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Trevor Eddolls

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CICS hot-pooling for Java applications – hints and tips

INTRODUCTION

CICS Transaction Server for OS/390 Release 1.3 (CICS TS 1.3) provides major performance improvements for Java application programs compiled using the Enterprise Toolkit for OS/390 Compiler and Binder (also known as the High Performance Java compiler or HPJ) via a technique known as 'hot-pooling'. Support for hot-pooling within CICS TS 1.3 was shipped and enabled via PTF UQ44003.

This article provides guidance on various aspects of hot-pooling utilization.

STACK AND HEAP STORAGE CONSIDERATIONS

For non hot-pooled Java programs, the **-lerunopts** option on the HPJ command (used to compile and bind the program) can specify values such as the Language Environment (LE) stack size. For hot-pooled programs, CICS provides User Replaceable Module (URM) DFHAPH8O, where values such as stack and heap are specified. DFHAPH8O has default initial settings of 128KB for stack storage and 4MB for heap storage.

Since garbage collection is disabled for hot-pooled programs, heap storage usage will grow with each reuse of an LE enclave until CICS determines that the enclave should be terminated and a new one created. This process is handled automatically, and is one of the factors that determines the lifetime of a hot-pooled enclave environment within CICS. You should therefore review the heap storage requirement for your Java programs (see below). 4MB of heap storage may be insufficient for your object requirements, and you will therefore need to increase the heap value specified within DFHAPH8O to provide a larger object storage capacity for the hot-pooled programs.

DFHAPH8O is an optional URM. If it is not available for use, CICS provides default settings for the **lerunopt** parameters used for the hot-pooled enclaves. These defaults are hard-coded within CICS itself. It should be noted that CICS TS 1.3 PTF UQ46069 has modified the hard-coded default value for stack storage from 4KB to 128KB. This makes the hard-coded default stack size the same as that given as the example stack size specification within DFHAPH8O. A 4KB stack size can lead to GETMAINs for additional stack storage by LE when a hot-pooled program is being executed, if this initial stack amount is insufficient for the program's needs. Such additional GETMAINs represent an increase in CPU utilization. For this reason, you should ensure PTF UQ46069 is applied to avoid additional GETMAIN calls/ CPU overhead, if DFHAPH8O is not being used.

LE OPTIONS AND STORAGE REPORTING

You can obtain reports on LE options and storage usage for hot-pooled Java programs by respectively specifying **RPTO(ON)** and **RPTS(ON)** within DFHAPH8O. Note that the supplied version of DFHAPH8O has these settings commented-out within the source. This means that use of the default DFHAPH8O will not generate option and storage reports. If you wish to produce such reports whilst setting up and testing programs in a hot-pooled environment, uncomment the two lines in the DFHAPH8O source code.

Specifying **RPTO(ON)** and **RPTS(ON)** results in additional processing overhead, since the report information is written to transient data queue CESE by LE when the reports are generated at each enclave termination. Requesting both options can result in approximately 200 writes to the CESE queue when one pair of reports is generated.

The supplied definition for CESE is as an extrapartition transient data queue that relates to destination CEEMSG.

DETERMINING HEAP STORAGE USAGE

To determine the heap usage for an enclave, one approach is to set the initial heap size in DFHAPH8O to a small value (eg 4KB). Set

RPTS(ON) as well, by uncommenting it within DFHAPH8O. The first run of a hot-pooled program will use more than this amount of heap, and so force an enclave termination. Analysis of the report generated from **RPTS(ON)** shows how much heap storage was actually required by this run of the program. Some example figures are given below:

```
HEAP statistics:

Initial size:                                    4096

Total heap storage used (sugg initial size):   3174072
```

The storage report shows that in this example 3,174,072 bytes were required for the test run. The amount includes both the initial set-up of the function references for the DLLs used by the program, along with the object storage used by the execution of the program itself. Now set the initial heap size to its intended value (eg 10MB). Re-run the program until another report is generated (as the result of a subsequent enclave termination after a number of reuses of the environment). This time, the example report is as follows:

```
HEAP statistics:

Initial size:                                10485760

Total heap storage used (sugg initial size):  10514808
```

In this example, it had been observed from analysis of the CICS trace that 57 runs of the hot-pooled program managed to use the enclave before it was terminated. So, 10514808-3174072 = 7340736 bytes were used by the last 56 runs, therefore each run used 131KB of heap storage on average for (for example) object storage.

DSA LIMITS AND MAXOPENTCBS VALUES

A CICS task running a hot-pooled Java program uses an LE enclave and an H8 Open TCB, managed by the Open Transaction Environment (OTE). Once a task has linked to a hot-pooled program, it maintains use of this TCB/enclave until the end of task. Each hot-pooled enclave within CICS is associated with a particular H8 TCB. The maximum throughput of hot-pooled transactions in a CICS region can therefore

be determined by dividing the number of available H8 TCBs by the average transaction response time. The number of concurrent H8 TCBs that may coexist within a single CICS region depends on the available storage for that system. The main restriction for this is below-the-line (< 16MB) storage, from both the CICS DSAs and the CICS Private Area storage within the address space.

Using the default LE options as provided within URM DFHAPH8O, an H8 TCB and its associated LE enclave require 6KB of below-the-line CICS Private Area storage and 20KB of below-the-line CICS DSA storage. This storage is in addition to any existing storage requirements that the CICS system may have.

The CICS-supplied statistics transaction STAT can be used when calculating current storage availability in both the CICS DSA and CICS Private Area storage. The following example was taken from such a STAT transaction for a CICS system that was to be used as a hot-pooled application-owning region:

```
Current DSA Limit..... 6,144K (set by DSALIM in the SIT)

Current DSA Used....... 5,196K

(Current DSA Limit) - (Current DSA Used) = (DSA available)

6,144K - 5,196K = 948K
```

Not all the available storage should be used when calculating how many H8 TCBs could exist in a CICS system. To provide sufficient relief from unexpectedly high demands on storage, a DSA buffer of approximately 500KB is recommended to be left. Therefore, assuming that 400KB of CICS DSA may be used by hot-pooled transactions, the example shows that (400K / 20K), or 20 H8 TCBs, could coexist with this CICS region's available DSA.

In the same example, using STAT to return CICS Private Area storage usage shows:

```
Private Area storage available below 16MB....: 1,990K
```

1,990KB would support the 120KB requirement for 20 H8 TCBs. Again, it is recommended that a 500KB buffer of free CICS Private

Area storage be left when determining Private Area availability for hot-pooling use.

OTE system tuning parameter MAXOPENTCBS limits the total number of concurrent Open TCBs that may exist in a given CICS TS 1.3 system. Assuming JVMs are not being used (ie no J8 TCBs exist), MAXOPENTCBS therefore reflects the total number of H8 TCBs that can coexist within a single CICS region. Therefore, attention needs to be paid to ensure that MAXOPENTCBS is not set to too high a value, and that the optimum balance between CICS DSA and Private Area storage needs to be found.

Note that you should use statistics taken at times of peak system activity when making this determination, since you need to know the peak storage requirements for the current system set-up, when determining what additional storage availability may be exploited by hot-pooling transactions. Note also that other subsystems (eg DB2) will utilize CICS Private Area storage too.

The CICS Performance Guide gives further detailed information on Java hot-pooling, and on storage tuning within a CICS system in general.

SUMMARY

The DSA limit should be adjusted to its optimum value, and then MAXOPENTCBS be set to the lesser of (DSA available - 500KB)/ 20KB or (Private Area available - 500KB)/6KB. If this calculation yields too low a number of H8 TCBs to satisfy transaction throughput requirements, one possibility is to spread the applications across multiple CICS Java Application Owning Regions (JORs).

Readers wishing to discuss the material in this article further are welcome to contact me via e-mail, at andy_wright@uk.ibm.com.

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CICS load module information

Ken Rogers, one of our *CICS Update* readers, e-mailed the following query:

I am trying to remember the CICS transaction utility that will tell me:

1 *What CICS load libraries a given CICS load module is located in.*

2 *Which one is currently being executed.*

3 *What the concatenation of load libraries is for a given CICS region.*

I think the easiest way to answer this question is to lead you through a set of CICS CPSM screen shots. CPSM (CICSPlex System Manager) supplies data from all attached CICS address spaces running in a TSO address space on the same plex as the set of CICS address spaces.

So to specifically answer Ken's question above, go into a TSO session, fire up the CSPM TSO End User Interface, and issue the PROGRAM command, which, after *Enter* is pressed, will provide the screen shown below:

```
12JUL2001  16:55:25 ——— INFORMATION DISPLAY ———————————-
COMMAND  ===>                                        SCROLL ===> PAGE
CURR WIN ===> 1        ALT WIN ===>
>W1 =PROGRAM=========PJPLX====PJPLX====12JUL2001==16:54:56==CPSM=====76
CMD Program  CICS Enabled Use    Current Program   Shared  CEDF   Copy
— Name——  System— Status— Count— Use—— Language- Status  Option Require
EYUTVOMD IYCWZCGF ENABLED  0       0 ASSEMBLER PRIVATE NOCEDF NOTREQU
EYUTVOSE IYCWZCGF ENABLED  0       0 ASSEMBLER PRIVATE NOCEDF NOTREQU
EYUTVOSK IYCWZCGF ENABLED  0       0 ASSEMBLER PRIVATE NOCEDF NOTREQU
EYUTVOSS IYCWZCGF ENABLED  0       0 ASSEMBLER PRIVATE NOCEDF NOTREQU
EYUTVTGE IYCWZCGF ENABLED  0       0 ASSEMBLER PRIVATE NOCEDF NOTREQU
EYUTVTGK IYCWZCGF ENABLED  0       0 ASSEMBLER PRIVATE NOCEDF NOTREQU
EYUTVTGS IYCWZCGF ENABLED  0       0 ASSEMBLER PRIVATE NOCEDF NOTREQU
EYUTVTHE IYCWZCGF ENABLED  0       0 ASSEMBLER PRIVATE NOCEDF NOTREQU
EYUTVTHK IYCWZCGF ENABLED  0       0 ASSEMBLER PRIVATE NOCEDF NOTREQU
EYUTVTHS IYCWZCGF ENABLED  0       0 ASSEMBLER PRIVATE NOCEDF NOTREQU
EYUTVTJE IYCWZCGF ENABLED  0       0 ASSEMBLER PRIVATE NOCEDF NOTREQU
EYUTVTJK IYCWZCGF ENABLED  0       0 ASSEMBLER PRIVATE NOCEDF NOTREQU
EYUTVTJS IYCWZCGF ENABLED  0       0 ASSEMBLER PRIVATE NOCEDF NOTREQU
```

```
 EYUTVTME IYCWZCGF ENABLED  Ø       Ø ASSEMBLER PRIVATE NOCEDF NOTREQU
 EYUTVTMK IYCWZCGF ENABLED  Ø       Ø ASSEMBLER PRIVATE NOCEDF NOTREQU
 EYUTVTMS IYCWZCGF ENABLED  Ø       Ø ASSEMBLER PRIVATE NOCEDF NOTREQU
 EYUTVTSE IYCWZCGF ENABLED  Ø       Ø ASSEMBLER PRIVATE NOCEDF NOTREQU
 EYUTVTSK IYCWZCGF ENABLED  Ø       Ø ASSEMBLER PRIVATE NOCEDF NOTREQU
```

If we wanted information on program EYUTVOMD, tab down the display till the cursor is under its name and hit *Enter*. The following detail screen results:

```
12JUL2ØØ1  16:54:56 ——— INFORMATION DISPLAY ———————————-
COMMAND  ===>                                          SCROLL ===> PAGE
CURR WIN ===> 1        ALT WIN ===>
<W1 =PROGRAM==PROGRAMD=PJPLX===PJPLX===12JUL2ØØ1==16:54:56===CPSM======1
    CICS System...    IYCWZCGF Curr Use Cnt.          1Ø
    Exec Key...... CICSEXECKEY Tot Use Cnt..          11
    Execution Set.     FULLAPI Use In Intvl.          11
    Mirror Tranid.             Newcopy Cnt..           Ø
    Shared Status.     PRIVATE Removed Cnt..           Ø
    LPA/SVA Stat..      NOTLPA Fetch Cnt....           1
    Current Loc...        RDSA RPL Number...           8
    Held Status...      NOHOLD Remote Name..
    Fetch Time.... ØØ:ØØ:ØØ.Ø1 Remote Sysid.
    Avg Fetch Time ØØ:ØØ:ØØ.Ø1 Copy Required NOTREQUIRED
    Concurrency...   QUASIRENT Runtime......    NONLE37Ø
    JVM Debug.....     NODEBUG
    JVM Profile...    DFHJVMPR
```

The answer to question 2 lies in the RPL number – 8 in this case. Tab down to this field and hit *Enter*. The following screen results, detailing the RPL concatenation; so 8 maps to BLDBSF.PLUXA .SEYULOAD – so answering question 3:

```
 12JUL2ØØ1  16:53:5Ø ——— INFORMATION DISPLAY ———————————-
 COMMAND  ===>                                          SCROLL ===> PAGE
 CURR WIN ===> 1        ALT WIN ===>
  W1 =RPLLISTD======PJPLX====PJPLX====12JUL2ØØ1==16:53:5Ø===CPSM======2Ø
  RPL CICS     Dataset
  Num System— Name———————————————
    Ø IYCWZCGF CPSMDEV.PJOHNSO.LOAD
    1 IYCWZCGF CPSMDEV.TEST.LOAD
    2 IYCWZCGF CPSMDEV.BSF.LOAD
    3 IYCWZCGF CPSMDEV.DUMMY.LOAD
    4 IYCWZCGF UTL.PJOHNSO.LOAD
    5 IYCWZCGF CPSMDEV.TABLE62Ø.LOAD
    6 IYCWZCGF PUBPLU.CPSM.LOAD
    7 IYCWZCGF PUBPLU.CPSM.TABLES
    8 IYCWZCGF BLDBSF.PLUXA.SEYULOAD
    9 IYCWZCGF PP.ADLE37Ø.OS39Ø21Ø.SCEECICS
```

```
10 IYCWZCGF PP.ADLE370.OS390210.SCEERUN
11 IYCWZCGF PP.PLI.V230.PLIBASE
12 IYCWZCGF PP.PLI.V230.PLILINK
13 IYCWZCGF PP.PLI.V230.SIBMBASE
14 IYCWZCGF BLDBSF.PLUXA.SDFHLOAD
15 IYCWZCGF BLDBSF.PLUXA.SDFHLOAD
16 IYCWZCGF BLDBSF.PLUXA.SDFHLOAD
17 IYCWZCGF BLDBSF.PLUXA.SDFHAUTH
```

To find which libraries a given program is located in, you could use the above list of libraries and search them via the library list utility under TSO (via cut and paste into a split screen). An alternative programming solution could use the EXEC CICSPlex SM application Programming Interface – see *CICS Update*, *Utilizing the power of the CICSPlex SM Web User Interface*, Issue 191, October 2001.

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Contributing to *CICS Update*

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Articles can be e-mailed to Trevor Eddolls at trevore@xephon.com. A copy of our *Notes for Contributors* is available from www.xephon.com/nfc.

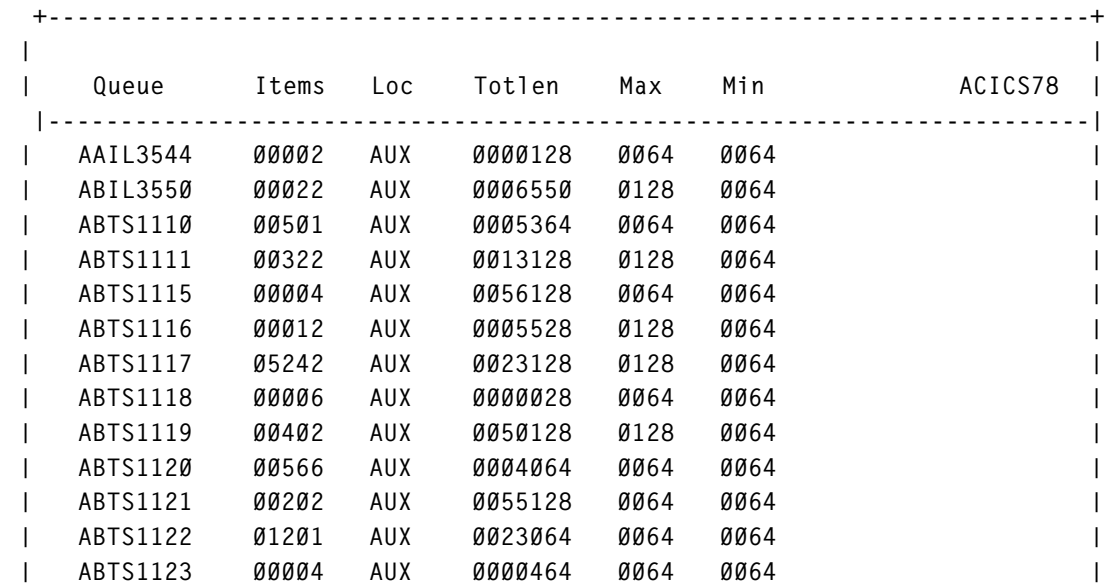
Displaying Temporary Storage queues

CICS provides CEBR as the standard transaction for the visualization of temporary storage queues. However, you must know beforehand the name of the queue you want to browse. If you are not sure what queue you are looking for, then it can be difficult to find what you want, specially if the number of queues in the system is large.

To solve this problem, I created a program that shows all the TS queues in a CICS region, along with each one's characteristics, as you can see below. To browse a queue, just put the cursor in the respective line and press *Enter*. The queue browsing is limited to the first 78 characters of each line, but that should be sufficient in most cases. If you need more complete browsing, then call CEBR for that queue. When you are in the visualization screen, you can jump directly to a specific line item by placing the desired item number in the **Item Nr** field that appears on top of it.

This application consists of a program (TSVIEW) and two BMS maps – one to show the queue names (TSVIEW1) and the other to display them (TSVIEW2). You can assign TSVIEW any transaction you want, because the program always returns to whatever transaction it was called by.

An example of the queue list screen is shown below:



Queue	Items	Loc	Totlen	Max	Min	ACICS78
AAIL3544	00002	AUX	0000128	0064	0064	
ABIL3550	00022	AUX	0006550	0128	0064	
ABTS1110	00501	AUX	0005364	0064	0064	
ABTS1111	00322	AUX	0013128	0128	0064	
ABTS1115	00004	AUX	0056128	0064	0064	
ABTS1116	00012	AUX	0005528	0128	0064	
ABTS1117	05242	AUX	0023128	0128	0064	
ABTS1118	00006	AUX	0000028	0064	0064	
ABTS1119	00402	AUX	0050128	0128	0064	
ABTS1120	00566	AUX	0004064	0064	0064	
ABTS1121	00202	AUX	0055128	0064	0064	
ABTS1122	01201	AUX	0023064	0064	0064	
ABTS1123	00004	AUX	0000464	0064	0064	

```
|   ABTS1300    00087   AUX    0000664   0064   0064                    |
|   ACFR1000    00459   AUX    0003876   0064   0064                    |
|   ACFR1001    00034   AUX    0003064   0064   0064                    |
|   ACFR1006    00007   AUX    0000464   0064   0064                    |
|   ACFR1100    00011   AUX    0000047   0064   0064      PF7 Prev page  |
|   ACFR1101    00076   AUX    0004164   0064   0064      PF8 Next page  |
|   BMZZ9000    00337   MAIN   0006612   0128   0128      PF3 Exit       |
 |-------------------------------------------------------------------------|
|   Place the cursor in front of a queue and press ENTER to display       |
|                                                                         |
 +-------------------------------------------------------------------------+
```

TSVIEW SOURCE CODE

```
       IDENTIFICATION DIVISION.
       PROGRAM-ID. TSVIEW.
      *=================================================================*
       ENVIRONMENT DIVISION.
       DATA DIVISION.
       WORKING-STORAGE SECTION.
       77  LIXO                PIC X     VALUE SPACE.
       77  X                   PIC 9(4)  COMP VALUE 0.
       77  Y                   PIC 9(4)  COMP VALUE 0.
       77  Z                   PIC 9(4)  COMP VALUE 78.
       77  Z1                  PIC 9(4)  COMP VALUE 78.
       77  QPLIMIT             PIC 9(4)  COMP VALUE 100.
       77  CURPOS              PIC S9(2) VALUE +0.
       77  COMMAREAL           PIC 9(4)  COMP VALUE 3900.
       77  SCREEN1-LINES       PIC 9(4)  COMP VALUE 20.
       77  SCREEN2-LINES       PIC 9(4)  COMP VALUE 20.
           COPY DFHAID.
       01  WORK-FIELDS.
           02   TXT.
              03   FILLER          PIC X(3).
              03   TXT-NUMITEMS    PIC 9(5).
              03   FILLER          PIC X(3).
              03   TXT-LOCATION    PIC X(4).
              03   FILLER          PIC X(3).
              03   TXT-FLENGTH     PIC 9(7).
              03   FILLER          PIC X(3).
              03   TXT-MAXL        PIC 9(4).
              03   FILLER          PIC X(3).
              03   TXT-MINL        PIC 9(4).
              03   FILLER          PIC X(7).

           02   TS-FIELDS.
              03   TS-QUEUE        PIC X(8).
              03   TS-NUMITEMS     PIC S9(4)  COMP.
              03   TS-FLENGTH      PIC S9(8)  COMP.
```

```
           03   TS-LOCATION     PIC S9(8)  COMP.
           03   TS-MAXITEMLEN   PIC S9(4)  COMP.
           03   TS-MINITEMLEN   PIC S9(4)  COMP.
           03   FILLER          PIC X(54).

        02   W-RESP             PIC S9(8)  COMP.
        02   W-RESP2            PIC S9(8)  COMP.
        02   W-NUMERIC8         PIC 9(8).
        02   FILLER REDEFINES W-NUMERIC8.
           03   FILLER          PIC X.
           03   W-NUMERIC7      PIC 9(7).
        02   FILLER REDEFINES W-NUMERIC8.
           03   FILLER          PIC X(3).
           03   W-NUMERIC5      PIC 9(5).
        02   FILLER REDEFINES W-NUMERIC8.
           03   FILLER          PIC X(4).
           03   W-NUMERIC4      PIC 9(4).

     01  COMMAREA.
        02   SELFLAG            PIC 9.
        02   NEXT-QUEUE         PIC X(8).
        02   QUEUE-DISPLAY      PIC X(8).
        02   Q-NRECX            PIC X(5).
        02   Q-NREC9 REDEFINES Q-NRECX PIC 9(5).
        02   QUEUE-NRECS        PIC S9(4) COMP.
        02   QUEUE-ITEM         PIC S9(4) COMP.
        02   QUEUE-EXTRA        PIC S9(4) COMP.
        02   QP                 PIC S9(4) COMP.
        02   QUEUE-FILLER       PIC X(800).
        02   QUEUE-TABLE REDEFINES QUEUE-FILLER
                                 PIC X(8) OCCURS 100.
        02   TSVIEW1I.
           03   FILLER          PIC X(12).
           03   SISIDL          PIC S9(4) COMP.
           03   SISIDA          PIC X.
           03   SISIDI          PIC X(8).
           03   SCREEN1-LINE  OCCURS 20.
              04  CMDL          PIC S9(4) COMP.
              04  CMDA          PIC X.
              04  CMDI          PIC X(3).
              04  QUEL          PIC S9(4) COMP.
              04  QUEA          PIC X.
              04  QUEI          PIC X(8).
              04  TXTL          PIC S9(4) COMP.
              04  TXTA          PIC X.
              04  TXTI          PIC X(46).
        02   TSVIEW1O REDEFINES TSVIEW1I PIC X(1343).

        02   TSVIEW2I.
           03   FILLER PIC X(12).
```

```
        03   QNAME2L         PIC S9(4) COMP.
        03   QNAME2A         PIC X.
        03   QNAME2I         PIC X(8).
        03   SITEM2L         PIC S9(4) COMP.
        03   SITEM2A         PIC X.
        03   SITEM2I         PIC 9(5).
        03   SCREEN2-LINE  OCCURS 20.
           04  QLINEL        PIC S9(4) COMP.
           04  QLINEA        PIC X.
           04  QLINEI        PIC X(78).
     02   TSVIEW2O REDEFINES TSVIEW2I PIC X(1651).
     02   FILLER             PIC X(500).
*
 LINKAGE SECTION.
*================================================================*
 01  DFHCOMMAREA.
     02  FILLER           PIC X(4000).
*================================================================*
 PROCEDURE DIVISION.
*================================================================*
*
     MOVE LOW-VALUES TO WORK-FIELDS COMMAREA.
*
 FIRST-TIME-ONLY.
*================*
     IF EIBCALEN = 0
        EXEC CICS ASSIGN APPLID (SISIDI)
        END-EXEC
        MOVE 1 TO QP
        MOVE SPACES TO QUEUE-FILLER
        PERFORM NEXT-PAGE1
        PERFORM GET-FIRST-FORWARD
        PERFORM SEND-MAP1
        MOVE 1 TO SELFLAG
        GO TO RETURN-TRANSID
     END-IF.
*
 OTHER-TIMES.
*===========*
     MOVE DFHCOMMAREA TO COMMAREA
     IF SELFLAG = 1
        PERFORM RECEIVE-MAP1
        IF EIBAID = DFHENTER
           PERFORM CHECK-COMMAND
        END-IF
        IF EIBAID = DFHPF7 OR EIBAID = DFHPF19
           IF QP > 1
              SUBTRACT 1 FROM QP
           END-IF
           MOVE QUEUE-TABLE(QP) TO NEXT-QUEUE
```

```
            PERFORM NEXT-PAGE1
         END-IF
         IF EIBAID = DFHPF8 OR EIBAID = DFHPF20
            IF QP < QPLIMIT
               ADD 1 TO QP
            END-IF
            MOVE QUEUE-TABLE(QP) TO NEXT-QUEUE
            PERFORM NEXT-PAGE1
            PERFORM GET-FIRST-FORWARD
         END-IF
         PERFORM SEND-MAP1
         GO TO RETURN-TRANSID
      END-IF.

      IF SELFLAG = 2
         PERFORM RECEIVE-MAP2
         IF EIBAID = DFHPF7 OR EIBAID = DFHPF19
            PERFORM PREV-PAGE2
         ELSE
            PERFORM NEXT-PAGE2
         END-IF
         PERFORM SEND-MAP2
         GO TO RETURN-TRANSID
      END-IF.
*
*================================================================*
*    Subroutines
*================================================================*
*
 NEXT-PAGE1.
*==========*
      PERFORM CLEAN-SCREEN1 VARYING X FROM 1 BY 1
              UNTIL X > SCREEN1-LINES
      EXEC CICS INQUIRE TSQUEUE START
      END-EXEC
      MOVE 0 TO X
      PERFORM LOAD-SCREEN1 THRU LOAD-SCREEN1-EXIT
              UNTIL X > SCREEN1-LINES.
*
 LOAD-SCREEN1.
*============*
      EXEC CICS INQUIRE TSQUEUE     (TS-QUEUE)
                        NUMITEMS    (TS-NUMITEMS)
                        FLENGTH     (TS-FLENGTH)
                        LOCATION    (TS-LOCATION)
                        MAXITEMLEN  (TS-MAXITEMLEN)
                        MINITEMLEN  (TS-MINITEMLEN)
                        RESP        (W-RESP)
                        RESP2       (W-RESP2)
                        NEXT
```

```
      END-EXEC
      IF W-RESP2 > Ø
         MOVE 21 TO X
         GO TO LOAD-SCREEN1-EXIT
      END-IF.
      IF TS-QUEUE < NEXT-QUEUE
         GO TO LOAD-SCREEN1-EXIT
      END-IF.
      ADD 1 TO X
      IF X > SCREEN1-LINES
         GO TO LOAD-SCREEN1-EXIT
      END-IF.
      IF TS-LOCATION = DFHVALUE(MAIN)
         MOVE 'MAIN'  TO  TXT-LOCATION
      END-IF.
      IF TS-LOCATION = DFHVALUE(AUXILIARY)
         MOVE 'AUX '  TO  TXT-LOCATION
      END-IF
      MOVE  TS-NUMITEMS    TO  W-NUMERIC8
      MOVE  W-NUMERIC5     TO  TXT-NUMITEMS
      MOVE  TS-FLENGTH     TO  W-NUMERIC8
      MOVE  W-NUMERIC7     TO  TXT-FLENGTH
      MOVE  TS-MAXITEMLEN  TO  W-NUMERIC8
      MOVE  W-NUMERIC4     TO  TXT-MAXL
      MOVE  TS-MINITEMLEN  TO  W-NUMERIC8
      MOVE  W-NUMERIC4     TO  TXT-MINL
      MOVE  TXT            TO  TXTI(X)
      MOVE  TS-QUEUE       TO  QUEI(X).
*
 LOAD-SCREEN1-EXIT.
*=================*
      EXIT.
*
 CLEAN-SCREEN1.
*=============*
      MOVE SPACES TO TXT TXTI(X) QUEI(X) CMDI(X).
*
 GET-FIRST-FORWARD.
*=================*
      EXEC CICS INQUIRE TSQUEUE (TS-QUEUE)
      END-EXEC
      IF QP < QPLIMIT
         ADD 1 TO QP
      END-IF
      MOVE TS-QUEUE TO QUEUE-TABLE(QP)
      SUBTRACT 1 FROM QP.
*
 CHECK-COMMAND.
*=============*
      COMPUTE CURPOS = EIBCPOSN / 8Ø - 1.
```

```
      IF CURPOS GREATER Ø AND
         CURPOS NOT GREATER SCREEN1-LINES
         MOVE QUEI(CURPOS) TO QUEUE-DISPLAY QNAME2I
         MOVE '*' TO CMDI(CURPOS)
         MOVE TXTI(CURPOS)(4:5) TO Q-NRECX
         MOVE Q-NREC9 TO QUEUE-NRECS
         MOVE 2 TO SELFLAG
         MOVE 1 TO QUEUE-ITEM
         MOVE Ø TO QUEUE-EXTRA
         PERFORM NEXT-PAGE2
         PERFORM SEND-MAP2
         GO TO RETURN-TRANSID
      END-IF.
*
 NEXT-PAGE2.
*==========*
      IF SITEM2L > Ø AND SITEM2I NUMERIC
         IF SITEM2I > Ø AND SITEM2I < QUEUE-NRECS
            MOVE SITEM2I TO QUEUE-ITEM
         END-IF
         IF SITEM2I > QUEUE-NRECS
            SUBTRACT 19 FROM QUEUE-NRECS GIVING QUEUE-ITEM
         END-IF
         IF SITEM2I < 1
            MOVE 1 TO QUEUE-ITEM
         END-IF
      END-IF
      IF QUEUE-ITEM LESS 1
         MOVE 1 TO QUEUE-ITEM
      END-IF
      EXEC CICS IGNORE CONDITION LENGERR
      END-EXEC
      PERFORM CLEAN-SCREEN2 VARYING Y FROM 1 BY 1
           UNTIL Y > SCREEN2-LINES
      PERFORM LOAD-SCREEN2 THRU LOAD-SCREEN2-EXIT
           VARYING Y FROM 1 BY 1 UNTIL Y > SCREEN2-LINES
      IF QUEUE-ITEM > QUEUE-NRECS
         MOVE SITEM2I TO QUEUE-ITEM
         MOVE 2Ø TO QUEUE-EXTRA
      END-IF.
*
 PREV-PAGE2.
*==========*
      SUBTRACT 4Ø FROM QUEUE-ITEM
      ADD QUEUE-EXTRA TO QUEUE-ITEM
      MOVE Ø TO QUEUE-EXTRA
      IF QUEUE-ITEM LESS 1
         MOVE 1 TO QUEUE-ITEM
      END-IF
      EXEC CICS IGNORE CONDITION LENGERR
```

```
     END-EXEC
     PERFORM CLEAN-SCREEN2 VARYING Y FROM 1 BY 1
          UNTIL Y > SCREEN2-LINES
     PERFORM LOAD-SCREEN2 THRU LOAD-SCREEN2-EXIT
          VARYING Y FROM 1 BY 1 UNTIL Y > SCREEN2-LINES.
*
 LOAD-SCREEN2.
*============*
     IF QUEUE-ITEM > QUEUE-NRECS
        GO TO LOAD-SCREEN2-EXIT
     END-IF
     IF Y = 1
        MOVE QUEUE-ITEM TO SITEM2I
     END-IF
     MOVE Z TO Z1
     EXEC CICS READQ TS QUEUE (QUEUE-DISPLAY)
                        ITEM  (QUEUE-ITEM)
                        INTO  (QLINEI(Y))
                        LENGTH(Z1)
     END-EXEC
     ADD 1 TO QUEUE-ITEM.
*
 LOAD-SCREEN2-EXIT.
*=================*
     EXIT.
*
 CLEAN-SCREEN2.
*=============*
     MOVE SPACES TO QLINEI(Y).
*
 RECEIVE-MAP1.
*============*
     EXEC CICS RECEIVE MAP('TSVIEW1')
     END-EXEC.
     IF EIBAID = DFHPF3 OR EIBAID = DFHPF15
        GO TO EXIT-PROGRAM
     END-IF.
*
 SEND-MAP1.
*=========*
     EXEC CICS SEND MAP('TSVIEW1') ERASE
     END-EXEC.
*
 RECEIVE-MAP2.
*============*
     EXEC CICS RECEIVE MAP('TSVIEW2')
     END-EXEC.
     IF EIBAID = DFHPF3 OR EIBAID = DFHPF15
        MOVE 1 TO SELFLAG
        PERFORM SEND-MAP1
```

```
              GO TO RETURN-TRANSID
           END-IF.
      *
       SEND-MAP2.
      *=========*
           EXEC CICS SEND MAP('TSVIEW2') ERASE
           END-EXEC.
      *
       RETURN-TRANSID.
      *==============*
           EXEC CICS RETURN TRANSID  (EIBTRNID)
                            COMMAREA (COMMAREA)
                            LENGTH   (COMMAREAL)
           END-EXEC.
      *
       EXIT-PROGRAM.
      *============*
           EXEC CICS SEND FROM(LIXO) LENGTH(1) ERASE
           END-EXEC
           EXEC CICS RETURN
           END-EXEC.
           GOBACK.
```

TSVIEW1 SOURCE CODE

```
MAPSET   DFHMSD TYPE=&SYSPARM,MODE=INOUT,CTRL=(FREEKB),                *
               LANG=COBOL,TIOAPFX=YES,EXTATT=MAPONLY
*
TSVIEW1  DFHMDI SIZE=(24,8Ø)
*
         DFHMDF POS=(Ø1,Ø6),LENGTH=46,ATTRB=(ASKIP,PROT),              *
               COLOR=TURQUOISE,                                        *
               INITIAL='Queue      Items   Loc    Totlen    Max    Min'
SISID    DFHMDF POS=(Ø1,68),LENGTH=Ø8,ATTRB=(PROT,FSET),               *
               COLOR=DEFAULT
*
         DFHMDF POS=(Ø2,Ø1),LENGTH=76,ATTRB=(ASKIP,PROT),              *
               COLOR=RED,                                              *
               INITIAL='————————————————————————*
               ————————————————'
*
CMDØ1    DFHMDF POS=(Ø3,Ø1),LENGTH=Ø3,ATTRB=(UNPROT,FSET),             *
               COLOR=RED
QUEØ1    DFHMDF POS=(Ø3,Ø5),LENGTH=Ø8,ATTRB=(ASKIP,PROT,FSET),         *
               COLOR=YELLOW
TXTØ1    DFHMDF POS=(Ø3,14),LENGTH=46,ATTRB=(ASKIP,PROT,FSET),         *
               COLOR=TURQUOISE
*
CMDØ2    DFHMDF POS=(Ø4,Ø1),LENGTH=Ø3,ATTRB=(UNPROT,FSET),             *
```

```
              COLOR=RED
QUEØ2     DFHMDF POS=(Ø4,Ø5),LENGTH=Ø8,ATTRB=(ASKIP,PROT,FSET),          *
              COLOR=YELLOW
TXTØ2     DFHMDF POS=(Ø4,14),LENGTH=46,ATTRB=(ASKIP,PROT,FSET),          *
              COLOR=TURQUOISE
*
CMDØ3     DFHMDF POS=(Ø5,Ø1),LENGTH=Ø3,ATTRB=(UNPROT,FSET),              *
              COLOR=RED
QUEØ3     DFHMDF POS=(Ø5,Ø5),LENGTH=Ø8,ATTRB=(ASKIP,PROT,FSET),          *
              COLOR=YELLOW
TXTØ3     DFHMDF POS=(Ø5,14),LENGTH=46,ATTRB=(ASKIP,PROT,FSET),          *
              COLOR=TURQUOISE
*
CMDØ4     DFHMDF POS=(Ø6,Ø1),LENGTH=Ø3,ATTRB=(UNPROT,FSET),              *
              COLOR=RED
QUEØ4     DFHMDF POS=(Ø6,Ø5),LENGTH=Ø8,ATTRB=(ASKIP,PROT,FSET),          *
              COLOR=YELLOW
TXTØ4     DFHMDF POS=(Ø6,14),LENGTH=46,ATTRB=(ASKIP,PROT,FSET),          *
              COLOR=TURQUOISE
*
CMDØ5     DFHMDF POS=(Ø7,Ø1),LENGTH=Ø3,ATTRB=(UNPROT,FSET),              *
              COLOR=RED
QUEØ5     DFHMDF POS=(Ø7,Ø5),LENGTH=Ø8,ATTRB=(ASKIP,PROT,FSET),          *
              COLOR=YELLOW
TXTØ5     DFHMDF POS=(Ø7,14),LENGTH=46,ATTRB=(ASKIP,PROT,FSET),          *
              COLOR=TURQUOISE
*
CMDØ6     DFHMDF POS=(Ø8,Ø1),LENGTH=Ø3,ATTRB=(UNPROT,FSET),              *
              COLOR=RED
QUEØ6     DFHMDF POS=(Ø8,Ø5),LENGTH=Ø8,ATTRB=(ASKIP,PROT,FSET),          *
              COLOR=YELLOW
TXTØ6     DFHMDF POS=(Ø8,14),LENGTH=46,ATTRB=(ASKIP,PROT,FSET),          *
              COLOR=TURQUOISE
*
CMDØ7     DFHMDF POS=(Ø9,Ø1),LENGTH=Ø3,ATTRB=(UNPROT,FSET),              *
              COLOR=RED
QUEØ7     DFHMDF POS=(Ø9,Ø5),LENGTH=Ø8,ATTRB=(ASKIP,PROT,FSET),          *
              COLOR=YELLOW
TXTØ7     DFHMDF POS=(Ø9,14),LENGTH=46,ATTRB=(ASKIP,PROT,FSET),          *
              COLOR=TURQUOISE
*
CMDØ8     DFHMDF POS=(1Ø,Ø1),LENGTH=Ø3,ATTRB=(UNPROT,FSET),              *
              COLOR=RED
QUEØ8     DFHMDF POS=(1Ø,Ø5),LENGTH=Ø8,ATTRB=(ASKIP,PROT,FSET),          *
              COLOR=YELLOW
TXTØ8     DFHMDF POS=(1Ø,14),LENGTH=46,ATTRB=(ASKIP,PROT,FSET),          *
              COLOR=TURQUOISE
*
CMDØ9     DFHMDF POS=(11,Ø1),LENGTH=Ø3,ATTRB=(UNPROT,FSET),              *
              COLOR=RED
```

```
QUEØ9    DFHMDF POS=(11,Ø5),LENGTH=Ø8,ATTRB=(ASKIP,PROT,FSET),         *
               COLOR=YELLOW
TXTØ9    DFHMDF POS=(11,14),LENGTH=46,ATTRB=(ASKIP,PROT,FSET),         *
               COLOR=TURQUOISE
*
CMD1Ø    DFHMDF POS=(12,Ø1),LENGTH=Ø3,ATTRB=(UNPROT,FSET),             *
               COLOR=RED
QUE1Ø    DFHMDF POS=(12,Ø5),LENGTH=Ø8,ATTRB=(ASKIP,PROT,FSET),         *
               COLOR=YELLOW
TXT1Ø    DFHMDF POS=(12,14),LENGTH=46,ATTRB=(ASKIP,PROT,FSET),         *
               COLOR=TURQUOISE
*
CMD11    DFHMDF POS=(13,Ø1),LENGTH=Ø3,ATTRB=(UNPROT,FSET),             *
               COLOR=RED
QUE11    DFHMDF POS=(13,Ø5),LENGTH=Ø8,ATTRB=(ASKIP,PROT,FSET),         *
               COLOR=YELLOW
TXT11    DFHMDF POS=(13,14),LENGTH=46,ATTRB=(ASKIP,PROT,FSET),         *
               COLOR=TURQUOISE
*
CMD12    DFHMDF POS=(14,Ø1),LENGTH=Ø3,ATTRB=(UNPROT,FSET),             *
               COLOR=RED
QUE12    DFHMDF POS=(14,Ø5),LENGTH=Ø8,ATTRB=(ASKIP,PROT,FSET),         *
               COLOR=YELLOW
TXT12    DFHMDF POS=(14,14),LENGTH=46,ATTRB=(ASKIP,PROT,FSET),         *
               COLOR=TURQUOISE
*
CMD13    DFHMDF POS=(15,Ø1),LENGTH=Ø3,ATTRB=(UNPROT,FSET),             *
               COLOR=RED
QUE13    DFHMDF POS=(15,Ø5),LENGTH=Ø8,ATTRB=(ASKIP,PROT,FSET),         *
               COLOR=YELLOW
TXT13    DFHMDF POS=(15,14),LENGTH=46,ATTRB=(ASKIP,PROT,FSET),         *
               COLOR=TURQUOISE
*
CMD14    DFHMDF POS=(16,Ø1),LENGTH=Ø3,ATTRB=(UNPROT,FSET),             *
               COLOR=RED
QUE14    DFHMDF POS=(16,Ø5),LENGTH=Ø8,ATTRB=(ASKIP,PROT,FSET),         *
               COLOR=YELLOW
TXT14    DFHMDF POS=(16,14),LENGTH=46,ATTRB=(ASKIP,PROT,FSET),         *
               COLOR=TURQUOISE
*
CMD15    DFHMDF POS=(17,Ø1),LENGTH=Ø3,ATTRB=(UNPROT,FSET),             *
               COLOR=RED
QUE15    DFHMDF POS=(17,Ø5),LENGTH=Ø8,ATTRB=(ASKIP,PROT,FSET),         *
               COLOR=YELLOW
TXT15    DFHMDF POS=(17,14),LENGTH=46,ATTRB=(ASKIP,PROT,FSET),         *
               COLOR=TURQUOISE
         DFHMDF POS=(17,61),LENGTH=Ø1,ATTRB=(ASKIP,PROT)
*
CMD16    DFHMDF POS=(18,Ø1),LENGTH=Ø3,ATTRB=(UNPROT,FSET),             *
               COLOR=RED
```

```
QUE16    DFHMDF POS=(18,Ø5),LENGTH=Ø8,ATTRB=(ASKIP,PROT,FSET),         *
               COLOR=YELLOW
TXT16    DFHMDF POS=(18,14),LENGTH=46,ATTRB=(ASKIP,PROT,FSET),         *
               COLOR=TURQUOISE
*
CMD17    DFHMDF POS=(19,Ø1),LENGTH=Ø3,ATTRB=(UNPROT,FSET),             *
               COLOR=RED
QUE17    DFHMDF POS=(19,Ø5),LENGTH=Ø8,ATTRB=(ASKIP,PROT,FSET),         *
               COLOR=YELLOW
TXT17    DFHMDF POS=(19,14),LENGTH=46,ATTRB=(ASKIP,PROT,FSET),         *
               COLOR=TURQUOISE
*
CMD18    DFHMDF POS=(2Ø,Ø1),LENGTH=Ø3,ATTRB=(UNPROT,FSET),             *
               COLOR=RED
QUE18    DFHMDF POS=(2Ø,Ø5),LENGTH=Ø8,ATTRB=(ASKIP,PROT,FSET),         *
               COLOR=YELLOW
TXT18    DFHMDF POS=(2Ø,14),LENGTH=46,ATTRB=(ASKIP,PROT,FSET),         *
               COLOR=TURQUOISE
         DFHMDF POS=(2Ø,63),LENGTH=13,ATTRB=(ASKIP,PROT),              *
               COLOR=NEUTRAL,                                          *
               INITIAL='PF7 Prev page'
*
CMD19    DFHMDF POS=(21,Ø1),LENGTH=Ø3,ATTRB=(UNPROT,FSET),             *
               COLOR=RED
QUE19    DFHMDF POS=(21,Ø5),LENGTH=Ø8,ATTRB=(ASKIP,PROT,FSET),         *
               COLOR=YELLOW
TXT19    DFHMDF POS=(21,14),LENGTH=46,ATTRB=(ASKIP,PROT,FSET),         *
               COLOR=TURQUOISE
         DFHMDF POS=(21,63),LENGTH=13,ATTRB=(ASKIP,PROT),              *
               COLOR=NEUTRAL,                                          *
               INITIAL='PF8 Next page'
*
CMD2Ø    DFHMDF POS=(22,Ø1),LENGTH=Ø3,ATTRB=(UNPROT,FSET),             *
               COLOR=RED
QUE2Ø    DFHMDF POS=(22,Ø5),LENGTH=Ø8,ATTRB=(ASKIP,PROT,FSET),         *
               COLOR=YELLOW
TXT2Ø    DFHMDF POS=(22,14),LENGTH=46,ATTRB=(ASKIP,PROT,FSET),         *
               COLOR=TURQUOISE
         DFHMDF POS=(22,63),LENGTH=Ø8,ATTRB=(ASKIP,PROT),              *
               COLOR=NEUTRAL,                                          *
               INITIAL='PF3 Exit'
*
         DFHMDF POS=(23,Ø1),LENGTH=75,ATTRB=(ASKIP,PROT),              *
               COLOR=RED,                                              *
               INITIAL='————————————————-——————*
               ———————————'
         DFHMDF POS=(24,Ø8),LENGTH=64,ATTRB=(ASKIP,PROT),              *
               COLOR=NEUTRAL,                                          *
               INITIAL='Place the cursor in front of a queue and press *
               ENTER to display it'
```

```
*
         DFHMSD TYPE=FINAL
         END
```

TSVIEW2 SOURCE CODE

```
MAPSET   DFHMSD TYPE=&SYSPARM,MODE=INOUT,CTRL=(FREEKB),               *
               LANG=COBOL,TIOAPFX=YES,EXTATT=MAPONLY
*
TSVIEW2  DFHMDI SIZE=(24,80)
*
         DFHMDF POS=(01,07),LENGTH=06,ATTRB=(ASKIP,PROT),             *
               COLOR=TURQUOISE,                                       *
               INITIAL='Queue:'
QNAME2   DFHMDF POS=(01,14),LENGTH=08,ATTRB=(ASKIP,PROT,FSET),       *
               COLOR=NEUTRAL
         DFHMDF POS=(01,30),LENGTH=12,ATTRB=(ASKIP,PROT),             *
               COLOR=YELLOW,                                          *
               INITIAL='Item Number:'
SITEM2   DFHMDF POS=(01,43),LENGTH=05,ATTRB=(UNPROT,NUM,IC),         *
               COLOR=NEUTRAL
         DFHMDF POS=(01,49),LENGTH=01
*
         DFHMDF POS=(02,01),LENGTH=76,ATTRB=(ASKIP,PROT),             *
               COLOR=RED,                                             *
               INITIAL='————————————————————————*
               ————————————————'
*
QLIN01   DFHMDF POS=(03,01),LENGTH=78,ATTRB=(ASKIP,PROT,FSET),       *
               COLOR=DEFAULT
QLIN02   DFHMDF POS=(04,01),LENGTH=78,ATTRB=(ASKIP,PROT,FSET),       *
               COLOR=DEFAULT
QLIN03   DFHMDF POS=(05,01),LENGTH=78,ATTRB=(ASKIP,PROT,FSET),       *
               COLOR=DEFAULT
QLIN04   DFHMDF POS=(06,01),LENGTH=78,ATTRB=(ASKIP,PROT,FSET),       *
               COLOR=DEFAULT
QLIN05   DFHMDF POS=(07,01),LENGTH=78,ATTRB=(ASKIP,PROT,FSET),       *
               COLOR=DEFAULT
QLIN06   DFHMDF POS=(08,01),LENGTH=78,ATTRB=(ASKIP,PROT,FSET),       *
               COLOR=DEFAULT
QLIN07   DFHMDF POS=(09,01),LENGTH=78,ATTRB=(ASKIP,PROT,FSET),       *
               COLOR=DEFAULT
QLIN08   DFHMDF POS=(10,01),LENGTH=78,ATTRB=(ASKIP,PROT,FSET),       *
               COLOR=DEFAULT
QLIN09   DFHMDF POS=(11,01),LENGTH=78,ATTRB=(ASKIP,PROT,FSET),       *
               COLOR=DEFAULT
QLIN10   DFHMDF POS=(12,01),LENGTH=78,ATTRB=(ASKIP,PROT,FSET),       *
               COLOR=DEFAULT
QLIN11   DFHMDF POS=(13,01),LENGTH=78,ATTRB=(ASKIP,PROT,FSET),       *
```

```
              COLOR=DEFAULT
QLIN12    DFHMDF POS=(14,Ø1),LENGTH=78,ATTRB=(ASKIP,PROT,FSET),         *
              COLOR=DEFAULT
QLIN13    DFHMDF POS=(15,Ø1),LENGTH=78,ATTRB=(ASKIP,PROT,FSET),         *
              COLOR=DEFAULT
QLIN14    DFHMDF POS=(16,Ø1),LENGTH=78,ATTRB=(ASKIP,PROT,FSET),         *
              COLOR=DEFAULT
QLIN15    DFHMDF POS=(17,Ø1),LENGTH=78,ATTRB=(ASKIP,PROT,FSET),         *
              COLOR=DEFAULT
QLIN16    DFHMDF POS=(18,Ø1),LENGTH=78,ATTRB=(ASKIP,PROT,FSET),         *
              COLOR=DEFAULT
QLIN17    DFHMDF POS=(19,Ø1),LENGTH=78,ATTRB=(ASKIP,PROT,FSET),         *
              COLOR=DEFAULT
QLIN18    DFHMDF POS=(2Ø,Ø1),LENGTH=78,ATTRB=(ASKIP,PROT,FSET),         *
              COLOR=DEFAULT
QLIN19    DFHMDF POS=(21,Ø1),LENGTH=78,ATTRB=(ASKIP,PROT,FSET),         *
              COLOR=DEFAULT
QLIN2Ø    DFHMDF POS=(22,Ø1),LENGTH=78,ATTRB=(ASKIP,PROT,FSET),         *
              COLOR=DEFAULT
*
          DFHMDF POS=(23,Ø1),LENGTH=75,ATTRB=(ASKIP,PROT),              *
              COLOR=RED,                                                *
              INITIAL='————————————————————————*
              ————————————'
*
          DFHMDF POS=(24,18),LENGTH=46,ATTRB=(ASKIP,PROT),              *
              COLOR=YELLOW,                                             *
              INITIAL='PF3/15 Return     PF8/2Ø Next     PF7/19 Prev'
*
          DFHMSD TYPE=FINAL
          END
```

Systems Programmer (Portugal)

Support for the COBOL SORT verb in CICS

This article describes the process which resulted in the creation of a CICS-compatible SORT routine, callable from general purpose COBOL programs via the SORT verb.

BACKGROUND

Some time ago I wrote a program that lists the terminals acquired by a CICS region, including information about running (or next) transaction code, user-id, and user names. The program returned the information in the order returned by CICS from the INQUIRE TERMINAL NEXT commands.

It became obvious that the program could be more useful, especially for fairly large sets of data (up to several hundred or more terminals), if the data could be sorted into other sequences, such as user name, terminal-id, network-id, or user-id.

I investigated alternatives to determine what was the easiest way to sort small amounts of data in CICS, and found from the COBOL manuals that the SORT verb is supported under CICS when using COBOL for OS/390 and VM.

Having found this, and knowing that I really didn't want to build a sort program from scratch, I proceeded to write the COBOL code to implement an in-store sort using input and output procedures, as required for use within CICS.

The first test failed dismally, which is when I discovered that COBOL doesn't actually implement a sort. It just builds an interface to the DFSORT (or compatible) module 'SORT'. My program received an abend because the SORT program could not be loaded.

I took a typically male approach at this point, trying to fix the problem without reading the manuals (a *bad* mistake). I ended up adding the system library containing DFSORT to my DFHRPL concatenation, and then to STEPLIB as well. At first look, this approach seemed to work. The abend went away, the data came back to the program

sorted, and I had the output I wanted. I was a bit concerned though that there was a long delay whenever I called the sort. Further investigation found even more problems. During the several seconds which even a small sort (<10 records) was taking, all work within the CICS region was suspended. It was clear that I had a problem.

Finally doing what I should have earlier and returning to the manuals, I found that DFSORT does not have a CICS-compatible routine, and I was doing an MVS sort in my CICS region, hogging the QR TCB for the life of the sort. This was when I discovered that IBM does not provide a CICS-compatible sort module.

I found that third parties do have sorts for CICS available (I believe that CA-CICSort and possibly Syncsort provide a routine) but my site was not a user, and I could not justify the expense.

I was left with two alternatives. I could implement a callable sort, and throw out the COBOL SORT verb, or I could implement a DFSORT and CICS-compatible sort routine myself.

I suspect that the former option would have been more sensible.

I built the sort routine.

DESIGN

Once I had decided to write the SORT module, I needed to find out what its interface should look like so that I could interface successfully with COBOL. My first attempt at this failed dismally. I asked IBM to provide the details I would need, pointing out to them that as their COBOL manual said that it was compatible with CICS, but they didn't provide a routine, they should at least give me enough information so that I could write the routine. After a wait of some weeks, I received a note from the change team saying that the information was proprietary and was not released to customers.

Back to the manuals again, after realizing that the DFSORT manuals document how to write the E15 and E35 exits routines so that DFSORT can call them. This gave me what I needed. All I needed to do was build a program that would correctly interface with routines

built to the E15 and E35 specifications in the manual.

After several test routines, which I used to determine which interface (24 or 31-bit) COBOL was using, and exactly how the sort parameter text was formatted, I got down to writing the interface code. I ended up with a program that could be called by COBOL, would call the E15 exit to obtain all the records, and would then call the E35 exit to return the records back to the program. Now I just had to solve my original problem – how was I going to sort the data?

SORT ALGORITHM

Realizing that sorting algorithms are well documented, I went to my university texts, and found samples of various sorts. I looked at implementing a shell sort and a heap sort, for which I had Pascal code available, but then realized that someone else may already have answered my need. I didn't find anything on the CBT tape, but I did find a CICS sort routine in the November 1990 edition of *CICS Update*, Issue 60. That program implemented a tag-key quick sort, which suited my purposes, so I downloaded the source and adapted it for my program.

The original TSQ sort program on which the sort component here is based was credited to Safran Menachem, Systems Programmer, Mivtachim Computers (Israel), © Xephon 1990. It is downloadable from Xephon's Web site at www.xephon.com/cics.

The routine has not been changed in any significant way except to add EXEC CICS SUSPEND calls after every hundred or so iterations. This is to ensure that a call to sort does not monopolize the QR TCB, or become vulnerable to an AICA abend.

Debug output is written to a TD queue. The name of the queue is coded in the program (at my site we have a standard debugging destination called NBUG).

USAGE

This routine is designed to be invoked from a COBOL program using

the SORT verb, and the example below shows that usage. It should work correctly when called by any program meeting its interface requirements for invocation and E15/E35 exits. It is, however, very sensitive to the format of the parameter text and cannot handle free format input.

The following extract from a COBOL program shows how the sort can be invoked:

```
……
INPUT-OUTPUT SECTION.
FILE-CONTROL.
* ---------------------------------------*
SELECT SDØ1-SORT-TERMINAL-FILE
ASSIGN TO SORTFILE.
DATA DIVISION.
* ---------------------------------------*
FILE SECTION.
* ---------------------------------------*
SD SDØ1-SORT-TERMINAL-FILE.
Ø1 SDØ1-SORT-TERMINAL-RECORD.
Ø5 SDØ1-LONG-KEY.
1Ø SDØ1-SHORT-KEY.
15 SDØ1-SHORT-KEY-9 PIC 9(8).
1Ø SDØ1-KEY-FILLER PIC X(242).
Ø5 SDØ1-DATA-AREA.
1Ø SDØ1-DATA-BYTE PIC X
OCCURS 1 TO 9999
DEPENDING ON RECLEN.
……
PROCEDURE DIVISION.
……
COMPUTE SORT-FILE-SIZE = NUMRECS
END-COMPUTE
COMPUTE SORT-CORE-SIZE =
( SORT-FILE-SIZE * RECLEN)
END-COMPUTE
……
SORT SDØ1-SORT-TERMINAL-FILE
ON DESCENDING KEY SDØ1-LONG-KEY
INPUT PROCEDURE IS X1-SORT-INPUT
OUTPUT PROCEDURE IS Y1-SORT-OUTPUT
.
……
X1-SORT-INPUT.
* ---------------------------------------
MOVE NUMRECS TO HIGHLIMIT
PERFORM X11-RELEASE-RECORD
```

```
VARYING NUMRECS FROM 1 BY 1
UNTIL NUMRECS > HIGHLIMIT
.
*
X11-RELEASE-RECORD.
* ----------------------------------------
MOVE NUMRECS TO SDØ1-SHORT-KEY-9
RELEASE SDØ1-SORT-TERMINAL-RECORD
.
*
X-SORT-EXIT.
* ----------------------------------------------
EXIT
.
Y1-SORT-OUTPUT.
* ----------------------------------------------
PERFORM Y11-RETURN-RECORD
UNTIL NO-MORE-TERMINALS
* GO TO Y-SORT-EXIT
.
*
Y11-RETURN-RECORD.
* ----------------------------------------------
RETURN SDØ1-SORT-TERMINAL-FILE
AT END
SET NO-MORE-TERMINALS TO TRUE
END-RETURN
.
*
Y-SORT-EXIT.
* ----------------------------------------------
EXIT
.
```

PERFORMANCE

Once I had completed and proved the routine, I wrote a test program so that I could analyse the performance of the sort. The following table shows approximate CPU times for a range of sorts. As with all CPU time statements, the numbers have to be taken with a pinch of salt, but the relationship between the tests should hold true, no matter what sort of CPU you are running on.

Figure 1 shows total transaction times for a test transaction with tests of small (260 byte) and large (10,000 byte) records. Figures were produced for a range of sort file sizes, from 5 records to 5000 records.

Because of performance evaluation during this testing, the routine will not sort sets of more than 5000 records. Sorts of large amounts of data (greater than the size of ECDSA) can make CICS go SOS, and so were eliminated from the test.

#Records	*Key length*	*Record length*	*Initial order*	*CPU time (milliseconds)*
5	8	260	In order	6.5
5	8	260	Reversed	4.6
50	8	260	In order	19
50	8	260	Reversed	20
500	8	260	In order	180
500	8	260	Reversed	179
5000	8	260	In order	2,600
5000	8	260	Reversed	2,700
5	250	260	In order	4.7
5	250	260	Reversed	4.7
50	250	260	In order	19
50	250	260	Reversed	20
500	250	260	In order	184
500	250	260	Reversed	185
5000	250	260	In order	3,600
5000	250	260	Reversed	3,400
5	8	10000	In order	4.8
5	8	10000	Reversed	4.9
50	8	10000	In order	22
50	8	10000	Reversed	22
500	8	10000	In order	209
500	8	10000	Reversed	211
5	250	10000	In order	4.8
5	250	10000	Reversed	5.1
50	250	10000	In order	23
50	250	10000	Reversed	23
500	250	10000	In order	213
500	250	10000	Reversed	214

Figure 1: Transaction times

DOCUMENTATION REFERENCE

In writing this routine, I referred to the IBM COBOL manuals and the DFSORT programming guide:

- *COBOL for OS/390 and VM, Language Reference*, SC26-9046-03
- *COBOL for OS/390 and VM, Programming Guide*, SC26-9049-04

- *DFSORT, Application Programming Guide*, SC33-4035-17.

SOFTWARE PREREQUISITES

The program has been tested with COBOL for OS/390 and VM V1.2 and V2.1. It runs with CICS V4.1. I have no reason to expect problems with any version of CICS/TS, although it has not been tested there because my company has not yet implemented it. Software was:

- COBOL for MVS and VM
- Language Environment
- CICS V4.1 or higher.

Restrictions:

- Maximum key length = 250 bytes
- Maximum record length = 32000 bytes
- Key type = character (only)
- Maximum number of keys = 1
- Duplicate result order = undefined
- Sufficient storage for all keys to be stored in main memory (approximately 1.2MB at the extreme limit).

POSSIBLE ENHANCEMENTS

The program could be enhanced to remove many of its restrictions. The parser of the sort parameters is extremely primitive, and is optimized to the parameter text produced by COBOL with a very restricted subset of available options. A more flexible parser, together with the ability to implement the options, would make the routine more generally useful.

Many COBOL SORT verb options are not supported. These include multiple keys, the **Duplicates In Order** phrase, data types for the keys except for characters and others. These features could be added to the program, but would require a rewrite of the sort algorithm. It

probably needs to have a generalized comparison routine, rather than the distributed comparisons used at various points in the current implementation. An enhanced parser is also needed, so that the more extensive parameter text required to control these options can be interpreted.

The following features would provide useful additions to the tool:

- Implementation of several sort algorithms.
- Selection of an appropriate sort algorithm based on the input data set size.
- Selectable alternative collating sequences.

PROBLEMS

The data to be sorted is stored in a temporary storage queue. As implemented here, a MAIN TS queue is used. This can cause a problem, because the NOSUSPEND option is implemented only for auxiliary TS calls. If the data overflows the available ECDSA, then an SOS will occur in ECDSA, and the region will hang. The call could be changed to remove the MAIN option. This will require an increased TS dataset size, and increase the elapsed time for many sorts. It will, however, mean that the sort cannot send the region SOS, so it should probably be implemented without the MAIN option.

The original implementation of this program (inherited from the base sort function design) was targeted at an application that could run only against a terminal. The temporary storage queue used to save the data while the sort was in progress was named using the EIBTRMID to provide ‘uniqueness’. A subsequent implementation of the routine ran in a program that was initiated by an MQSeries message. This program ran without a primary facility. On several occasions, data belonging to two separate transactions was intermingled by sorts operating concurrently.

This has been resolved by changing the temporary storage queue name so that EIBTASKN is used in the name instead of EIBTRMID. As an additional precaution, an enqueue is performed against the queue name before entering the sort. If the enqueue fails, a failure return code is passed back to the application.

SORT ASSEMBLER

```
*  SORT - This program implements a SORT function
*         which can run only inside CICS. It is designed
*         to be called via a COBOL SORT statement. The SORT
*         statement must conform to the restrictions documented
*         in the COBOL for MVS manual, regarding use of SORT
*         under CICS.
*
*         Features implemented:
*           Single key
*           Ascending and Descending
*           Fixed and variable length records
*           E15 exit for record input
*           E35 exit for record output
*           In storage sort
*           Number of records and Core size parameters
*           Storage is acquired and freed as required
*           QuickSort
*           Key length between 1 and 250
*           Record size up to 32000 bytes
*
*         Standard sort features not supported:
*           Input from and output to files (CICS restriction)
*           Intermediate work files (CICS restriction)
*           Large data sets. This routine limits the number of
*              records input to the sort to 5000.
*           Many sort techniques. This routine will always sort
*              using a quicksort SORT as described in
*              the Xephon Update article from 1990:
*                'A CICS sort utility program'
*           Multiple keys
*
*         The program parses the SORT CONTROL STATEMENTS, and
*         expects it to be in a specific format (which is produced
*         by COBOL).
*
*         The format expected is:
*         ' SORT FIELDS=(0001,0008,CH,A) '
*         ' RECORD TYPE=F,LENGTH=(000067,,) '
*         ' OPTION MAINSIZE=00001005,FILSZ=E0000003 '
*                    for fixed length records
*                        or
*         ' SORT FIELDS=(0001,0008,CH,A) '
*         ' RECORD TYPE=V,LENGTH=(000079,,,000071,) '
*         ' OPTION MAINSIZE=00001005,FILSZ=E0000003 '
*                    for variable length records
*
*         The only field type is CH, Ascending or Descending
*         Key location can be anywhere inside the record.
```

```
*         Key location + key length must be < min record length
*         Maximum key length is 250 bytes
*
*         The Parse process for the sort control statements is
*         very primitive, and cannot cope with free format
*         input. It has been tested with COBOL for MVS, and
*         LE for MVS V1.8. Changes to the sort control statement
*         format between COBOL or LE versions will not be handled.
*         A worthwhile improvement to the code would be to build
*         a more capable parser, which at least coped with blank
*         space between verbs, and with variable order of terms.
*         It should also cope with optional values like those
*         available in the LENGTH suboption, and with variable
*         length numeric values.
*
*         Further possible enhancements would be to choose an
*         appropriate sort mechanism based on the file
*         size, and to implement different sort algorithms.
*         Currently, QuickSort is used. Alternatives would be
*         ShellSort, HeapSort, TournamentSort, RadixSort, or
*         even BubbleSort for very small data sets (<10-20).
*
*         Alternative comparison types, for signed binary or
*         packed decimal data would be useful, as would multiple
*         independant key parts, so that a sequence could be
*         ascending on one key, and descending on another
*         subsidiary key.
*
         DFHREGS                       Build register equates
*************************************************************************
SORTPARM DSECT                         Sort extended parameter list
SPCSAA   DS      A                     Address of Control Statement Area
SPE15A   DS      A                     Address of E15 exit
SPE35A   DS      A                     Address of E35 exit
SPUEAC   DS      A                     Address of User Exit Constant
SPALTSQA DS      A                     Address of ALTSEQ tranlate table
SPESTAEA DS      A                     Address of ESTAE area pointer
SPE18A   DS      A                     Address of E18 exit
SPE39A   DS      A                     Address of E39 exit
SPCALLID DS      CL4                   4-character call identifier
SPEND    DS      CL4                   End parm list indicator
*
SORTCNTL DSECT                         Sort Control Statement area
SCLEN    DS      H                     Length of control statement area
SCAREA   DS      0C                    Start of Sort control statements
*
DFHEISTG DSECT                         Dynamic storage area
         DFHEISTG
RETCODE  DS      F                     Program return code
PROCRET1 DS      A                     Address to return after subroutine
```

```
PROCRET2 DS      A                Address to return after subroutine
PROCRET3 DS      A                Address to return after subroutine
PARMLIST DS      A                Address of extended sort parm list
*
PARSDATA DS      ØF               Parsed information follows
KEYLEN   DS      H                Length of the sort key
MAXKEY   EQU     25Ø              Maximum size of key to sort
KEYOFFST DS      H                Location in the rec of sort key
CNTLGOOD DS      C                Control Statemnts parsed correctly
SORTKW   DS      C                SORT Keyword handled Ok
RECORDKW DS      C                RECORD Keyword handled Ok
OPTIONKW DS      C                OPTION Keyword handled Ok
SORTDIR  DS      C                What direction is the sort (A/D)
RECFM    DS      C                Fixed or Variable?
KEYLENA2 DS      H                Length of the sort key
LRECL    DS      H                Length of record (maximum)
MINRECL  DS      H                Length of record (minimum)
QRECLEN  DS      H                Length of record from TS queue
QCOUNT   DS      H                Number of items in SORT queue
MAXSIZE  EQU     32760            Maximum size of record to sort
MAINSIZE DS      F                Recommended size of mainstore
MAXRECS  EQU     5ØØØ             Maximum records into sort.
TABPTR   DS      A                Address of sort table
STCKPTR  DS      A                Address work stack
STCKLEN  DS      F                Length of work stack
SORTQNM  DS      ØCL8             Name of SORT TSQ
SORTQSRT DS      CL4              Constant = NBST
SORTQTSK DS      PL4              Follow with EIBTASKN
FILESIZE DS      H                Number of records in file to sort
PARSLEN  EQU     *-PARSDATA       Length of the parsed information
*
CURVALUE DS      CL25Ø            Current Value of key in sort
TEMP     DS      CL252            Work space for swap
RIGHT    DS      H                Pointer to right side of partition
LEFT     DS      H                pointer to left side of partition
AIDLEFT  DS      H                Temp hold for left pointer
*
         DS      ØD               Set alignment for CVB
WORKPACK DS      PL8              Work field for disp->bin conv
*
E15PARM  DS      ØF               E15 exit parm list
E15NEWA  DS      A                Address of new record
E15UEAC  DS      A                Address of user exit address const
*
E35PARM  DS      ØF               E35 exit parm list
E35NEWA  DS      A                Address of new record
E35OUTA  DS      A                Address of record in out buffer
E35UEAC  DS      A                Address of user exit address const
*
         DFHEIEND
```

```
*
SORT     AMODE 31
SORT     RMODE ANY
SORT     DFHEIENT CODEREG=(2,11),                                      X
               DATAREG=(13),                                           X
               EIBREG=(3)
*
SORTINIT EQU     *
         ST      R1,PARMLIST         Save parm list pointer
*                                    Get the EIB address
         EXEC CICS ADDRESS EIB(DFHEIBR)
         ST      DFHEIBR,DFHEIBP
         LA      R4,8                Set bad return code for testing
*        SR      R4,R4               Clear a work register
         ST      R4,RETCODE          Set default return code to zero
         MVC     SORTQSRT,=C'NBST'   Set the constant bit
         MVC     SORTQTSK,EIBTASKN   Set the variable bit
*                                    ENQ the TS Q name. This will
*                                    ensure that a task cannot
*                                    recursively call sort, and that
*                                    getting caught by an unexpected
*                                    TST is not a disaster.
         EXEC CICS ENQ                                                 X
               RESOURCE(SORTQNM)                                       X
               LENGTH(=H'8')                                           X
               NOSUSPEND                                               X
               NOHANDLE
         CLC   EIBRESP,DFHRESP(NORMAL) Was the ENQ successful?
         BNE   RETURN              No... So sad. A return code has
*                                  already been set up.
*
*                                  ENQ was good, so go for it.
SORTMAIN EQU     *
         BAL     R14,VALIDATE        Validate the sort parameter list
*
         BAL     R14,PARSCNTL        Parse the control statements
*
         BAL     R14,GETSTG          Acquire storage for the sort
*
         BAL     R14,GETRECS         Get the records from the E15 exit
*
         BAL     R14,DOSORT          Do the sort of the record pointers
*
         BAL     R14,PUTRECS         Give the output to the E35 exit
*
         BAL     R14,RELSTG          Release storage from the sort
*
         SR      R14,R14             Zero
         ST      R14,RETCODE         Zero RETCODE unless early term.
*
```

```
RETURN   EQU     *
*                                Delete the queue (just in case)
         EXEC CICS DELETEQ TS                                    X
               QUEUE(SORTQNM)                                    X
               NOHANDLE
*                                Delete the ENQ so the task can
*                                sort again.
         EXEC CICS DEQ                                           X
               RESOURCE(SORTQNM)                                 X
               LENGTH(=H'8')                                     X
               NOHANDLE
         L       R15,RETCODE     Get return code to pass back
         L       R1Ø,4(,R13)     Get previous save area
         ST      R15,16(,R1Ø)    Set the return code
*
         B       EXITPT          Give up and return to caller
*
*
*                                SUBROUTINES FOLLOW.
*
*********************************************************************
VALIDATE EQU   *
*                                Validate that the parameter list
*                                matches what we can cope with.
*
         ST    R14,PROCRET1      Save the subroutine return address
*        *     *
VALØØØ   EQU   *                 Check parm list pointer
         L     R5,PARMLIST       Address the sort parm list
         USING SORTPARM,R5       Map the sort parameters
         LTR   R5,R5             Any Parm list passed?
         BNZ   VALØ1Ø            Yes, continue checks
         LA    RØ,8              Generate value 8
         ST    RØ,RETCODE        Propagate into RETCODE
         EXEC CICS WRITEQ TD                                     X
               QUEUE(NBUG)                                       X
               FROM(SRTERRØØ)                                    X
               LENGTH(=AL2(L'SRTERRØØ))                          X
               NOHANDLE
*
         B     RETURN            Give up immediately.
*        *     *
VALØ1Ø   EQU   *                 Check control statement pointer
*
*       EXEC CICS WRITEQ TD                                     X
*            QUEUE(NBUG)                                        X
*            FROM(SPCSAA)                                       X
*            LENGTH(4Ø)                                         X
*            NOHANDLE
*
```

```
         L     R6,SPCSAA             Get Control statement area
         USING SORTCNTL,R6           Map the sort control statements
         LTR   R6,R6                 Any Sort Control Area passed?
         BNZ   VAL020                Yes, continue checks
         LA    R0,8                  Generate value 8
         ST    R0,RETCODE            Propagate into RETCODE
         EXEC CICS WRITEQ TD                                          X
               QUEUE(NBUG)                                            X
               FROM(SRTERR01)                                         X
               LENGTH(=AL2(L'SRTERR01))                               X
               NOHANDLE
*
         B     RETURN                Give up immediately.
*
VAL020   EQU   *                     Check E15 exit address
*
*
*       EXEC CICS WRITEQ TD                                         X
*            QUEUE(NBUG)                                            X
*            FROM(SORTCNTL)                                         X
*            LENGTH(SCLEN)                                          X
*            NOHANDLE
*
*
         L     R1,SPE15A             Get E15 exit address
         C     R1,=F'-1'             Has end of list been reached
         BE    VAL025                Yes, but too early - error
         LTR   R1,R1                 Is it zero?
         BNZ   VAL030                Address provided, so continue
VAL025   EQU   *
         LA    R0,8                  Generate value 8
         ST    R0,RETCODE            Propagate into RETCODE
         EXEC CICS WRITEQ TD                                          X
               QUEUE(NBUG)                                            X
               FROM(SRTERR02)                                         X
               LENGTH(=AL2(L'SRTERR02))                               X
               NOHANDLE
*
         B     RETURN                Give up immediately.
*
VAL030   EQU   *                     Check E35 exit address
         L     R1,SPE35A             Get E35 exit address
         C     R1,=F'-1'             Has end of list been reached
         BE    VAL032                Yes, but too early - error
         LTR   R1,R1                 Is it zero?
         BNZ   VAL035                Address provided, so continue
VAL032   EQU   *
         LA    R0,8                  Generate value 8
         ST    R0,RETCODE            Propagate into RETCODE
         EXEC CICS WRITEQ TD                                          X
```

```
              QUEUE(NBUG)                                              X
              FROM(SRTERRØ3)                                           X
              LENGTH(=AL2(L'SRTERRØ3))                                 X
              NOHANDLE
*
         B    RETURN               Give up immediately.
*
VALØ35   EQU  *                    Check User Exit Address Constant
         SR   R1,R1                Null pointer
         ST   R1,E15UEAC           Save default UEAC value
         L    R1,SPUEAC            Get User Exit Addres Constant
         C    R1,=F'-1'            Has end of list been reached
         BE   VALSØØ               Yes, so accept the parm list
         ST   R1,E15UEAC           Save passed UEAC value
*
VALØ4Ø   EQU  *                    Check ALTSEQ translate table
         L    R1,SPALTSQA          Get ALTSEQ table address
         C    R1,=F'-1'            Has end of list been reached
         BE   VALSØØ               Yes, so accept the parm list
         LTR  R1,R1                Is it zero?
         BZ   VALØ45               No table, so continue
         LA   RØ,8                 Generate value 8
         ST   RØ,RETCODE           Propagate into RETCODE
         EXEC CICS WRITEQ TD                                           X
              QUEUE(NBUG)                                              X
              FROM(SRTERRØ4)                                           X
              LENGTH(=AL2(L'SRTERRØ4))                                 X
              NOHANDLE
*
         B    RETURN               Give up immediately.
*
VALØ45   EQU  *                    Check ESTAE routine address
         L    R1,SPESTAEA          Get ESTAE address
         C    R1,=F'-1'            Has end of list been reached
         BE   VALSØØ               Yes, so accept the parm list
*
VALØ5Ø   EQU  *                    Check E18 exit address
         L    R1,SPE18A            Get E18 exit address
         C    R1,=F'-1'            Has end of list been reached
         BE   VALSØØ               Yes, so accept the parm list
         LTR  R1,R1                Is it zero?
         BZ   VALØ6Ø               No exit, so continue
         LA   RØ,8                 Generate value 8
         ST   RØ,RETCODE           Propagate into RETCODE
         EXEC CICS WRITEQ TD                                           X
              QUEUE(NBUG)                                              X
              FROM(SRTERRØ5)                                           X
              LENGTH(=AL2(L'SRTERRØ5))                                 X
              NOHANDLE
*
```

```
         B     RETURN               Give up immediately.
*
VAL06Ø   EQU   *                    Check E39 exit address
         L     R1,SPE39A            Get E39 exit address
         C     R1,=F'-1'            Has end of list been reached
         BE    VAL5ØØ               Yes, so accept the parm list
         LTR   R1,R1                Is it zero?
         BZ    VAL07Ø               No exit, so continue
         LA    RØ,8                 Generate value 8
         ST    RØ,RETCODE           Propagate into RETCODE
         EXEC CICS WRITEQ TD                                        X
               QUEUE(NBUG)                                          X
               FROM(SRTERRØ6)                                       X
               LENGTH(=AL2(L'SRTERRØ6))                             X
               NOHANDLE
*
         B     RETURN               Give up immediately.
*
VAL07Ø   EQU   *                    Check CALL-ID field
         CLC   SPCALLID,=F'-1'      Get CALLID value
         BE    VAL5ØØ               Yes, so accept the parm list
*
VAL08Ø   EQU   *                    Check correct end indicator
         CLC   SPEND,=F'-1'         Is End indicator = x'FFFFFFFF'?
         BE    VAL5ØØ               Yes, so continue on
         LA    RØ,8                 Generate value 8
         ST    RØ,RETCODE           Propagate into RETCODE
         EXEC CICS WRITEQ TD                                        X
               QUEUE(NBUG)                                          X
               FROM(SRTERRØ7)                                       X
               LENGTH(=AL2(L'SRTERRØ7))                             X
               NOHANDLE
*
         B     RETURN               Give up immediately.
*
VAL5ØØ   EQU   *                    Validation is done, return
         L     R14,PROCRET1         Restore return address
         BR    R14                  Return to caller
*********************************************************************
*                                   Check that we can understand the
*                                   sort control statements. Set up
*                                   control variables so that we do
*                                   what we are told.
*
PARSCNTL EQU   *                    Parse the Sort control statements
         ST    R14,PROCRET1         Save the subroutine return address
*        *     *
*                                   Write out the sort control
PARSØØØ  EQU   *
*                                   Set up everything before we start
```

```
         LA    R4,SCAREA             Point to start of Sort control
         LH    R7,SCLEN              Record length not yet examined
         MVI   CNTLGOOD,C'Y'         Expect everything will be OK
         MVI   SORTKW,C'N'           SORT Keyword error   (Y = good)
         MVI   RECORDKW,C'N'         RECORD Keyword error (Y = good)
         MVI   OPTIONKW,C'N'         OPTION Keyword error (Y = good)
         BAL   R14,PARS600           Skip over excess spaces
*
PARS100  EQU   *                     Start of keyword scan
         CLC   =C'SORT ',0(R4)       Is SORT keyword at 1
         BNE   PARS200               No, so give up. We can't cope
         BAL   R14,PARS700           Yes, so process the subfields
*
PARS110  EQU   *
         CLC   =C' RECORD ',28(R4)   Is RECORD keyword at 30
         BNE   PARS200               No, so give up. We can't cope
         BAL   R14,PARS800           Yes, so process the subfields
*
PARS120  EQU   *
         CLC   =C' OPTION ',61(R4)    Is OPTION keyword at 63
         BNE   PARS400               No, indicate an error
         BAL   R14,PARS900           Yes, so process the subfields
*
*         We are done with the parse, now check how it went.
PARS200  EQU   *
         CLI   SORTKW,C'Y'           Sort keyword processed Ok?
         BNE   PARS400               No, indicate bad controls
         CLI   RECORDKW,C'Y'         Record keyword processed Ok?
         BNE   PARS400               No, indicate bad controls
         CLI   OPTIONKW,C'Y'         OPTION keyword processed Ok?
         BNE   PARS400               No, indicate bad controls
         B     PARS500               Everything must by Ok
*
PARS400  EQU   *
         MVI   CNTLGOOD,C'N'         Indicate a problem with statements
*                                    Write (txn, trm etc.)
         MVC   SRTERR18+26(4),EIBTRNID  Record transaction
         MVC   SRTERR18+41(4),EIBTASKN  Record terminal
         EXEC CICS WRITEQ TD                                          X
               QUEUE(CSMT)                                            X
               FROM(SRTERR18)                                         X
               LENGTH(=AL2(L'SRTERR18))                               X
               NOHANDLE
*                                    Write error message
         EXEC CICS WRITEQ TD                                          X
               QUEUE(CSMT)                                            X
               FROM(SRTERR08)                                         X
               LENGTH(=AL2(L'SRTERR08))                               X
               NOHANDLE
*                                    Write sort control statements
```

```
         EXEC CICS WRITEQ TD                                          X
               QUEUE(NBUG)                                            X
               FROM(SORTCNTL)                                         X
               LENGTH(SCLEN)                                          X
               NOHANDLE
*
*       EXEC CICS ABEND                                              X
*            ABCODE('SORT')                                          X
*            NOHANDLE
*
         B     RETURN               Give up immediately.
*
PARS500  EQU   *
         L     R14,PROCRET1         Restore return address
         BR    R14                  Return to caller
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
PARS600  EQU   *                    Skip over blanks, but stop at end
         ST    R14,PROCRET2         Save the subroutine return address
*        *     *
PARS610  EQU   *                    Skip over blanks, but stop at end
         CLI   0(R4),C' '           Is it space?
         BNE   PARS620              No, so exit
         LA    R4,1(R4)             Increment pointer
         BCT   R7,PARS610           Decrement count and branch back
*
PARS620  EQU   *
         L     R14,PROCRET2         Restore return addres
         BR    R14                  Go back.
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
PARS700  EQU   *                    Process the SORT keyword options
         ST    R14,PROCRET3         Save the subroutine return address
         CLC   =C'FIELDS=(',5(R4)   Is FIELDS keyword at 6
         BNE   PARS780              No - nothing else supported
*
PARS710  EQU   *                    Process the FIELDS data
*                                   Assume 4 digit location then ','
         PACK  WORKPACK,13(4,R4)    pack the location field
         CVB   R9,WORKPACK          Now in binary
         BCTR  R9,0                 Decrement to form offset
         STH   R9,KEYOFFST          Save the key offset value
*
         CLI   17(R4),C','          Comma next?
         BNE   PARS780              Give up, can't parse it.
*

         PACK  WORKPACK,18(4,R4)    pack the key length field
         CVB   R9,WORKPACK          Now in binary
         STH   R9,KEYLEN            Save the key length value
         CH    R9,=AL2(MAXKEY)      Key length Ok?
         BNH   PARS715              Yes, continue parse
```

```
*                                   Bad key length - report
         EXEC CICS WRITEQ TD                                          X
               QUEUE(NBUG)                                            X
               FROM(SRTERR1Ø)                                         X
               LENGTH(=AL2(L'SRTERR1Ø))                               X
               NOHANDLE
*
         B     RETURN                Give up immediately.
*
PARS715  EQU   *
         CLI   22(R4),C','           Comma next?
         BNE   PARS78Ø               Give up, can't parse it.
*
         CLC   =C'CH',23(R4)         Is it character comparison?
         BNE   PARS78Ø               No, so we can't do it.
*
         CLI   25(R4),C','           Comma again?
         BNE   PARS78Ø               Give up, can't parse it.
*
         CLI   26(R4),C'A'           Ascending sort?
         BNE   PARS72Ø               No - is it descending?
         B     PARS73Ø               Yes, so save it
*
PARS72Ø  EQU   *
         CLI   26(R4),C'D'           Descending sort?
         BNE   PARS78Ø               No - Error, so give up
         B     PARS73Ø               Yes, so save it and skip forward
*
PARS73Ø  EQU   *
         MVC   SORTDIR,26(R4)        Save the sort direction
         CLI   27(R4),C')'           Followed by )?
         BNE   PARS78Ø               No, so we can't cope with it
         MVI   SORTKW,C'Y'           Parsed the SORT statement OK.
*
PARS78Ø  EQU   *
         SR    R7,R7                 Set parse length to zero
*        *     *
PARS79Ø  EQU   *
         L     R14,PROCRET3          Restore return addres
         BR    R14                   Go back.
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
PARS8ØØ  EQU   *                     Process RECORD keyword
         ST    R14,PROCRET3          Save the subroutine return address
         MVI   RECFM,C' '            Clear RECFM
         SR    R8,R8
         STH   R8,LRECL              Clear LRECL
*
PARS81Ø  EQU   *                     Loop through RECORD keywords
         CLC   =C'TYPE=',36(R4)      Is it TYPE keyword?
         BNE   PARS88Ø               No - give up
```

```
*
PARS82Ø  EQU   *                    Process the TYPE data
*        *     *
         CLI   41(R4),C'F'           Is it TYPE=F?
         BE    PARS83Ø               Yes, so we deal with it.
         CLI   41(R4),C'V'           Is it TYPE=V?
         BNE   PARS88Ø               No, so we can't deal with it.
PARS83Ø  EQU   *
         MVC   RECFM,41(R4)          Save the record type
         CLI   42(R4),C','           Is it followed by comma
         BNE   PARS88Ø               No, so we must be done
*
         CLC   =C'LENGTH=(',43(R4)   Is it LENGTH keyword
         BNE   PARS88Ø               No - nothing else supported
*
PARS84Ø  EQU   *                    Process the LENGTH=( data
*        *     *
         PACK  WORKPACK,51(6,R4)     Pack the length value
         CVB   R9,WORKPACK           Make it binary
         STH   R9,LRECL              Save the (Max) record length
         STH   R9,MINRECL            Save the (possible) min lrecl
         CLI   RECFM,C'F'            Fixed format?
         BE    PARS845               Yep, no more to do
*
*                                    Variable format, so grab min len
         PACK  WORKPACK,6Ø(6,R4)     Pack the length value
         CVB   R9,WORKPACK           Make it binary
         STH   R9,MINRECL            Save the (Min) record length
         LA    R4,8(,R4)             Increment over the min rec length
*
PARS845  EQU   *
         LH    R1Ø,KEYLEN            Get key length
         AH    R1Ø,KEYOFFST          Add to position
         CR    R9,R1Ø                Key inside record?
         BNL   PARS85Ø               Yes, so continue
*
         EXEC CICS WRITEQ TD                                          X
               QUEUE(NBUG)                                            X
               FROM(SRTERR11)                                         X
               LENGTH(=AL2(L'SRTERR11))                               X
               NOHANDLE
*
         B     RETURN                Give up immediately.
*
PARS85Ø  EQU   *                    Check record length v. max
         CH    R9,=AL2(MAXSIZE)      Is it <= max?
         BNH   PARS86Ø
*        *     *
         EXEC CICS WRITEQ TD                                          X
               QUEUE(NBUG)                                            X
```

```
                FROM(SRTERR12)                                          X
                LENGTH(=AL2(L'SRTERR12))                                X
                NOHANDLE
*
          B     RETURN                Give up immediately.
*
PARS86Ø   EQU   *                     Keep on checking
          CLC   =C',)',58(R4)         Is it followed by ',)'?
          BNE   PARS88Ø               No, so we can't handle it
          B     PARS89Ø               Everything is done
*
PARS88Ø   EQU   *
          SR    R7,R7                 Set parse length to zero
*         *     *
*
PARS89Ø   EQU   *
          CLI   RECFM,C' '            RECFM is set?
          BE    PARS895               No, so no good - don't set good
          CLC   LRECL,=H'Ø'           LRECL set?
          BE    PARS895               No, so no good - don't set good
          MVI   RECORDKW,C'Y'         Everything Ok. Flag good parms
*
PARS895   EQU   *
          L     R14,PROCRET3          Restore return addres
          BR    R14                   Go back.
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
PARS9ØØ   EQU   *                     Process OPTION keyword
          ST    R14,PROCRET3          Save the subroutine return address
          SR    R8,R8
          STH   R8,FILESIZE           Clear File record count
          ST    R8,MAINSIZE           Clear File record count
*
PARS91Ø   EQU   *                     Loop through OPTION keywords
          CLC   =C' MAINSIZE=',68(R4) Is it MAINSIZE?
          BNE   PARS98Ø               Yes - process it
*
PARS92Ø   EQU   *                     Process the MAINSIZE data
*         *     *
          PACK  WORKPACK,78(8,R4)     Pack it into work field
          CVB   R9,WORKPACK           Convert it to binary
          ST    R9,MAINSIZE           Save the mainstore size
          CLI   86(R4),C','           Is it followed by comma
          BNE   PARS98Ø               No, so we must be done
```

Editor's note: this article will be concluded in the next issue.

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December 1999 – November 2001 index

Items below are references to articles that have appeared in *CICS Update* since Issue 169, December 1999. References show the issue number followed by the page number(s). Back-issues of *CICS Update* are available back to issue 169 (December 1999). See page 2 for details.

CICS news

Micro Focus International has announced enhancements to Component Generator that enable users to access CICS data and business processes across the latest platform technology. These updates include support for WAP and J2ME protocols for wireless devices and support for mapping mainframe data to XML Document Type Definitions (DTDs).

Component Generator enables IT organizations to capture complete CICS business processes and produce components in the form of JavaBeans, EJBs, COM, and XML.

Component Generator generates the entire component, middleware, and back-end source code needed to access CICS applications. The company claims that no hand coding or changes to legacy systems are required.

There's now wireless connectivity to CICS applications and business workflows through WAP- and J2ME-enabled devices, including Palm, PocketPC, and mobile phones.

For further information contact:
Merant, Abbey View, Everard Close, St Albans, Herts, AL1 2PS, UK.
Tel: 01727 812812.
URL: http://www.microfocus.com.

* * *

IBM has announced the second release of z/OS, with enhancements in IP networking, Internet and intranet security, and distributed print management for the Web.

A new function in the InfoPrint Server feature is designed to make it easy to incorporate legacy transaction programs into a printing infrastructure and to get output to the people who need it.

Infoprint Server converts SCS data and 3270 output from CICS, IMS, and other VTAM application programs directly to any PCL printer in the network. A new function enables transmission of output as e-mail.

For further information contact your local IBM representative.
URL: http://www.ibm.com/servers/eserver/zseries.

* * *

Xephon is holding a one-day conference entitled *CICS Update 2001* at the Radisson SAS Portman hotel, London, on 11 December 2001.

For further details about *CICS Update 2001*, or information about Xephon's complete range of seminars and conferences, call 01635 33823 or browse www.xephon.com/events.