
HEAPPOOLS
storage statistics 226, 227, 517, 518
user-created, __uheapreport() 518
user-created, _uheapreport 227
trace report 87, 118, 399, 435
HEAPPOOLS run-time option 361
HEAPPOOLS64
storage statistics 516
HEAPPOOLS64 run-time option 361

I

I/O
conventions 167, 475
IBM prefix 29, 31
IGZ prefix 29, 31
INFOMSGFILTER run-time option
function 8, 360
INITIALIZE statement 238
instance specific information (ISI) 370
instruction length counter (ILC) in dump 60, 393
Inter-procedural Analysis (IPA) 359
interactive problem control system (IPCS)
analyzing a storage dump 225, 514
cbf command 462
Verbexit 397, 398, 401, 442
INTERRUPT compiler option
function 7
INTERRUPT run-time option 8
interruption code in dump 60, 393
IOHEAP64 run-time option 361
ITBLK in dump 250

K

keyboard 529

L

LAA (library anchor area) 463
language constructs 237
Language Environment
return codes to CICS 350
symbolic feedback code 25, 368
Language Environment dump 375, 377
C information in 196
CEEDUMP 8, 35, 359
COBOL information in 245
default options 38
example traceback in 62, 394
Fortran information in 271
multiple enclaves and 80

Language Environment dump *(continued)*
options
BLOCKS 37
CONDITION 38, 62
ENCLAVE 36
ENTRY 38
FILES 37
FNAME 38
NOBLOCKS 37
NOCONDITION 38
NOENTRY 38
NOFILES 37
NOSTORAGE 37
NOTRACEBACK 37
NOVARIABLES 37
PAGESIZE(n) 38
STACKFRAME 38
STORAGE 37
THREAD 37
TRACEBACK 37, 62
VARIABLES 37, 62
output
for C routines 190
for COBOL program 241
for Fortran routines 271
for PL/I routines 289, 324
information for multiple enclaves 43, 377
PL/I information in 291, 327
section descriptions 56, 389
TERMTHDACT suboptions 40, 376
title 56, 389
traceback with condition information
C routine 190, 492
COBOL program 243
Fortran routine 264, 271, 272
Language Environment routine 56, 389
PL/I routine 289, 324
using C functions 43, 377
using CDUMP/CPDUMP subroutine 265
using CEE3DMP callable service 35, 56, 389
using DUMP/PDUMP subroutine 265
using PLIDUMP subroutine 43, 289, 324
using SDUMP subroutine 265
using TERMTHDACT run-time option 39, 375
LCA (library communication area) 463
LEDATA
IPCS Verbexit 85, 397
C/C++ Output 123, 442
COBOL Output 147
Format 86, 398
Parameters 86, 398
Understanding Output 89, 401
LIBHEAP64 run-time option 361
linkage section
for COBOL programs in dump 246
LIST compiler option 4, 5, 7
listings generated by compiler
COBOL 241
Fortran 265
PL/I 282, 318
LMESSAGE compiler option 7
local
variables 60
LP64
compiler option 359, 475

M

machine state information
in dump 60, 393
mainframe
education xxi
MAP compiler option 5, 7
MEMLIMIT storage parameter 371
memory file control block (MFCB) 197, 198
message
classifying errors and 30, 372
run-time, CICS 347
user-created 24
using in your routine 24
module
fetchable 167, 475
module name prefixes, Language Environment 29, 371
MSG suboption
of TERMTHDACT 39, 375
MSGFILE run-time option
function 8
run-time messages and 30, 372
MSGQ run-time option 8

N

nested condition 27, 370
no response (wait/loop) 30, 372
NOBLOCKS option of CEE3DMP callable service 37
NOCONDITION option of CEE3DMP callable service 38
NOENTRY option of CEE3DMP callable service 38
NOFILES option of CEE3DMP callable service 37
NOSTORAGE option of CEE3DMP callable service 37
Notices 531
NOTRACEBACK option of CEE3DMP callable service 37
NOVARIABLES option of CEE3DMP callable service 37

O

OFFSET compiler option 4, 5, 7
optimizing
C 3, 63
COBOL 5
Fortran 268
PL/I 6
options
C compiler 3
COBOL compiler 5
defaults for dump 40, 376
determining run-time in effect 9, 11, 360
Fortran compiler 5
Language Environment run-time 8, 359

options *(continued)*
PL/I compiler 6, 7
out-of-storage condition
virtual storage 371
OUTDD compiler option 5
output
incorrect 30, 372
missing 30, 372

P

page number
in dump 56, 390
PAGESIZE(n) option of CEE3DMP callable service 38
parameter
checking value of 23
perror() function 174, 483
PL/I
address of interrupt, finding in dump 294, 329
CAA address, finding in dump 300, 333
common anchor area (CAA) 300, 333
compiler listings
object code listing 286
static storage map 285
variable storage map 286
compiler options
generating listings with 282, 318
list of 6
CSECT 285
debugging examples 301, 307, 334, 342
dump
error type, finding in 294, 328
parameter list, finding contents in 298, 331
PL/I information, finding in 291, 298, 327, 331
PLIDUMP subroutine and 289, 324
statement number, finding in 294, 329
timestamp, finding in 298
variables, finding in 297, 330
ERROR ON-unit 280, 294, 316, 328
errors 279, 282, 315, 318
floating-point register 280, 316
object code listing 286
ON statement control block 286
static storage listing 285
SUBSCRIPTRANGE condition 281, 301, 304, 305, 316, 317, 334, 338
PLIDUMP subroutine 289, 325
PMR (problem management record) 525
pointer
variable 167, 475
PPA 523
preventive service planning (PSP) bucket 522
printf() function 25, 168, 476
problem management record (PMR) 525
procedure division listings 241
process
control block 62, 394
member list 62, 394
process control block (PCB) 62, 394
PROFILE run-time option
function 9, 360
program
class storage 246
program prolog area 523
program status word (PSW) 60, 393
PSP (preventive service planning) bucket 522

Q

QUIET suboption of TERMTHDACT run-time option 39, 375

R

reason code
nonzero returned to CICS 353
under CICS 349
registers 0–15
in dump 57
release number
in dump 56, 390
request parameter list (RPL) 198
return code
bad or nonzero 30, 372
RPTOPTS run-time option 9
RPTSTG run-time option 11, 361
run unit
COBOL 248
level control block 248
storage in dump 62, 248
run-time
messages
under CICS 347
run-time options 20, 367
determining those in effect 9, 11, 360
sample options report 9
specifying 23

S

scope
terminator 237
SDUMP routine
description 268
format specifications 268
output 268
usage considerations 268
service routines
CDUMP/CPDUMP 267
DUMP/PDUMP 266
SDUMP 268
SET statement 238
shortcut keys 529
signal information in dump 197
sorted cross-reference listing 241
SOURCE compiler option 4, 5, 7
stack
frame 63
frame format 64, 65
STACK64 run-time option 361
STACKFRAME option of CEE3DMP callable service 38

statement numbers
in dump 57, 390
static
variables in dump 297, 330
writable map 179, 180, 184
status
of routines in dump 392
stderr 25, 372, 375, 376
stdio.h 168, 476
stdout 25
storage
evaluating use of 11, 361
for active routines 61, 393
leak detecting 62, 112, 394, 428
report 11, 361
statistics 17, 18
STORAGE compiler option 7
storage dump
written to an HFS file 224, 514
STORAGE option of CEE3DMP callable service 37
STORAGE run-time option 9, 360
structure
map 183
variable example code 183
symbolic
feedback code 25, 368
symbolic dumps 268
how to call under Fortran 268
syntax diagrams
how to read xix
system abend
with TRAP(OFF) 30, 372
with TRAP(ON) 30, 372
system dump
generating 81, 394
in z/OS UNIX shell 83

T

task global table (TGT) 245
TERMINAL compiler option 4, 7
TERMTHDACT run-time option
function 8, 39, 305, 338, 359, 375
generating a dump and 21, 367
modifying condition handling behavior and 9, 360
suboptions 39, 375
TEST compiler option 4, 5, 6
TEST run-time option 9, 360
text file name prefixes, Language Environment 29, 371
THDCOM in dump 250
THREAD option of CEE3DMP callable service 37
THREADSTACK64 run-time option 361
time
in dump 56, 390
TRACE run-time option
function 9, 360
trace table 154, 466
TRACE suboption of TERMTHDACT run-time option 39, 375
TRACEBACK option of CEE3DMP callable service 37, 62
transaction
dump 349
rollback 353
rollback effects of assembler user exit on 353
work area 349
TRAP run-time option
function 9, 360
Language Environment condition handling and 22, 81, 395
Language Environment exception handling and 368

U

UADUMP suboption of TERMTHDACT run-time option 21, 40, 367, 376
UAIMM suboption of TERMTHDACT run-time option 21, 40, 367, 376
UAONLY suboption of TERMTHDACT run-time option 21, 39, 367, 376
UATRACE suboption of TERMTHDACT run-time option 21, 39, 367, 376
unhandled conditions 24, 27, 370
establishing enclave termination behavior for 24
USE EXCEPTION/ERROR declaratives 238
USE FOR DEBUGGING declarative 239
user
abend 32, 373, 374
code 30, 372
exit 23, 24
heap
statistics 18
stack
statistics 17
user-specified abends 32, 373
USRHDLR run-time option 8, 22, 359
utility and service subroutines
CDUMP/CPDUMP 267
DUMP/PDUMP 266
SDUMP 268

V

variables
in Language Environment dump 62
structure example code 183
VARIABLES option of CEE3DMP callable service 37, 62
VBREF compiler option 5
verb cross-reference 241
Verbexit
LEDATA 85, 397
version number
in dump 56, 390

W

working storage
in dump 61, 246, 393
Writable Static Area 177

X

XPLINK
  downward-growing stack 64
  finding XPLINK information in a dump 206
  stack frame format 64, 65
  storage statistics 17
  trace table entries for 207
XREF compiler option 5, 7
XUFLOW run-time option
  function 9
  modifying condition handling behavior and 22

Z

z/OS Basic Skills information center xxi
z/OS UNIX System Services
  C application program and 224, 514
  generating a system dump 83

Readers' Comments — We'd Like to Hear from You

z/OS
Language Environment
Debugging Guide

Publication No. GA22-7560-10

We appreciate your comments about this publication. Please comment on specific errors or omissions, accuracy, organization, subject matter, or completeness of this book. The comments you send should pertain to only the information in this manual or product and the way in which the information is presented.

For technical questions and information about products and prices, please contact your IBM branch office, your IBM business partner, or your authorized remarketer.

When you send comments to IBM, you grant IBM a nonexclusive right to use or distribute your comments in any way it believes appropriate without incurring any obligation to you. IBM or any other organizations will only use the personal information that you supply to contact you about the issues that you state on this form.

Comments:

Thank you for your support.

Submit your comments using one of these channels:

- Send your comments to the address on the reverse side of this form.
- Send your comments via e-mail to: mhvrcfs@us.ibm.com

If you would like a response from IBM, please fill in the following information:

Name	Address
Company or Organization	
Phone No.	E-mail address

Readers' Comments — We'd Like to Hear from You
GA22-7560-10

Cut or Fold
Along Line

Fold and Tape | **Please do not staple** | Fold and Tape

NO POSTAGE
NECESSARY
IF MAILED IN THE
UNITED STATES

BUSINESS REPLY MAIL

FIRST-CLASS MAIL PERMIT NO. 40 ARMONK, NEW YORK

POSTAGE WILL BE PAID BY ADDRESSEE

IBM Corporation
MHVRCFS, Mail Station P181
2455 South Road
Poughkeepsie, NY
12601-5400

Fold and Tape | **Please do not staple** | Fold and Tape

Cut or Fold
Along Line

Program Number: 5694-A01

Printed in USA

GA22-7560-10