EY-0019E-TP-0101

VAX/VMS System Programmer

Tests and Exercises

Prepared by Educational Services
of
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	VMS	IAS

CONTENTS

WRITING PRIVILEGED CODE

TEST

Before starting the lab assignment, copy the MAKETQE and STOPTQE files from a directory specified by your instructor. Change all references in your copy of the files from EXE$GL_SITESPEC to CTL$GL_SITESPEC. In doing so, you can run your copy of the programs without interfering with other students running their copies of the programs.

1. Use the MAKETQE.COM command procedure discussed in the module to assemble and link all the programs needed to run the MAKETQE and STOPTQE programs. That command procedure also defines DELTA as the debugger to use, and incorporates it into the programs. It also produces a file (TQEDEF.OBJ) defining all the symbolic offsets for TQE symbols.

Listing of TQEDEF.MAR File

```
;                                   TQEDEF.MAR
;       This program defines the offsets in a TQE block.

        $TQEDEF GLOBAL
        .END
```

1. Run the MAKETQE program without the control of the DELTA debugger.

2. Use SDA to analyze the current system.

3. Display the contents of the site-specific longword, CTL$GL_SITESPEC. It should contain the address of the TQE built by the MAKETQE program.

4. Make the TQE offsets known to SDA by reading in the TQEDEF.OBJ file created earlier. Note that the file SYS$SYSTEM:SYSDEF.STB can be read to define many of the system data structures. Similar files exist for RMS and DCL symbols (try a directory of SYS$SYSTEM:*.STB).

5. Format the block pointed to by CTL$GL_SITESPEC as a TQE. You should notice that the RQTYPE field contains a 5 (for a REPEAT, SYSTEM SUBROUTINE request - TQE$C_SSREPT). The FPC field should contain a system address (pointing to the code in the block from nonpaged pool).

6. Use the FPC field displayed above to display the contents of the code block, and location being updated. Display a range of address starting at the FPC value (minus 12, hex C) for 20 hex bytes. You should see the INCL instruction (D6 FF ...), which was copied into the block by the MAKETQE program (check the MAKETQE listing file in the module).

7. Repeat the above instruction several times. You should find the value in the first location being incremented each time you repeat the command.

8. Try to find the TQE block on the timer queue. The timer queue listhead is EXE$GL_TQFL. Note, howver, that you may not be able to find the TQE, since you are examining a running system, and as you traverse forward links, the data structures may be re-used, and no longer be valid TQEs. You will know when you reach the end of the TQE queue when you find a forward link pointing to EXE$GL_TQFL+008.

9. Exit from SDA.

10. Run the STOPTQE program without the control of the DELTA debugger.

11. Invoke SDA again for the currently running system.

12. Display the contents of the CTL$GL_SITESPEC location. That location should now contain a 0.

13. Redisplay the contents of the data block several times. You should find that the first location is not changing. The data block should have been returned to nonpaged pool, so the first two longwords may be being used as forward and backward links. Depending on how busy the system is, that data block might already have been reused, or it may still contain the INCL instruction.

14. Again read the file containing TQE symbols.

15. Format the pool space previously containing the TQE as a TQE. Again, depending on system activity, this block may or may not have been reused, and the contents may or may not have changed.

16. Try to find the old TQE block on the timer queue again. This time, you shouldn't find it there.

Solution to Problem 1 (Page 1 of 3)

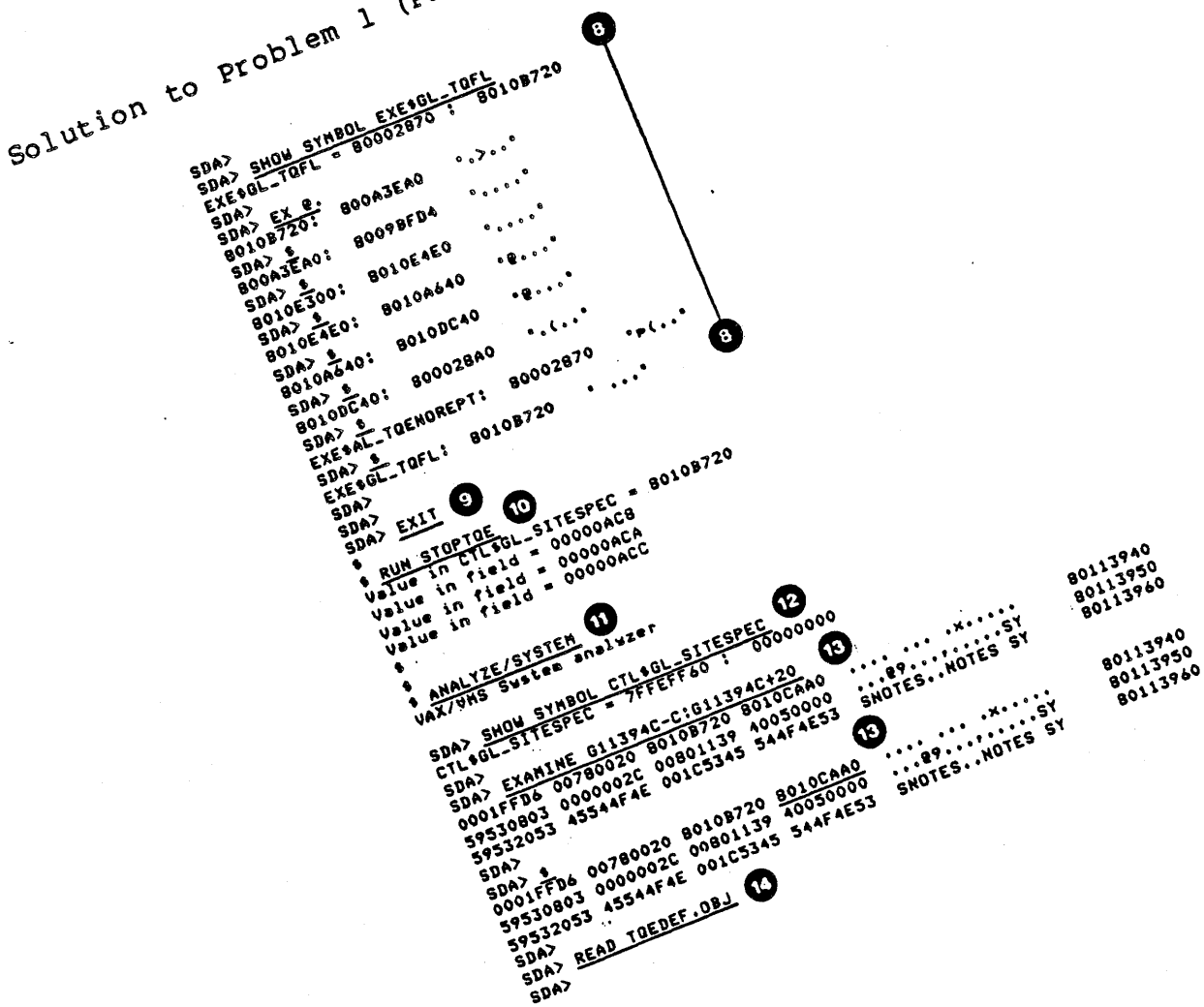
```
$ RUN/NODEBUG MAKETQE (1)
$
$ ANALYZE/SYSTEM (2)
VAX/VMS System Analyzer

SDA> SHOW SYMBOL CTL$GL_SITESPEC (3)
CTL$GL_SITESPEC = 7FFEFF60 :  8010B720
SDA>
SDA> READ TQEDEF.OBJ (4)
SDA>
SDA> FORMAT G10B720/TYPE=TQE (5)
8010B720    TQE$L_TQFL                  800A3EA0
8010B724    TQE$L_TQBL                  80002870
8010B728    TQE$W_SIZE                      0030
8010B72A    TQE$B_TYPE                    0F
8010B72B    TQE$B_RQTYPE                05          <--
8010B72C    TQE$L_FPC                   8011394C    <--
            TQE$L_PID
8010B730    TQE$L_AST                   004D0000
            TQE$L_FR3
8010B734    TQE$L_ASTPRM                00030071
            TQE$L_FR4
8010B738    TQE$Q_TIME                  245B4460
8010B73C                                008A72A2
8010B740    TQE$Q_DELTA                 000F4240
8010B744                                00000000
8010B748    TQE$B_RMOD                        45
8010B749    TQE$B_EFN                       46
8010B74A                                5720
8010B74C    TQE$L_RQPID                 3A4B524F

SDA>
SDA> EXAMINE 811394C-C:811394C+20    (6)
0001FFD6 00780020 00000000 000003A6  ........ .x.....    80113940
59530803 0000002C 00801139 40050000  ...89...,.....SY    80113950
59532053 45544F4E 001C5345 544F4E53  SNOTES..NOTES SY    80113960
SDA>
SDA> $                               (7)
0001FFD6 00780020 00000000 000003E7  ........ .x.....    80113940
59530803 0000002C 00801139 40050000  ...89...,.....SY    80113950
59532053 45544F4E 001C5345 544F4E53  SNOTES..NOTES SY    80113960
SDA>
SDA> $                               (7)
0001FFD6 00780020 00000000 0000040F  ........ .x.....    80113940
59530803 0000002C 00801139 40050000  ...89...,.....SY    80113950
59532053 45544F4E 001C5345 544F4E53  SNOTES..NOTES SY    80113960
SDA>
```

WRITING PRIVILEGED CODE

Solution to Problem 1 (Page 2 of 3)



Solution to Problem 1 (Page 3 of 3)

```
SDA>
SDA> FORMAT G10B720/TYPE=TQE                                    (15)
8010B720    TQE$L_TQFL                  80113940
8010B724    TQE$L_TQBL                  8010C620
8010B728    TQE$W_SIZE                     0015
8010B72A    TQE$B_TYPE                   13
8010B72B    TQE$B_RQTYPE                00
8010B72C    TQE$L_FPC                   00000000
            TQE$L_PID
8010B730    TQE$L_AST                   004D0000
            TQE$L_FR3
8010B734    TQE$L_ASTPRM                00030041
            TQE$L_FR4
8010B738    TQE$Q_TIME                  A50AFE20
8010B73C                                008A72A2
8010B740    TQE$Q_DELTA                 000F4240
8010B744                                00000000
8010B748    TQE$B_RMOD                     43
8010B749    TQE$B_EFN                    00
8010B74A                                0000
8010B74C    TQE$L_RQPID                 00010040

SDA>
SDA> EXAMINE EXE$GL_TQFL                                        (16)
EXE$GL_TQFL:  8009BFD4   '....'
SDA> EX @.
800A3EA0:  8009BFD4   '....'
SDA> ↓
DZDRIVER+A34:  80002878   'x(..'
SDA> ↓                                                          (16)
EXE$GL_TQFL+008:  8010E300   '....'
SDA>
SDA>
SDA> EXIT
$
```

2. Either print a copy of the MAKETQE and STOPTQE map files, or use the following section of those files to perform the following activities using the DELTA debugger. You will also need to consult the listing files in the module for MAKETQE and STOPTQE (or print copies for yourself).

Relevant Section of MAKETQE.MAP File

```
WORK:[MUIZNIEKS.SYSPRG.PRIVCODE]MAKETQE.EXE;1                14-MAY-1982 16:28

                                  +--------------------------+
                                  ! Program Section Synopsis !
                                  +--------------------------+

Psect Name      Module Name      Base     End          Length              Align
----------      -----------      ----     ---          ------              -----

NONSHARED_DATA                   00000200 00000212 00000013 (      19.) LONG 2
                MAKETQE          00000200 00000212 00000013 (      19.) LONG 2

CODE                             00000400 000004AC 000000AD (     173.) BYTE 0
                MAKETQE          00000400 000004AC 000000AD (     173.) BYTE 0

. BLANK .                        00000600 00000600 00000000 (       0.) BYTE 0
                MAKETQE          00000600 00000600 00000000 (       0.) BYTE 0
                SYS$SSDEF        00000600 00000600 00000000 (       0.) BYTE 0
                SYS$P1_VECTOR    00000600 00000600 00000000 (       0.) BYTE 0
```

Relevant Section of STOPTQE.MAP File

```
WORK:[MUIZNIEKS.SYSPRG.PRIVCODE]STOPTQE.EXE;1                14-MAY-1982 16:28

                                  +--------------------------+
                                  ! Program Section Synopsis !
                                  +--------------------------+

Psect Name      Module Name      Base     End          Length              Align
----------      -----------      ----     ---          ------              -----

NONSHARED_DATA                   00000200 000002AE 000000AF (     175.) LONG 2
                STOPTQE          00000200 000002AE 000000AF (     175.) LONG 2

CODE                             00000400 00000568 00000169 (     361.) BYTE 0
                STOPTQE          00000400 00000568 00000169 (     361.) BYTE 0

. BLANK .                        00000600 00000600 00000000 (       0.) BYTE 0
                STOPTQE          00000600 00000600 00000000 (       0.) BYTE 0
                SYS$P1_VECTOR    00000600 00000600 00000000 (       0.) BYTE 0
```

1. Run the MAKETQE program under the control of DELTA.

2. Set a breakpoint at the TSTL G^CTL$GL_SITESPEC instruction (line 62 in listing file), and start the program.

3. When the breakpoint is reached, single step program execution for two instructions. Then, display the contents of location DELTA (line 32 in the listing file). You should confirm that the right value is present (ØØØF4240), as indicated by the listing file.

4. Set a breakpoint at the RET instruction on line 146 in the listing file. Recall that DELTA cannot be used when debugging code that executes at any IPL greater than Ø. Proceed execution from the breakpoint.

5. Examine the contents of RØ, R1, and R2 when the breakpoint is reached. RØ should have a success code, and R1 and R2 will have system addresses. Proceed execution from the breakpoint.

6. When the program exits, exit from DELTA. (Be careful issuing the EXIT command. If you issue it at kernel mode, your process will be deleted, and when you hit <CR>, you will see a Username: prompt.)

7. Run the STOPTQE program under the control of DELTA.

8. Set a breakpoint at line 61 in the listing file, the call to $LKWSET. Then, start program execution.

9. When the breakpoint is reached, issue the O instruction four times. You will notice that the arguments are pushed on the stack for the system service call (as the system service call macro is expanded). Notice that after the last O, the system service code is executed, and control is not returned until the system service completes. Set a breakpoint at line 79, the $OUTPUT macro, and continue executing the program.

1Ø. When this breakpoint is reached, issue the S instruction eleven times, while arguments are pushed on the stack. After the last S, you will notice that the call is not skipped over, but entered.

11. Resume execution, and when the program completes, exit from DELTA.

Solution to Problem 2

```
$ RUN MAKETOE                                    (1)
DELTA Version X2.2

00000402/PUSHL    #00     414;BP                 (2)

1 BRK AT 00000414
00000414/TSTL     @#7FFEFF60      S
0000041A/BEQL     00000424        S
00000424/MOVL     #17,R1          200/000F4240 ___   (3)

4A8;BP                                           (4)

2 BRK AT 000004A8
000004A8/RET                R0/00000001 R1/008A72A3 R2/80002870____

;P                                               (5)

 EXIT 00000001
80011D28/POPR     #03     EXIT                   (6)

$
$ RUN/DEBUG STOPTOE                              (7)
DELTA Version X2.2

00000402/PUSHL    #00     414;BP                 (8)

1 BRK AT 00000414
00000414/PUSHL    #00     0                      (9)
00000416/PUSHL    #00     0
00000418/PUSHAQ   00000200        0
0000041E/CALLS    #03,@#7FFEDFA0          0
00000425/BLBS     R0,00000429     4A9;BP

2 BRK AT 000004A9
000004A9/CLRQ     -(SP)           S              (10)
000004AB/PUSHL    #20     S
000004AD/PUSHL    #00     S
000004AF/PUSHL    0000025F        S
000004B5/PUSHAL   0000026B        S
000004BB/CLRQ     -(SP)           S
000004BD/PUSHL    #00     S
000004BF/MOVZWL   #30,-(SP)       S
000004C2/MOVZWL   00000208,-(SP)          S
000004C9/PUSHL    #00     S
000004CB/CALLS    #0C,@#7FFEDE00          S
7FFEDE02/CHMK     #002C           !P

Value in CTL$GL_SITESPEC = 80112AA0              (11)
Value in field = 0000030C
Value in field = 0000030F
Value in field = 00000311
 EXIT 00000001
80011D28/POPR     #03     EXIT                   (11)

$
```

3. Write a program that that will allocate and build an AST control block, and queue it to your own process.

   1. The program should determine its own process id, using the PCB$L_PID field.

   2. It should then allocate enough space for an AST control block from nonpaged pool, using the EXE$ALONONPAGED routine found in the module.

   3. It should initialize at least the following fields:

      - ACB$W_SIZE (using size from EXE$ALONONPAGED)
      - ACB$B_TYPE (using appropriate DYN$... symbol)
      - ACB$L_PID (using PID previously determined)
      - ACB$L_AST (using address of AST routine)
      - ACB$B_RMOD (using USER mode, PSL$C_USER)

   4. It should call on routine SCH$QAST to queue the AST (consult the supplied listing for required inputs and outputs). Note that this routine will raise IPL to SYNCH to queue the AST, and return at the same IPL at which it was called.

   5. The main program should then hibernate.

   6. The AST routine simply issues a $WAKE system service, so the main program can exit.

Listing of ASTDEL Module (Page 1 of 3)

```
ASTDEL                  - AST ENQUEUE AND DELIVERY              27-APR-1982 01:08:27  VAX-11 Macro V03-00
V03-000                 SCH$QAST - ENQUEUE AST CONTROL BLOCK FOR 12-MAR-1982 17:09:55  _DB80:[SYS.SRC]ASTDEL.M

                        01AF   455          .SBTTL  SCH$QAST - ENQUEUE AST CONTROL BLOCK FOR PROCESS
                        01AF   456 ;++
                        01AF   457 ; FUNCTIONAL DESCRIPTION:
                        01AF   458 ;       SCH$QAST INSERTS THE AST CONTROL BLOCK SUPPLIED IN THE PROPER
                        01AF   459 ;       POSITION BY ACCESS MODE IN THE AST QUEUE OF THE PROCESS SPECIF
                        01AF   460 ;       BY THE PID FIELD OF THE AST CONTROL BLOCK.  AN AST ARRIVAL EVE
                        01AF   461 ;       IS THEN REPORTED FOR THE PROCESS TO REACTIVATE FROM A WAIT STA
                        01AF   462 ;       IF APPROPRIATE.  THE AST CONTROL BLOCK WILL BE RELEASED IMMEDI
                        01AF   463 ;       IF THE PID SPECIFIES A NON-EXISTENT PROCESS.
                        01AF   464 ;
                        01AF   465 ;       LOADABLE MULTI-PROCESSING CODE WILL REPLACE THIS ROUTINE WITH
                        01AF   466 ;       ENTIRELY NEW CODE, AT MPH$QAST.
                        01AF   467 ;
                        01AF   468 ; CALLING SEQUENCE:
                        01AF   469 ;       BSB/JSB SCH$QAST
                        01AF   470 ;
                        01AF   471 ; INPUT PARAMETERS:
                        01AF   472 ;       R2 - PRIORITY INCREMENT CLASS
                        01AF   473 ;       R5 - POINTER TO AST CONTROL BLOCK
                        01AF   474 ;
                        01AF   475 ; IMPLICIT INPUTS:
                        01AF   476 ;       PCB OF PROCESS IDENTIFIED BY PID FIELD
                        01AF   477 ;
                        01AF   478 ; OUTPUT PARAMETERS:
                        01AF   479 ;       R0 - COMPLETION STATUS CODE
                        01AF   480 ;       R4 - PCB ADDRESS OF PROCESS FOR WHICH AST WAS QUEUED
                        01AF   481 ;
                        01AF   482 ; SIDE EFFECTS:
                        01AF   483 ;       THE PROCESS IDENTIFIED BY THE PID IN THE AST CONTROL BLOCK
                        01AF   484 ;       WILL BE MADE EXECUTABLE IF NOT SUSPENDED.
                        01AF   485 ;
                        01AF   486 ; COMPLETION CODES:
                        01AF   487 ;       SS$_NORMAL  -  NORMAL SUCCESSFUL COMPLETION STATUS
                        01AF   488 ;       SS$_NONEXPR -  NON-EXISTENT PROCESS
                        01AF   489 ;--
                        01AF   490          .ENABL  LSB
                        01AF   491 QNONEXPR:                                    ;
              50    55  D0  01AF   492          MOVL    R5,R0                     ; RELEASE AST CONTROL BLOCK
                 FE4B' 30  01B2   493          BSBW    EXE$DEANONPAGED           ; IF NO SUCH PROCESS
           50    08E8 8F  3C  01B5   494          MOVZWL  #SS$_NONEXPR,R0           ; SET ERROR STATUS CODE
                    43  11  01BA   495          BRB     QEXIT                     ; AND EXIT
                        01BC   496
                        01BC   497 MPH$QAST::                                   ; MULTI-PROCESSING HOOK TO REP
                        01BC   498 SCH$QAST::                                   ; ENQUEUE AST FOR PROCESS
              50    0C A5  3C  01BC   499          MOVZWL  ACB$L_PID(R5),R0          ; GET PROCESS INDEX FOR AST TA
                        01C0   500          DSBINT  #IPL$_SYNCH               ; DISABLE SYSTEM EVENTS
           54    0000'DF40  D0  01C6   501          MOVL    @W^SCH$GL_PCBVEC[R0],R4 ; LOOK UP PCB ADDRESS
            60 A4    0C A5  D1  01CC   502          CMPL    ACB$L_PID(R5),PCB$L_PID(R4) ; CHECK FOR MATCH IN PID
                       0C  12  01D1   503          BNEQ    QNONEXPR                  ; PID MISMATCHES
                       50  D4  01D3   504          CLRL    R0                        ; ASSUME KERNEL MODE AND CLEAR
              10 A4    65  0E  01D5   505          INSQUE  (R5),PCB$L_ASTQFL(R4)     ; ASSUME QUEUE IS EMPTY AND AT
                       2D  12  01D9   506          BNEQ    50$                       ; BR IF IT WAS NOT EMPTY
                    08 A5  95  01DB   507          TSTB    ACB$B_RMOD(R5)            ; CHECK FOR SPECIAL KERNEL AST
                       06  19  01DE   508          BLSS    10$                       ; BR IF YES
50    08 A5    FC 8F  8B  01E0   509          BICB3   #^C<3>,ACB$B_RMOD(R5),R0; GET AST MODE
                        01E6   510 ;
                        01E6   511 ; THE PROCESS HEADER ADDRESS IS ALWAYS A SYSTEM SPACE ADDRESS (NEGATIV
```

Listing of ASTDEL Module (Page 2 of 3)

```
                - AST ENQUEUE AND DELIVERY              27-APR-1982 01:08:27  VAX-11 Macro V03-00         Page  14
                SCH$QAST - ENQUEUE AST CONTROL BLOCK FOR 12-MAR-1982 17:09:55  _DB80:[SYS.SRC]ASTDEL.MAR;1       (1)

                                    01E6    512 ; WHILE THE PROCESS HEADER IS RESIDENT.  DURING THE OUTSWAP TRANSITION IT IS
                                    01E6    513 ; THE BALANCE SLOT INDEX, A SMALL POSITIVE NUMBER.  FINALLY, AFTER OUTSWAP IT
                                    01E6    514 ; IS SET TO ZERO.  HENCE, THE FOLLOWING TEST COMBINES THE FETCH OF THE PHD
                                    01E6    515 ; ADDRESS WITH THE TEST FOR PROCESS RESIDENCE.
                                    01E6    516 ;
      51    64 A4    00  01E6    517 10$:    MOVL    PCB$L_PHD(R4),R1        ; POINT TO PROCESS HEADER
                05    18  01EA    518         BGEQ    20$                     ; DON'T SET ASTLVL IF NOT RESIDENT
   00CB C1    50    90  01EC    519         MOVB    R0,PHD$B_ASTLVL(R1)     ; SET ASTLVL IN PROCESS HEADER
   54   0000'CF    D1  01F1    520 20$:    CMPL    W^SCH$GL_CURPCB,R4      ; IS PROCESS CURRENT PROCESS
                0B    13  01F6    521         BEQL    40$                     ; YES,
                                    01F8    522         RPTEVT  AST             ; REPORT AST ARRIVAL
      50    01    3C  01FC    523 30$:    MOVZWL  #SS$_NORMAL,R0          ; SET SUCCESS STATUS CODE
                                    01FF    524 QEXIT:  ENBINT                  ; ENABLE INTERRUPTS
                05    0202    525         RSB                             ; AND RETURN
                                    0203    526 ;
                                    0203    527 ; IF THE AST IS BEING ENQUEUED FOR THE CURRENT PROCESS, THEN THE REPORTING
                                    0203    528 ; OF THE AST EVENT CAN BE BYPASSED AND THE ASTLVL PROCESSOR REGISTER MUST BE
                                    0203    529 ; SET INSTEAD.
                                    0203    530 ;
      13    50    DA  0203    531 40$:    MTPR    R0,#PR$_ASTLVL          ; ALSO SET ASTLVL REGISTER
                F4    11  0206    532         BRB     30$                     ;
                                    0208    533 ;
                                    0208    534 ; THE AST QUEUE WAS NOT EMPTY (ITS USUAL CONDITION) AND THE PROPER
                                    0208    535 ; POSITION FOR THE NEW AST MUST BE LOCATED.  SINCE THE AST CONTROL
                                    0208    536 ; BLOCK HAS BEEN ERRONEOUSLY INSERTED ON THE QUEUE, IT MUST BE REMOVED
                                    0208    537 ; FIRST.
                                    0209    538 ;
      55    65    0F  0208    539 50$:    REMQUE  (R5),R5                 ; ELSE CORRECT MISTAKE
   51    10 A4    DE  0208    540         MOVAL   PCB$L_ASTQFL(R4),R1     ; POINT TO QUEUE HEADER
      53    61    D0  020F    541         MOVL    (R1),R3                 ; GET FIRST ENTRY ON QUEUE
         08 A5    95  0212    542         TSTB    ACB$B_RMOD(R5)          ; CHECK FOR SPECIAL KERNEL AST
                0F    18  0215    543         BGEQ    70$                     ; BR IF NOT
                                    0217    544 ;
                                    0217    545 ; THE NEW AST IS A SPECIAL KERNEL AST.  IT WILL GO AFTER ALL OTHER SPECIAL
                                    0217    546 ; KERNEL ASTS OR AT THE HEAD OF THE QUEUE IF THERE ARE NONE.
                                    0217    547 ;
      53    51    01  0217    548 60$:    CMPL    R1,R3                   ; CHECK FOR END OF QUEUE
                27    13  021A    549         BEQL    110$                    ; BR IF NOT
         08 A3    95  021C    550         TSTB    ACB$B_RMOD(R3)          ; CHECK FOR SPECIAL KERNEL IN QUEUE
                22    18  021F    551         BGEQ    110$                    ; BR IF NOT
      53    63    D0  0221    552         MOVL    (R3),R3                 ; FLINK ON TO NEXT ACB
                F1    11  0224    553         BRB     60$                     ;
                                    0226    554 ;
                                    0226    555 ; THE NEW AST IS A NORMAL AST.  IT WILL GO AFTER ALL SPECIAL KERNEL ASTS
                                    0226    556 ; AND ASTS WITH LOWER ACCESS MODE.
                                    0226    557 ;
50 08 A5    FC  8F  88  0226    558 70$:    BICB3   #^C<3>,ACB$B_RMOD(R5),R0; GET AST MODE
      53    51    01  022C    559 80$:    CMPL    R1,R3                   ; CHECK FOR END OF QUEUE
                12    13  022F    560         BEQL    110$                    ; INSERT IF AT END
      02    00    ED  0231    561         CMPZV   #ACB$V_MODE,#ACB$S_MODE,-
   50    08 A3    0234    562                 ACB$B_RMOD(R3),R0       ; COMPARE ACCESS MODES
                05    14  0237    563         BGTR    100$                    ; IF GTR AT RIGHT PLACE
      53    63    D0  0239    564 90$:    MOVL    (R3),R3                 ; FLINK ON TO NEXT ACB
                EE    11  023C    565         BRB     80$                     ;
         08 A3    95  023E    566 100$:   TSTB    ACB$B_RMOD(R3)          ; IS THIS ENTRY A SPECIAL KAST?
                F6    19  0241    567         BLSS    90$                     ; YES, MUST GO AFTER THIS
                                    0243    568 ;
```

Listing of ASTDEL Module (Page 3 of 3)

```
ASTDEL                          - AST ENQUEUE AND DELIVERY              27-APR-1982 01:08:27  VAX-11 Macro V03-00
V03-000                         SCH$QAST - ENQUEUE AST CONTROL BLOCK FOR 12-MAR-1982 17:09:55  _DB$0:[SYS.SRC]ASTDEL.MAR;1

                                0243   569 ; NOW THE CORRECT POSITION HAS BEEN LOCATED.  INSERT THE AST CONTROL BLOCK
                                0243   570 ; ON THE QUEUE AND COMPUTE THE NEW VALUE FOR ASTLVL BY INTERROGATING THE
                                0243   571 ; MODE OF THE AST CONTROL BLOCK AT THE HEAD OF THE QUEUE.
                                0243   572 ;
        04 B3    65     0E      0243   573 110$:   INSQUE  (R5),@ACB$L_ASTQBL(R3)  ; INSERT AFTER PREVIOUS
                 50     D4      0247   574         CLRL    R0                      ; ASSUME KERNEL MODE
        51    10 A4     D0      0249   575         MOVL    PCB$L_ASTQFL(R4),R1     ; GET HEAD OF AST QUEUE
              08 A1     95      024D   576         TSTB    ACB$B_RMOD(R1)          ; IS IT KAST?
                 94     19      0250   577         BLSS    10$                     ; BR IF YES TO SET ASTLVL
50    08 A1    FC 8F    88      0252   578         BICB3   #^C<3>,ACB$B_RMOD(R1),R0; GET AST MODE FOR HEAD OF QUEUE
                 8C     11      0258   579         BRB     10$                     ; GO SET ASTLVL
                                025A   580
                                025A   581         .DSABL LSB
                                025A   582         ASSUME  ACB$V_MODE EQ 0
                                025A   583         ASSUME  ACB$S_MODE EQ 2
                                025A   584         ASSUME  ACB$V_KAST EQ 7
                                025A   585
```

Listing of OWNAST.MAR File

```
;                                                       OWNAST.MAR

;       This program allocates and builds an AST control block,
;       which it queues to itself.

;
;       Global symbols
        $CYNDEF
        $ACBDEF
        $PPIDEF
        $IPLDEF
        $PSLDEF
;
;       Local Storage
        .PSECT  NONSHARED_DATA  PIC, NOEXE, LONG
PID:    .BLKL   1                       ; Location to store PID
AST:    .ADDRESS ASTADR                 ; Address of AST routine
;
;       Program entry point
        .PSECT  CODE    PIC, SHR, NOWRT
START:  .WORD   0                       ; no registers need be saved
        $CMKRNL_S ROUTIN=10$            ; go queue AST to self
        BLBS    R0,7$                   ; exit if error
        RET
7$:     $HIBER_S                        ; wait for AST to wake
        RET
;
;       Queue AST to self
10$:    .WORD   ^M<R2,R3,R4,R5>         ; save some registers
        MOVL    G^SCH$GL_CURPCB,R0      ; get CURRENT PCB address
        MOVL    PCB$L_PID(R0),PID       ; get PID from PCB field
        MOVL    #ACB$K_LENGTH, R1       ; get length of AST block
        SETIPL  #IPL$_ASTDEL            ; prevent process deletion
        JSB     G^EXE$ALONONPAGED       ; get pool space
        BLBS    R0, 20$                 ; exit if none
        SETIPL  #0                      ; lower IPL if error
        RET
;
;       Initialize code block to look like ACB
20$:    MOVW    R1, ACB$W_SIZE(R2)      ; record size of block allocated
        MOVB    #DYN$C_ACB, ACB$B_TYPE(R2)      ; and type
        MOVL    PID, ACB$L_PID(R2)      ; get pid from GETJPI
        MOVL    AST, ACB$L_AST(R2)      ; store AST address
        MOVB    #PSL$C_USER, ACB$B_RMOD(R2)     ; user mode AST
;
;       Prepare registers to queue AST (SCH$QAST raises IPL to SYNCH)
        MOVL    R2, R5                  ; need address of AST block
        MOVL    #PRI$_TICOM, R2         ; give big boost
        JSB     G^SCH$QAST              ; queue AST
        MOVL    #SS$_NORMAL, R0         ; indicate success
        SETIPL  #0                      ; lower IPL before returning
        RET
;
;       AST routine simply awakens main
ASTADR: .WORD   0                               ; no registers saved
        $WAKE_S
        BLBC    R0, 40$
        RET
40$:    $EXIT_S CODE=R0

        .END    START
```

Sample Run

```
$ TYPE OWNAST.COM
$!                                              OWNAST.COM
$!
$ MACRO OWNAST+SYS$LIBRARY:LIB/LIB
$ LINK OWNAST, SYS$SYSTEM:SYS.STB/SELECTIVE
$
$ @OWNAST
$
$ SET PROCESS/PRIV=(CMKRNL)
$
$ RUN OWNAST
$
```

4. If you receive MAIL while you are logged in, the system displays the following message on your terminal "New mail from xyzuser". Use the PATCH utility, as described below, to alter that message.

    1. Copy the file OLDMAIL.EXE to your directory from a directory specified by your instructor. (This file may not be exactly the same as SYS$SYSTEM:MAIL.EXE.) You will patch your own copy of this MAIL file, not the one that is being used on the system.

    2. Use the DUMP command to display the contents of the OLDMAIL.EXE file (you probably want to use the /OUTPUT= qualifier so you can print the output file). Also, use the ANALYZE/IMAGE/OUTPUT= command to obtain a listing of the image section descriptors.

    3. Locate the text of the "New mail from !AS" message. The descriptor for the string follows the text (string length, string address). If you didn't know where the descriptor was, once you found the string, you could use the SEARCH command to search the file for the string address, and decide if any of the occurrences could be part of the descriptor.

    4. If you only wanted to change the text (keeping the same number of characters in the string), you could simply deposit over the locations containing the text you want altered. For example, changing "New" to "Fan".

    5. If you want to change the message to have a different number of characters, you will have to insert a new text string in the image file, and update the descriptor to contain the new string length and address.

    6. To add a different string like "Junk mail from !AS", you must locate some unused space in the image file. Look in the image section containing the message for empty space (all Ø's in the DUMP output). Note that the number of blocks in each image section is specified in the ANALYZE/IMAGE output.

    7. Run the PATCH utility, creating a journal file, and specify your copy of MAIL as input.

        1. Ask to CREATE a command procedure file with the PATCH commands you issue.

        2. SET the ECO level.

3. Issue DEPOSIT commands to add the ASCII text you want at an unused location in the image file. (Note that a BYTE value of 7 rings the bell. You may want to ring the bell before displaying the message.)

4. Overwrite the string descriptor with the length of the text string you chose to use, and the address of the text string you entered.

5. Issue the UPDATE command to make the changes in the file.

6. EXIT from PATCH.

8. Test your MAIL program by sending MAIL to yourself, and seeing if the right text string is displayed. You will require the following privileges to run your copy of MAIL: (WORLD, OPER, NETMBX, SYSPRV)

9. You should verify your PATCH session was a success by displaying the journal file and the produced command procedure. You can also issue the ANALYZE/IMAGE/PATCH command to examine the file you patched.

Relevant Section of ANALYZE/IMAGE Output

```
Analyze Image                                  14-MAY-1982 16:44:46.10    Page 1
WORK:[MUIZNIEKS.SYSPRG.PRIVCODE]OLDMAIL.EXE;1

IMAGE HEADER

        Fixed Header Information

                image format major id: 02, minor id: 04
                header block count: 1
                image type: executable (IHD$K_EXE)
                I/O channel count: default
                I/O page count: default
                linker flags:
                        (0)  IHD$V_LNKDEBUG    0
                        (1)  IHD$V_LNKNOTFR    0
                        (2)  IHD$V_NOPOBUFS    0
                        (3)  IHD$V_PICING      1
                        (4)  IHD$V_POIMAGE     0

        Image Activation Information

                first transfer address:  %X'00001810'
                second transfer address: %X'00000000'
                third transfer address:  %X'00000000'

        Global Symbol Table & Debug Symbol Table Information

                debug symbol table VBN:  0, block count: 0
                global symbol table VBN: 0, record count: 0

        Image Identification Information

                image name: "MAIL"
                image file identification: "V03-001"
                link date/time: 24-FEB-1982 09:34:06.12
                linker identification: "03-14"

        Patch Information

                There are no patches at this time.

        Image Section Descriptors (ISD)

                1)  image section descriptor (16 bytes)
                        page count: 3
                        base virtual address: %X'00000200' (P0 space)
                        page fault cluster size: default
                        ISD flags:
                                (0)  ISD$V_GBL         0
                                (1)  ISD$V_CRF         0
                                (2)  ISD$V_DZRO        0
                                (3)  ISD$V_WRT         0
                                (7)  ISD$V_LASTCLU     1
                                (8)  ISD$V_COPYALWAY   0
                                (9)  ISD$V_BASED       0
                                (10) ISD$V_FIXUPVEC    0
                                (17) ISD$V_VECTOR      0
                                (18) ISD$V_PROTECT     0
```

Relevant Section of DUMP Command Output (Page 1 of 2)

```
Dump of file WORK1:[MUIZNIEKS.SYSPRG.PRIVCODE]OLDMAIL.EXE;1 on 14-MAY-1982 16:45:
53.02
File ID (3726,23,0)   End of file block 36 / Allocated 36

Virtual block number 3 (00000003), 512 (0200) bytes

 00000410 010E0005 0054454E 24535953 SYS$NET......... 000000
 0000223D 4C49414D 223A3A3A 54454E5F _NET:::"MAIL=".. 000010
 66204E52 55544552 20737365 72500A0D ..Press RETURN f 000020
 0000001A 00002E2E 2E65726F 6D20726F or more......... 000030
 00000007 00534121 202A2321 00000420  ...!#* !AS..... 000040
 20206D6F 72462023 20202020 00000444 D...     # From   000050
 44202020 20202020 20202020 20202020                D 000060
 6A627553 20202020 20202020 20657461 ate         SubJ 000070
 00000020 00000454 0000002F 00746365 ect./...T... ... 000080
 4C553521 00003A3A 0000048C 00000001 ........::..!5UL 000090
 44412120 53413231 21204441 30322120  !20AD !12AS !AD 0000A0
 49444524 4C49414D 0000049C 00000014 ........MAIL$EDI 0000B0
 21402024 000004B8 00000009 00000054 T.........$ @! 0000C0
 00002253 41212220 22534121 22205341 AS "!AS" "!AS".. 0000D0
 54535953 24535953 000004CC 00000012 ........SYS$SYST 0000E0
 004D4F43 2E534944 454C4941 4D3A4D45 EM:MAILEDIT.COM. 0000F0
 6F792072 65746E45 000004EB 00000017 ........Enter wo 000100
 776F6C65 62206567 61737365 6D207275 ur message below 000110
 77205A2F 4C525443 20737365 7250202E . Press CTRL/Z w 000120
 5443202C 6574656C 706D6F63 206E6568 hen complete, CT 000130
 0000003A 74697571 206F7420 432F4C52 RL/C to quit:... 000140
 00000003 00000001 00000508 00000045 E.............. 000150
 00000560 00000008 504C4548 4C49414D MAILHELP....`... 000160
 00000042 4C482E3A 504C4548 24535953 SYS$HELP:.HLB... 000170
 00001764 0202000C 00000570 0000000D ....p........d... 000180
 00001778 00001770 031D0008 00001760 `........p....x... 000190
 7266206C 69616D20 77654E07 00000000 .....New mail fr 0001A0
 000005A4 00000012 00005341 21206D6F om !AS.......... 0001B0
 00000007 00000054 4E495250 24535953 SYS$PRINT....... 0001C0
 6E652057 55212042 6F4A2020 000005C0 ....  Job !UW en 0001D0
 21206575 65757120 6E6F2064 65726574 tered on queue ! 0001E0
 72500A0D 000005D4 0000001E 00004341 AC.............Pr 0001F0
```

Message to be changed starts at 5A4 (hex)

Descriptor for message to be changed
length = 12 (hex) = 18 decimal bytes
5A4 = starting address of string

Relevant Section of DUMP Command Output (Page 2 of 2)

```
Dump of file WORK:[MUIZNIEKS.SYSPRG.PRIVCODE]OLDMAIL.EXE;1 on 14-MAY-1982 16:45:
53.02
File ID (3726,23,0)   End of file block 36 / Allocated 36

Virtual block number 4 (00000004), 512 (0200) bytes

 6D20726F 66204E52 55544552 20737365 ess RETURN for m 000000
 000005FC 0000001A 00002E2E 2E65726F ore............. 000010
 0000000C 4C552123 20534121 202A2321 !#* !AS #!UL.... 000020
 00000000 00000000 00000000 00000620  ............... 000030
 00000000 00000000 00000000 00000000 ................ 000040
 00000000 00000000 00000000 00000000 ................ 000050
 00000000 00000000 00000000 00000000 ................ 000060
 00000000 00000000 00000000 00000000 ................ 000070
 00000000 00000000 00000000 00000000 ................ 000080
 00000000 00000000 00000000 00000000 ................ 000090
 00000000 00000000 00000000 00000000 ................ 0000A0
 00000000 00000000 00000000 00000000 ................ 0000B0
 00000000 00000000 00000000 00000000 ................ 0000C0
 00000000 00000000 00000000 00000000 ................ 0000D0
 00000000 00000000 00000000 00000000 ................ 0000E0
 00000000 00000000 00000000 00000000 ................ 0000F0
 00000000 00000000 00000000 00000000 ................ 000100
 00000000 00000000 00000000 00000000 ................ 000110
 00000000 00000000 00000000 00000000 ................ 000120
 00000000 00000000 00000000 00000000 ................ 000130
 00000000 00000000 00000000 00000000 ................ 000140
 00000000 00000000 00000000 00000000 ................ 000150
 00000000 00000000 00000000 00000000 ................ 000160
 00000000 00000000 00000000 00000000 ................ 000170
 00000000 00000000 00000000 00000000 ................ 000180
 00000000 00000000 00000000 00000000 ................ 000190
 00000000 00000000 00000000 00000000 ................ 0001A0
 00000000 00000000 00000000 00000000 ................ 0001B0
 00000000 00000000 00000000 00000000 ................ 0001C0
 00000000 00000000 00000000 00000000 ................ 0001D0
 00000000 00000000 00000000 00000000 ................ 0001E0
 00000000 00000000 00000000 00000000 ................ 0001F0
```

Unused space in image section - will be used to hold text of new message starting at 634 (hex)

Patching the New MAIL File Terminal Session

```
$ PATCH/JOURNAL NEWMAIL.EXE

  PATCH  Version 3-00  15-Mar-1982

%PATCH-I-NOLCL, image does not contain local symbols
%PATCH-I-NOGBL, some or all global symbols not accessible
PATCH>CREATE PATCHMAIL
PATCH>SET ECO 1
PATCH>DEPOSIT/ASCII                <-- Enter new message
LOC>^X634                              in unused area
NEW>' Jun'
NEW>'k ma'
NEW>'il f'
NEW>'rom '
NEW>'!AS '
NEW>EXIT
old:     00000634:  ''
old:     00000638:  ''
old:     0000063C:  ''
old:     00000640:  ''
old:     00000644:  ''
new:     00000634:  ' Jun'
new:     00000638:  'k ma'
new:     0000063C:  'il f'
new:     00000640:  'rom '
new:     00000644:  '!AS '
PATCH>DEPOSIT/BYTE                 <-- Make first character
LOC>^X634                              ring terminal bell
NEW>7
NEW>EXIT
old:     00000634:  20
new:     00000634:  07
PATCH>DEPOSIT                      <-- Update descriptor to point
LOC>5B8                                to new message.  New message
NEW>^X13                               length now 19 (decimal) =
NEW>^X634                              13 (hex) bytes
NEW>EXIT
old:     000005B8:  00000012
old:     000005BC:  000005A4
new:     000005B8:  00000013
new:     000005BC:  00000634
PATCH>UPDATE
%PATCH-I-WRTFIL, updating image file WORK:[HUIZNIEKS.SYSPRG.PRIVCODE]NEWMAIL.EXE
;2
PATCH>EXIT
$
```

Sample Run To Test Patched File

```
$ SET PROCESS/PRIV=(WORLD,OPER,NETMBX,SYSPRV)
$
$ RUN NEWMAIL

MAIL> SEND
To: MUIZNIEKS
Subj: TESTING NEW MAIL VERSION
Enter your message below. Press CTRL/Z when complete, CTRL/C to quit:
This should be sent with JUNK MAIL message
^Z
Junk mail from MUIZNIEKS

                              MAIL> EXIT
$
$ MAIL

You have 1 new message.

MAIL>
                                                                MAIL #53
From:    MUIZNIEKS      14-MAY-1982 16:53
To:      MUIZNIEKS
Subj:    TESTING NEW MAIL VERSION

This should be sent with JUNK MAIL message

MAIL> DELETE

MAIL> SEND
To: MUIZNIEKS
Subj: STILL TESTING
Enter your message below. Press CTRL/Z when complete, CTRL/C to quit:
This message should still be sent with regular NEW MAIL indication
^Z
New mail from MUIZNIEKS

MAIL> READ MAIL
                                                                MAIL #53
From:    MUIZNIEKS      14-MAY-1982 16:54
To:      MUIZNIEKS
Subj:    STILL TESTING

This message should still be sent with regular NEW MAIL indication

MAIL> DEL

MAIL> EXIT
$
```

Examining Journal File

```
$ TYPE NEWMAIL.JNL

  PATCH  Version 3-00  15-Mar-1982

IMAGE FILE BEING PATCHED:       "WORK:[MUIZNIEKS.SYSPRG.PRIVCODE]NEWMAIL.EXE;1"
JOURNAL FILE:                   "WORK:[MUIZNIEKS.SYSPRG.PRIVCODE]NEWMAIL.JNL;1"
DATE/TIME OF PATCH:             14-MAY-1982 16:47:48.54

%PATCH-I-NOLCL, image does not contain local symbols
%PATCH-I-NOGBL, some or all global symbols not accessible
PATCH>CREATE PATCHMAIL
COMMAND FILE:                   "WORK:[MUIZNIEKS.SYSPRG.PRIVCODE]PATCHMAIL.COM;2
*
PATCH>SET ECO 1
PATCH>DEPOSIT/ASCII
LOC>  ^X634
NEW>  ' Jun'
NEW>  'k ma'
NEW>  'il f'
NEW>  'rom '
NEW>  '!AS '
NEW>  EXIT
old:    00000634:  ''
old:    00000638:  ''
old:    0000063C:  ''
old:    00000640:  ''
old:    00000644:  ''
new:    00000634:  ' Jun'
new:    00000638:  'k ma'
new:    0000063C:  'il f'
new:    00000640:  'rom '
new:    00000644:  '!AS '
PATCH>DEPOSIT/BYTE
LOC>  ^X634
NEW>  7
NEW>  EXIT
old:    00000634:  20
new:    00000634:  07
PATCH>DEPOSIT
LOC>  5B8
NEW>  ^X13
NEW>  ^X634
NEW>  EXIT
old:    000005B8:  00000012
old:    000005BC:  000005A4
new:    000005B8:  00000013
new:    000005BC:  00000634
PATCH>UPDATE
%PATCH-I-WRTFIL, updating image file WORK:[MUIZNIEKS.SYSPRG.PRIVCODE]NEWMAIL.EXE
;2
PATCH>EXIT
$
```

Relevant Sections of ANALYZE/IMAGE/PATCH Output (Page 1 of 2)

```
Analyze Image                                  14-MAY-1982 16:59:22.98    Page 1
WORK:[MUIZNIEKS.SYSPRG.PRIVCODE]NEWMAIL.EXE;2

IMAGE HEADER

        Fixed Header Information

                image format major id: 02, minor id: 04
                header block count: 1
                image type: executable (IHD$K_EXE)
                I/O channel count: default
                I/O page count: default
                linker flags:
                        (0)  IHD$V_LNKDEBUG    0
                        (1)  IHD$V_LNKNOTFR    0
                        (2)  IHD$V_NOPOBUFS    0
                        (3)  IHD$V_PICIMG      1
                        (4)  IHD$V_POIMAGE     0

        Image Activation Information

                first transfer address:  %X'00001810'
                second transfer address: %X'00000000'
                third transfer address:  %X'00000000'

        Global Symbol Table & Debug Symbol Table Information

                debug symbol table VBN:  0, block count: 0
                global symbol table VBN: 0, record count: 0

        Image Identification Information

                image name: "MAIL"
                image file identification: "V03-001"
                link date/time: 24-FEB-1982 09:34:06.12
                linker identification: "03-14"

        Patch Information

                DEC eco levels   1- 98: %X'00000001', %X'00000000', %X'00000000'
                user eco levels 99-132: %X'00000000'
                read/write patch area address: %X'00000000', length: 0
                read-only patch area address:  %X'00000000', length: 0
                patch command text VBN: 37
                last patch date/time: 14-MAY-1982 16:47:48.54

        Image Section Descriptors (ISD)

                1)  image section descriptor (16 bytes)
                        page count: 3
                        base virtual address: %X'00000200' (P0 space)
                        page fault cluster size: default
                        ISD flags:
                                (0)  ISD$V_GBL         0
                                (1)  ISD$V_CRF         0
                                (2)  ISD$V_DZRO        0
                                (3)  ISD$V_WRT         0
                                (7)  ISD$V_LASTCLU     1
```

Relevant Sections of ANALYZE/IMAGE/PATCH Output (Page 2 of 2)

```
Analyze Image                                  14-MAY-1982 17:01:03.85   Page 6
WORK:[MUIZNIEKS.SYSPRG.PRIVCODE]NEWMAIL.EXE;2


PATCH TEXT

        /JOURNAL NEWMAIL.EXE
        SE EC
        ^X00000001
        D /AS
        ^X00000634
        ' Jun'
        'k ea'
        'il f'
        'rom '
        'IAS '
        EXI
        D /B
        ^X00000634
        ^X00000007
        EXI
        D
        ^X000005B8
        ^X00000013
        ^X00000634
        EXI


The analysis uncovered NO errors.


ANALYZE/IMAGE/PATCH NEWMAIL.EXE
$
```

Relevant Sections of DUMP Output for Patched File (Page 1 of 2)

```
Dump of file WORK:[MUIZNIEKS.SYSPRG.PRIVCODE]NEWMAIL.EXE;2 on 14-MAY-1982 17:01:
20.06
File ID (7567,16,0)   End of file block 37 / Allocated 39

Virtual block number 3 (00000003), 512 (0200) bytes

 00000410 010E0005 0054454E 24535953 SYS$NET......... 000000
 0000223D 4C49414D 223A3A3A 54454E5F _NET:::"MAIL+"... 000010
 66204E52 55544552 20737365 72500A0D ..Press RETURN f 000020
 0000001A 00002E2E 2E65726F 6D20726F or more......... 000030
 00000007 00534121 202A2321 00000420  ...!@$ !AS..... 000040
 20206D6F 72462023 20202020 00000444 D...    # From   000050
 44202020 20202020 20202020 20202020                D 000060
 6A627553 20202020 20202020 20657461 ate         SubJ 000070
 00000020 00000454 0000002F 00746365 ect./...T... ... 000080
 4C553521 00003A3A 0000048C 00000001 ........::..!5UL 000090
 44412120 53413231 21204441 30322120  !20AD !12AS !AD 0000A0
 49444524 4C49414D 0000049C 00000014 ........MAIL$EDI 0000B0
 21402024 000004B8 00000009 00000054 T...........$ @! 0000C0
 00002253 41212220 22534121 22205341 AS "!AS" "!AS".. 0000D0
 54535953 24535953 000004CC 00000012 ........SYS$SYST 0000E0
 004D4F43 2E544944 4541C4941 4D3A4D45 EM:MAILEDIT.COM. 0000F0
 6F792072 65746E45 000004E8 00000017 ........Enter wo 000100
 776F6C65 62206567 61737365 6D207275 ur message below 000110
 77205A2F 4C525443 20737365 7250202E . Press CTRL/Z w 000120
 5443202C 6574656C 706D6F63 206E6568 hen complete, CT 000130
 0000003A 74697571 206F7420 432F4C52 RL/C to quit:... 000140
 00000003 00000001 00000508 00000045 E............... 000150
 00000560 00000008 504C4548 4C49414D MAILHELP....`... 000160
 00000042 4C482E3A 504C4548 24535953 SYS$HELP:.HLB... 000170
 00001764 0202000C 00000570 0000000D ....p.......d... 000180
 00001778 00001770 031D0008 00001760 `.......p...x... 000190
 7266206C 69616D2C 77654E07 00000000 .....New mail fr 0001A0
 00000634 00000013 00005341 21206D6F om !AS......4... 0001B0
 00000009 00000054 4E495250 24535953 SYS$PRINT..... 0001C0
 6E652057 55212062 6F4A2020 000005C0 ....  Job !UW en 0001D0
 21206575 65757120 6E6F2064 65726574 tered on queue ! 0001E0
 72500A0D 000005D4 0000001E 00004341 AC.....Pr 0001F0
```

Original text still there

Descriptor updated

Relevant Sections of DUMP Output for Patched File (Page 2 of 2)

```
Dump of file WORK:[MUIZNIEKS.SYSPRG.PRIVCODE]NEWMAIL.EXE;2 on 14-MAY-1982 17:01:
20.06
File ID (7567,16,0)    End of file block 37 / Allocated 39

Virtual block number 4 (00000004), 512 (0200) bytes

 6D20726F 66204E52 55544552 20737365 ess RETURN for m 000000
 000005FC 0000001A 00002E2E 2E65726F ore............. 000010
 0000000C 4C552123 20534121 202A2321 !#* !AS #!UL.... 000020
 66206C69 616D206B 6E754A07 00000620  ....Junk mail f 000030 <-- New text added
 00000000 00000000 20534121 206D6F72 rom !AS ........ 000040
 00000000 00000000 00000000 00000000 ................ 000050
 00000000 00000000 00000000 00000000 ................ 000060
 00000000 00000000 00000000 00000000 ................ 000070
 00000000 00000000 00000000 00000000 ................ 000080
 00000000 00000000 00000000 00000000 ................ 000090
 00000000 00000000 00000000 00000000 ................ 0000A0
 00000000 00000000 00000000 00000000 ................ 0000B0
 00000000 00000000 00000000 00000000 ................ 0000C0
 00000000 00000000 00000000 00000000 ................ 0000D0
 00000000 00000000 00000000 00000000 ................ 0000E0
 00000000 00000000 00000000 00000000 ................ 0000F0
 00000000 00000000 00000000 00000000 ................ 000100
 00000000 00000000 00000000 00000000 ................ 000110
 00000000 00000000 00000000 00000000 ................ 000120
 00000000 00000000 00000000 00000000 ................ 000130
 00000000 00000000 00000000 00000000 ................ 000140
 00000000 00000000 00000000 00000000 ................ 000150
 00000000 00000000 00000000 00000000 ................ 000160
 00000000 00000000 00000000 00000000 ................ 000170
 00000000 00000000 00000000 00000000 ................ 000180
 00000000 00000000 00000000 00000000 ................ 000190
 00000000 00000000 00000000 00000000 ................ 0001A0
 00000000 00000000 00000000 00000000 ................ 0001B0
 00000000 00000000 00000000 00000000 ................ 0001C0
 00000000 00000000 00000000 00000000 ................ 0001D0
 00000000 00000000 00000000 00000000 ................ 0001E0
 00000000 00000000 00000000 00000000 ................ 0001F0
```

Command Procedure Produced by PATCH

```
$ TYPE PATCHMAIL.COM
/JOURNAL NEWMAIL.EXE
SE EC
^X00000001
D /AS
^X00000634
' Jun'
'k ba'
'il f'
'rom '
'!AS '
EXI
D /B
^X00000634
^X00000007
EXI
D
^X000005B8
^X00000013
^X00000634
EXI
U
EXI
$
```

USER-WRITTEN SYSTEM SERVICES

TEST

Your assignment is to develop a number of programs, and user-written system service, that allow a process to declare TBIT exception handler. This handler will receive contro immediately following a TBIT exception, without executing all o the VMS exception dispatching code.

The TBIT exception (Trace Trap) is generated following an instruction for which the Trace Bit (bit 4) is set in th Processor Status Word (PSW). This bit is often used by debugger (for single stepping instructions), or for performanc monitoring/testing.

You will first have to write a dispatcher that can transfe control to a user-written handler following a TBIT exception This dispatcher will be patterned after the change mode handler that can be declared using the $DCLCMH system service. Thes handlers are entered following an exception (by the hardware using vectors in the SCB). They transfer control by looking fo an address in a fixed location in P1 space, where the address of user-declared handler may be stored.

You will then need to write a system service that allows a user t declare a TBIT handler on a per-process basis. The system servic will load the handler address in the fixed location in P1 space.

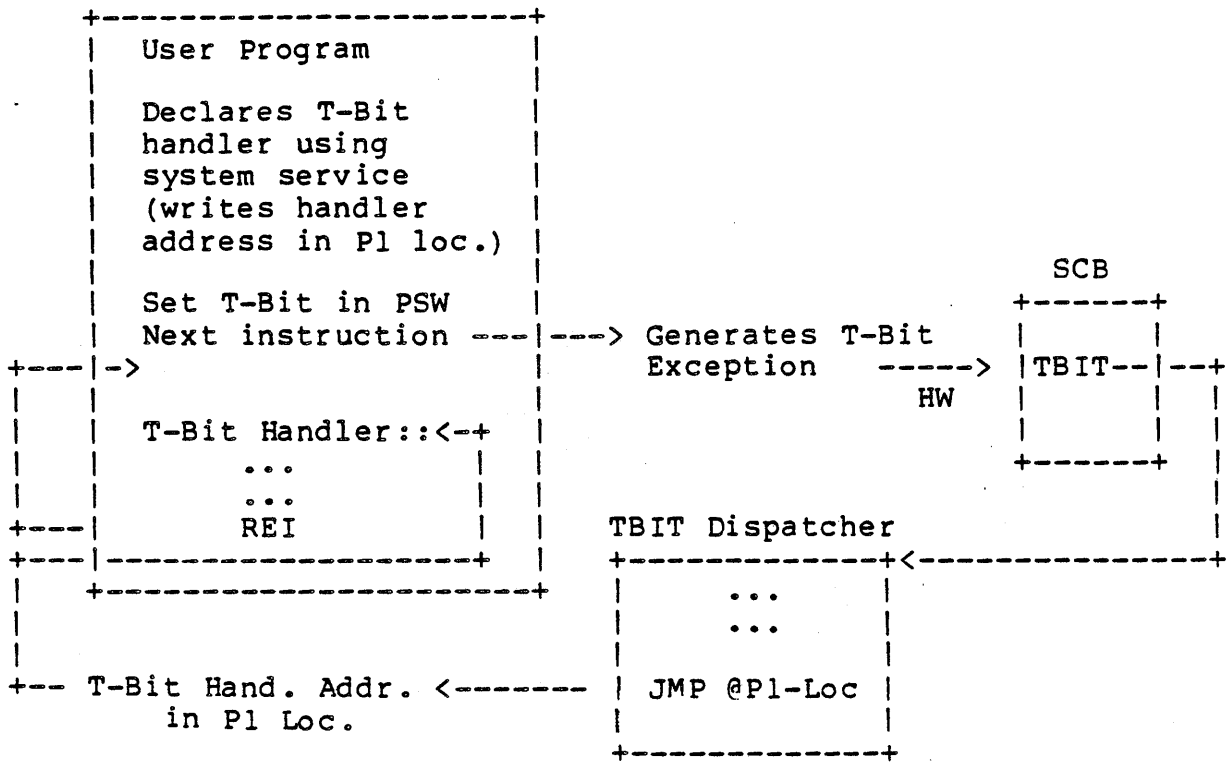
Finally, you will want to write a program that will restore th default system routine (EXE$TBIT) for handling TBIT exceptions.

This exercise has been split into several parts. You should rea the description of all the parts before starting to solve any o them. You will probably want to work on some of the parts "out o order", and use solutions provided by the instructor for som parts to test other parts you are writing. In particular, you ma want to solve this exercise in the following order:

- Do Part 2 first, which involves writing a system service
- Use Part 5 to build and test the entire application (you ma need to modify the command procedure somewhat)
- Do Part 3 next, since it is simpler than Part 1
- Then do Part 1
- Finally do Part 4

Note that it is quite unlikely that you will be able to complet all five parts in one day.

Overview of Control Flow



PART 1 - Loading TBIT Dispatcher (LOADTBIT.MAR)

In order to receive control after a TBIT exception, you first need to:

- Allocate a block of nonpaged pool to store the TBIT dispatcher
  - Use EXE$ALONONPAGED
  - Assume TBIT dispatcher block type is DYN_K_TBIT
- Copy the dispatch code to the pool block
  - The code must be PIC, since it is copied
  - Any register used by the routine must be saved, and later restored (perhaps by the user's handler). The supplied dispatcher does not use any registers.
  - Special considerations include:
    - Access mode at which handler entered

      The supplied solution enters the handler in kernel mode. It is possible to change access mode (using REI) to the mode of the caller, but this takes more time, and introduces considerable complexity (probing accessibility of stack, so can copy arguments to that stack, etc.). To help prevent a system security problem (non-privileged users being able to write and execute kernel mode code), the system service will check to make sure the establisher of the TBIT handler has CMKRNL privilege.
    - If no handler specified, transfer control to system handler, EXE$TBIT
    - Handler address will be specified in fixed location in P1 space (CTL$GL_SITESPEC). That way, separate TBIT handlers can be declared by each process in the system.
    - Transfer control to the TBIT handler with JMP instruction
- Modify the SCB to point to the dispatch code in the allocated block for TBIT exceptions

- SCB address at EXE$GL_SCB
- Assume TBIT offset is SCB_L_TBIT

In addition, it is necessary to test for the presence of XDELTA (since XDELTA uses the TBIT entry in the SCB). If XDELTA is present, you do not want to load your dispatcher. In such a case, exit the program and indicate that XDELTA is present.

- To test for the presence of XDELTA, examine the RPB$V_DEBUG bit in the RPB$L_BOOTR5 offset in the Restart Parameter Block. When set, XDELTA is present.
- EXE$GL_RPB contains the address of the RPB.

Since you later want to be able to restore the SCB, and deallocate the block of nonpaged pool containing the dispatcher, store the address of the block in EXE$GL_SITESPEC. Before using this location, however, test to make sure it is not being used (i.e., it contains a 0). If it is being used, exit the program.

- Note that in order to synchronize access to the EXE$GL_SITESPEC location, you must execute at IPL SYNCH from the time you first test the location, to the time it is modified.

The file TBITDEF.MAR contains several macros that may be of use to you, including:

_TBITDEF	Defines offsets in TBIT dispatcher block:	
	TBIT_W_SIZE	for size of block
	TBIT_B_TYPE	for type of block
	TBIT_B_CODE	code is loaded beginning here
	TBIT_L_HANDLER	address of new TBIT dispatcher (used for consistency checks)
_SCBDEF	Defines offset of TBIT vector (SCB_L_TBIT) in SCB.	
_DYNDEF	Defines type code for TBIT dispatcher block (DYN_K_TBIT).	

The file TBITMSG.MSG defines some specific error codes that you may wish to report:

TBIT__VECINUSE	Site specific longword already in use
TBIT__INSFMEM	Nonpaged pool allocation failed
TBIT__XDELTA	Dispatcher cannot be installed in system with XDELTA

LOADTBIT Program Solution (Page 1 of 5)

```
LOADTBIT                Create new path to TBIT handler          14-MAY-1982 18:22:43  VAX-11 Macro V03-00
V02                                                              14-MAY-1982 18:05:30  WORK:[MUIZNIEKS.SYSPRG.USSDI

                                                                                        LOADTBIT.MAR

                        .title  loadtbit        Create new path to TBIT handler
                        .ident  "V02"
                ;++
                ;
                ;  Facility:
                ;
                ;       This code is dynamically patched into the running executive.
                ;       It introduces a new dispatch method to handle TBIT exceptions,
                ;       similar to the method used to handle CHMS, CHMU, and
                ;       compatibility mode exceptions.
                ;
                ;       This program is designed to provide an environment for the
                ;       user-written system service USSDCLTBIT, also included as a part
                ;       of this example.
                ;
                ;  Environment:
                ;
                ;       This program must execute in kernel mode in order to write
                ;       protected locations. IPL is raised to 7 (SYNCH) to synchronize
                ;       access to the site specific location EXE$GL_SITESPEC.
                ;
                ;  Author:
                ;
                ;       Larry Kenah
                ;
                ;  Creation Date:
                ;
                ;       19 May 1980
                ;
                ;  Revisions:
                ;
                ;       27 Mar. 1982            Vik Muiznieks
                ;
                ;                               Removed patch to EXE$RUNDWN
                ;                               Added synchronization for EXE$GL_SITESPEC
                ;
                ;       12 June 1980            Have new exception service routine execute
                ;                               in kernel mode, simplifying stack problems.
                ;
                ;--
                ;
                ;  Include Files:
                ;
                        $dyndef                         ;define type field identifier
                        $ipldef                         ;define ipl constants
                        $psldef                         ;define fields in PSL
                        $rpbdef                         ;define offsets into Restart Param
                        $scbdef                         ;define system control block offse
                        $tbitdef                        ;this macro is defined especially
                                                        ; the set of programs in this exam
```

LOADTBIT Program Solution (Page 2 of 5)

```
Create new path to TBIT handler          14-MAY-1982 18:22:43  VAX-11 Macro V03-00          Page   2
add fast dispatch method                 14-MAY-1982 18:05:30  WORK:[MUIZNIEKS.SYSPRG.USS]LOADTBI(1)

                        .subtitle       add fast dispatch method

;++
;  Functional Description:
;
;       The kernel mode procedure beginning at label 10$ allocates
;       a block of nonpaged pool and copies the new dispatcher for
;       TBIT exceptions to that block. The last instruction of the new
;       dispatcher is a JMP to the normal dispatcher so that continuity
;       is established.
;
;       If no debugger support was selected at initialization time,
;       the address of the new dispatcher is simply moved into the
;       TBIT vector in the system control block.
;
;       If debugger support was selected, then XDELTA has already
;       intercepted the system control block vector. This dispatcher
;       could steal the SCB vector contents and JMP to XDELTA as its
;       last instruction but that hierarchy (first this, then XDELTA,
;       and finally the normal dispatch path) is out of order. Since
;       this new dispatch path exists on a per process basis, it should
;       execute after XDELTA executes. However, due to the difficulty
;       in patching XDELTA with its PC relative references to EXE$TBIT,
;       this program does nothing (except indicate an error) when
;       XDELTA is included in the system.
;
;  Implicit Output:
;
;       1.  A block of pool is allocated and a new TBIT exception
;           dispatcher is loaded into the block of pool.
;
;       2.  The new dispatcher is plugged into the executive by modifying
;           the TBIT vector in the SCB if no XDELTA support was included
;
;  Completion Codes:
;
;       R0 low bit set => success
;
;               SS$_NORMAL      Normal Successful Completion
;
;       R0 low bit clear => failure
;
;               TBIT__VECINUSE  The site specific longword is already being used
;
;               TBIT__INSFMEM   Insufficient dynamic memory is available. (This
;                               status is only returned if the current process
;                               has disabled resource wait mode.)
;
;               TBIT__XDELTA    The system included XDELTA at initialization
;                               time. This program does nothing in this case.
;
;--
```

LOADTBIT Program Solution (Page 3 of 5)

```
LOADTBIT                    Create new path to TBIT handler          14-MAY-1982 18:22:43  VAX-11 Macro V03-00
02                          add fast dispatch method                 14-MAY-1982 18:05:30  WORK:[MUIZNIEKS.SYSPRG.USS]

                              00000000   108          .psect nonshared_data   pic,noexe,long
                                  0000   109
                     00000029' 0000   110 range:    .address lock_begin
                     000000C3' 0004   111          .address lock_end
                                  0008   112
                              00000000   113          .psect  tbit_code       pic,shr,nowrt
                                  0000   114
                          0000  0000   115          .entry  begin,0
                                  0002   116          $cmkrnl_s       -
                                  0002   117                  routin=10$
                            04    0011   118          ret
                                  0012   119
                          003C    0012   120 10$:      .word   ^m<r2,r3,r4,r5>         ;save volatile registers
                                  0014   121          $lkset_s inadr=range            ;lock pages in working set
                     01 50        E8  0025   122          blbs    r0,lock_begin           ;continue on success
                                  04  0028   123          ret
                                      0029   124 lock_begin:
                                      0029   125          setipl  #ipl$_synch             ;synchronize access to sitespec
              00000000'GF         D5  002C   126          tstl    g^exe$gl_sitespec       ;see if site specific pointer
                                      0032   127                                          ; is already being used
                       5C         12  0032   128          bnequ   inuse                   ;error if already loaded
                                      0034   129
          51  00000000'GF         D0  0034   130          movl    g^exe$gl_rpb,r1         ;get address of restart parameter
               55    30 A1        D0  0038   131          movl    rpb$l_bootr5(r1),r5     ;r5 contains bootstrap flags
               58 55    01        E0  003F   132          bbs     #rpb$v_debug,r5,xdelta  ;do nothing if XDELTA included
                                      0043   133
          51  0000001E'8F         D0  0043   134          movl    #<<handler_end-handler_start>+12>,r1 ;size of block includ
                                      004A   135                                          ; 12 byte header
              00000000'GF     16  004A   136          jsb     g^exe$alononpaged
                    53 50     E9  0050   137          blbc    r0,nopool
        00000000'GF   52        D0  0053   138          movl    r2,g^exe$gl_sitespec    ;save address of block for program
                                      005A   139                                          ; that unloads this dispatcher
                 7E    0C A2    9E  005A   140          movab   tbit_b_code(r2),-(sp)   ;save address of beginning of code
                          04    BB  005E   141          pushr   #^m<r2>                 ; and address of beginning of bloc
                          82    7C  0060   142          clrq    (r2)+                   ;clear out first 8 bytes of header
                       82    51   B0  0062   143          movw    r1,(r2)+                ;save size of block for deallocati
                    82    7F 8F    98  0065   144          movzbw  #dyn_k_tbit,(r2)+       ;store block type and clear spare
                                      0069   145
                                      0069   146 ;  r2 now points to the portion of the block that is to be loaded with
                                      0069   147 ;  the new dispatch code. The address of the beginning of the block
                                      0069   148 ;  and the address of the portion of the block where the code is to be
                                      0069   149 ;  loaded are stored on the stack. No other register contents need to be
                                      0069   150 ;  saved across the MOVC3 instruction.
                                      0069   151
    62  00000081'EF   0012'8F     28  0069   152          movc3   #<handler_end-handler_start>,handler_start,(r2)
                             0C   BA  0073   153          popr    #^m<r2,r3>              ;restore address of beginning of
                                      0075   154                                          ; into r2 and address of code int
          51  00000000'GF         D0  0075   155          movl    g^exe$gl_scb,r1         ;otherwise, simply modify SCB vec
           28 A1    0000'C3     9E  007C   156          movab   tbit-handler_start(r3),scb_l_tbit(r1) ;load address of ne
                                      0082   157                                          ; dispatcher into SCB
              62    0000'C3     9E  0082   158          movab   tbit-handler_start(r3),tbit_l_handler(r2) ; and also save
                                      0087   159                                          ; of the header longwords in the
                                      0087   160          setipl  #0                      ;safe to allow process deletion n
              50    0000'8F     3C  008A   161          movzwl  #ss$_normal,r0          ;indicate success
                                04    008F   162          ret
                                      0090   163
                                      0090   164 inuse:                                 ;site specific longword is alread
```

LOADTBIT Program Solution (Page 4 of 5)

```
                        Create new path to TBIT handler          14-MAY-1982 18:22:43  VAX-11 Macro V03-00          Page   4
                        add fast dispatch method                 14-MAY-1982 18:05:30  WORK:[MUIZNIEKS.SYSPRG.USSJLOADTBI(1)

  50    00000000'8F    D0  0090   165          movl    @tbit__vecinuse,r0
                       00  0097   166          setipl  #0
                       04  009A   167          ret
                           0099   168
  50    00000000'8F    D0  0098   169 xdelta:  movl    @tbit__xdelta,r0        ;XDELTA was included at bootstrap time.
                           00A2   170          setipl  #0
                       04  00A5   171          ret                             ;pass back failure code
                           00A6   172
                           00A6   173 nopool:                                  ;insufficient nonpaged pool space
                           00A6   174          setipl  #0
  50    00000000'8F    D0  00A9   175          movl    @tbit__insfmem,r0
                       04  00B0   176          ret
                           00B1   177
```

LOADTBIT Program Solution (Page 5 of 5)

```
)ADTBIT                 Create new path to TBIT handler          14-MAY-1982 18:22:43  VAX-11 Macro V03-00
)2                      dispatch code for TBIT exceptions        14-MAY-1982 18:05:30  WORK:[MUIZNIEKS.SYSPRG.USSJI

                        0081   179          .sbttl  dispatch code for TBIT exceptions
                        0081   180
                        0081   181 ;++
                        0081   182 ;
                        0081   183 ;  Functional Description:
                        0081   184 ;
                        0081   185 ;       This code is designed to be the first code that executes following
                        0081   186 ;       a TBIT exception (if no XDELTA). It checks whether a special TBIT
                        0081   187 ;       handler has been declared by the process and, if so, dispatches to
                        0081   188 ;       that dispatcher with only the exception PC and PSL on the stack.
                        0081   189 ;
                        0081   190 ;       This design is closely modeled on the existing rapid dispatchers
                        0081   191 ;       for change mode and compatibility mode exceptions. Such dispatcher
                        0081   192 ;       can be accessed quickly without the overhead of searching for
                        0081   193 ;       addresses of condition handlers in exception vectors and in call fr
                        0081   194 ;       Handlers accessed with this method are not procedures and can only
                        0081   195 ;       be written in a language that allows JSB like linkage.
                        0081   196 ;
                        0081   197 ;       The method of getting this dispatch scheme into the system imposes
                        0081   198 ;       several constraints on this code.
                        0081   199 ;
                        0081   200 ;       1.  The code must be position independent since it is simply
                        0081   201 ;           copied into nonpaged pool with no attempt at dynamic relocatior
                        0081   202 ;
                        0081   203 ;       2.  Any registers used by this routine must first be saved.
                        0081   204 ;           (None is currently used.) In addition,
                        0081   205 ;           stack usage must be watched carefully.
                        0081   206 ;
                        0081   207 ;       3.  The initial design of this dispatch method transfers control
                        0081   208 ;           to the user specified dispatcher in kernel mode. One improvemer
                        0081   209 ;           which would slow up the dispatching and add stack concerns,
                        0081   210 ;           would be to change to the access mode in which the TBIT
                        0081   211 ;           exception occurred.
                        0081   212 ;
                        0081   213 ;--
                        0081   214
                        0081   215 handler_start:                          ;address of beginning of block of c
                        0081   216                                         ; that is loaded into nonpaged pool
                        0081   217
                        0081   218 tbit:                                   ;address of tbit handler
00000000'GF     DD      0081   219          pushl   G^ctl$gl_sitespec      ;store contents on stack
          02    13      0087   220          beql    10$                    ;if empty, no dispatcher
          9E    17      0089   221          jmp     @(sp)+                 ;transfer to user written dispatche
                        0088   222
          8E    05      0088   223 10$:     tstl    (sp)+                  ;clean stack
00000000'GF     17      008D   224          jmp     g^exe$tbit             ;and transfer to VMS TBIT exceptior
                        00C3   225
                        00C3   226 handler_end:                            ;end of code that is being loaded
                        00C3   227                                         ; into nonpaged pool
                        00C3   228 lock_end:
                        00C3   229
                        00C3   230          .end    begin
```

TBITDEF.MAR File

```
;                                                       TBITDEF.MAR

;+
;  This file contains all symbolic definitions for the fast TBIT
;  exception dispatcher.
;
;  1.    The _tbitdef macro is included in the loader and unloader
;        programs to define the offsets into the tbit block.
;
;  2.    The _scbdef and _dyndef macros are also included in both
;        the loader and unloader programs.
;
;-

        .macro  _dyndef                 ;define type field identifier

        dyn_k_tbit = ^X80 + 1           ;use largest positive integer

        .endm   _dyndef

        .macro  _scbdef                 ;define system control block vectors

        scb_l_tbit = ^X28               ;TBIT exception

        .endm   _scbdef

        .macro  _tbitdef                ;define offsets into tbit block
        $defini tbit

        $def    tbit_l_handler          ;address of new TBIT dispatcher
        .blkl   1
        $def    tbit_l_spare            ;currently not used
        .blkl   1
        $def    tbit_w_size             ;size of allocated block
        .blkw   1
        $def    tbit_b_type             ;code used by SDA et al.
        .blkb   1
        .blkb   1                       ;spare
        $def    tbit_b_code             ;code is loaded beginning at this point

        $defend tbit
        .endm   _tbitdef
```

TBITMSG.MSG File

```
                                                TBITMSG.MSG

This file defines specific error messages for the
TBIT dispatching programs

.title  tbit_handler    Alternate TBIT dispatcher

.facility       TBIT,1/prefix=TBIT__

.severity       SEVERE

VECINUSE        <Site specific longword already in use>
INSFMEM         <Nonpaged pool allocation failed>
XDELTA          <Dispatcher cannot be installed in system with XDELTA>
NOHANDLER       <Site specific longword contains no data block address>
BADHANDLR       <Data in block is inconsistent with LOADTBIT input>

.end
```

PART 2 - User-Written System Service To Declare TBIT Handler (TBITDISP.MAR)

In order to incorporate a system service to declare a TBIT handler, you will first need to:

1. Copy SYS$EXAMPLES:USSDISP.MAR to your directory.

2. Edit that file to remove the sample system services, the supplied rundown routine, and the executive mode dispatcher.

3. Add a DEFINE_SERVICE macro for your system service:

   - Call it USSDCLTBIT
   - You want 2 parameters:
     - First is address of TBIT handler to be established (or Ø to disable previous handler)
     - Second is address of longword to receive previous handler address, if any (this parameter is optional)
   - Service should execute in kernel mode

4. Include the offset to a RUNDOWN routine in the privileged library vector

5. Add code for USSDCLTBIT system service:

   - Test for CMKRNL privilege, since handler will execute in kernel mode (unless in Part 1 your dispatcher changed access mode).
   - Could test for presence of TBIT dispatcher loaded in Part 1.
     - Not really necessary since VMS does not use CTL$GL_SITESPEC location.
     - However, TBIT handler declared will never be entered for a TBIT exception until program from Part 1 is run to establish TBIT dispatcher.
   - If user requested address of previous handler, make sure user can write to the address specified.

- Copy address of handler being declared to location CTL$GL_SITESPEC.

6. Add code for RUNDOWN routine

   - Routine entered at image rundown time (with JSB instruction)

   - Executes in kernel mode

   - Should clear CTL$GL_SITESPEC location, so next image not effected by handler declared in previous image

   - Should exit with RSB instruction

TBITDISP.MAR File (Page 1 of 6)

```
Declare TBIT Handler                    14-MAY-1982 18:22:56  VAX-11 Macro V03-00          Page   1
                                        14-MAY-1982 17:54:52  WORK:[MUIZNIEKS.SYSPRG.USS]TBITDIS(1)

                                                        TBITDISP.MAR

                        ;       This file contains both an edited user-written system service
                        ;       dispatcher (from SYS$EXAMPLES:USSDISP.MAR) and the system
                        ;       service code itself for the load TBIT dispatcher system service.
                        ;
                        ;       Macro Definitions
                        ;
                        ;       DEFINE_SERVICE - A macro to make the appropriate entries in several
                        ;                        different PSECTs required to define an EXEC or KERNEL
                        ;                        mode service.  These include the transfer vector,
                        ;                        the case table for dispatching, and a table containing
                        ;                        the number of required arguments.
                        ;
                        ;       DEFINE_SERVICE Name,Number_of_Arguments,Mode
                        ;
                                .MACRO  DEFINE_SERVICE,NAME,NARG=0,MODE=KERNEL
                                .PSECT  $$$TRANSFER_VECTOR,PAGE,NOWRT,EXE,PIC
                                .ALIGN  QUAD                    ; Align entry points for speed and style
                                .TRANSFER       NAME            ; Define name as universal symbol for entry
                                .MASK   NAME                    ; Use entry mask defined in main routine
                                .IF     IDN MODE,KERNEL
                                CHMK    #<KCODE_BASE+KERNEL_COUNTER> ; Change to kernel mode and execute
                                RET                             ; Return
                                KERNEL_COUNTER=KERNEL_COUNTER+1 ; Advance counter
                                .PSECT  KERNEL_NARG,BYTE,NOWRT,EXE,PIC
                                .BYTE   NARG                    ; Define number of required arguments
                                .PSECT  USER_KERNEL_DISP1,BYTE,NOWRT,EXE,PIC
                                .WORD   2+NAME-KCASE_BASE       ; Make entry in kernel mode CASE table
                                .IFF
                                CHME    #<ECODE_BASE+EXEC_COUNTER> ; Change to executive mode and execute
                                RET                             ; Return
                                EXEC_COUNTER=EXEC_COUNTER+1     ; Advance counter
                                .PSECT  EXEC_NARG,BYTE,NOWRT,EXE,PIC
                                .BYTE   NARG                    ; Define number of required arguments
                                .PSECT  USER_EXEC_DISP1,BYTE,NOWRT,EXE,PIC
                                .WORD   2+NAME-ECASE_BASE       ; Make entry in exec mode CASE table
                                .ENDC                           ;
                                .ENDM   DEFINE_SERVICE          ;
                        ;
                        ;       Equated Symbols
                        ;

                                $PHDDEF                         ; Define process header offsets
                                $PLVDEF                         ; Define PLV offsets and values
                                $PRDEF                          ; Define processor register numbers
                        ;
                        ;       Initialize counters for change mode dispatching codes
                        ;
00000000                KERNEL_COUNTER=0                        ; Kernel code counter
00000000                EXEC_COUNTER=0                          ; Exec code counter

                                                                                
```

TBITDISP.MAR File (Page 2 of 6)

```
;SDCLTBIT                Declare TBIT Handler                    14-MAY-1982 18:22:56  VAX-11 Macro V03-00
)2                                                               14-MAY-1982 17:54:52  WORK:[MUIZNIEKS.SYSPRG.USS]T

                    0000     59 ;
                    0000     59 ;       Own Storage
                    0000     60 ;
                 00000000    61         .PSECT  KERNEL_NARG,BYTE,NOWRT,EXE,PIC
                    0000     62 KERNEL_NARG:                         ; Base of byte table containing the
                    0000     63                                      ;  number of required arguments.
                 00000000    64         .PSECT  EXEC_NARG,BYTE,NOWRT,EXE,PIC
                    0000     65 EXEC_NARG:                           ; Base of byte table containing the
                    0000     66                                      ;  number of required arguments.
                    0000     67
                    0000     68
                    0000     69         DEFINE_SERVICE  USSOCLTBIT,2,KERNEL     ; Declare TBIT system servi
                    0002     70
                    0002     71 ;
                    0002     72 ; The base values used to generate the dispatching codes should be negative
                    0002     73 ; user services and must be chosen to avoid overlap with any other privileg
                    0002     74 ; shareable images that will be used concurrently.  Their definition is
                    0002     75 ; deferred to this point in the assembly to cause their use in the precedin
                    0002     76 ; macro calls to be forward references that guarantee the size of the chang
                    0002     77 ; mode instructions to be four bytes.  This satisfies an assumption that is
                    0002     78 ; made by for services that have to wait and be retried.  The PC for retryi
                    0002     79 ; the change mode instruction that invokes the service is assumed to be 4 b
                    0002     80 ; less than that saved in the change mode exception frame.  Of course, the
                    0002     81 ; service routine determines whether this is possible.
                    0002     82 ;
FFFFFE0C            0002     83 KCODE_BASE=-500                      ; Base CHMK code value for these se
FFFFFE0C            0002     84 ECODE_BASE=-500                      ; Base CHME code value for these se
                    0002     85 ;
                    0002     86 ;
                 00000000    87         .PSECT  USER_SERVICES,PAGE,VEC,PIC,NOWRT,EXE
                    0000     88
00000001            0000     89         .LONG   PLV$C_TYP_CMOD          ; Set type of vector to change mode
00000000'           0004     90         .LONG   SYS$K_VERSION           ; Identify system version
00000005'           0008     91         .LONG   KERNEL_DISPATCH-.       ; Offset to kernel mode dispatcher
00000000            000C     92         .LONG   0                       ; Offset to executive mode dispatch
00000024'           0010     93         .LONG   RUNDOWN-.               ; Offset to RUNDOWN routine
00000000            0014     94         .LONG   0                       ; Reserved.
00000000            0018     95         .LONG   0                       ; No RMS dispatcher
00000000            001C     96         .LONG   0                       ; Address check - PIC image
```

TBITDISP.MAR File (Page 3 of 6)

```
IT                      Declare TBIT Handler                    14-MAY-1982 18:22:56  VAX-11 Macro V03-00          Page   3
                        Kernel Mode Dispatcher                  14-MAY-1982 17:54:52  WORK:[MUIZNIEKS.SYSPRG.USSJTBITDIS(1)

                                0020    98          .SBTTL  Kernel Mode Dispatcher
                                0020    99 ;++
                                0020   100 ; Input Parameters:
                                0020   101 ;
                                0020   102 ;       (SP) - Return address if bad change mode value
                                0020   103 ;
                                0020   104 ;        R0  - Change mode argument value.
                                0020   105 ;
                                0020   106 ;        R4  - Current PCB Address. (Therefore R4 must be specified in all
                                0020   107 ;                register save masks for kernel routines.)
                                0020   108 ;
                                0020   109 ;        AP  - Argument pointer existing when the change
                                0020   110 ;              mode instruction was executed.
                                0020   111 ;
                                0020   112 ;        FP  - Address of minimal call frame to exit
                                0020   113 ;              the change mode dispatcher and return to
                                0020   114 ;              the original mode.
                                0020   115 ;--
                           00000000   116          .PSECT  USER_KERNEL_DISP0,BYTE,NOWRT,EXE,PIC
                                0000   117 KACCVIO:                                ; Kernel access violation
        50    0000'8F    3C  0000   118          MOVZWL  #SS$_ACCVIO,R0          ; Set access violation status code
                           04  0005   119          RET                             ;  and return
                                0006   120 KINSFARG:                              ; Kernel insufficient arguments.
        50    0000'8F    3C  0006   121          MOVZWL  #SS$_INSFARG,R0         ; Set status code and
                           04  0008   122          RET                             ;  return
                           05  000C   123 KNOTME: RSB                             ; RSB to forward request
                                000D   124
                                0000   125 KERNEL_DISPATCH::                     ; Entry to dispatcher
        51    01F4 CO      9E  0000   126          MOVAB   W^-KCODE_BASE(R0),R1    ; Normalize dispatch code value
                     F8     19  0012   127          BLSS    KNOTME                  ; Branch if code value too low
              01    51     B1  0014   128          CMPW    R1,#KERNEL_COUNTER      ; Check high limit
                     F3     1E  0017   129          BGEQU   KNOTME                  ; Branch if out of range
                                0019   130 ;
                                0019   131 ; The dispatch code has now been verified as being handled by this dispatcher,
                                0019   132 ; now the argument list will be probed and the required number of arguments
                                0019   133 ; verified.
                                0019   134 ;
     51    0000'CF41    9A  0019   135          MOVZBL  W^KERNEL_NARG[R1],R1    ; Get required argument count
51    00000004 9F41    DE  001F   136          MOVAL   @#4[R1],R1              ; Compute byte count including arg count
                           0027   137          IFNORD  R1,(AP),KACCVIO         ; Branch if arglist not readable
     01F4'CF40     6C  91  002D   138          CMPB    (AP),W^<KERNEL_NARG-KCODE_BASE>[R0] ; Check for required number
                     01    1F  0033   139          BLSSU   KINSFARG                ;  of arguments
                     50    AF  0035   140          CASEW   R0,-                    ; Case on change mode
                                0037   141                  -                      ; argument value
                                0037   142                  #KCODE_BASE,-          ; Base value
        00    FE0C 8F         0037   143                  #<KERNEL_COUNTER-1>    ; Limit value (number of entries)
                                0038   144 KCASE_BASE:                           ; Case table base address for DEFINE_SERVICE
                                0038   145 ;
                                0038   146 ;       Case table entries are made in the PSECT USER_KERNEL_DISP1 by
                                0039   147 ;       invocations of the DEFINE_SERVICE macro.  The three PSECTS,
                                0038   148 ;       USER_KERNEL_DISP0,1,2 will be abutted in lexical order at link-time.
                                0038   149 ;
                           00000000   150          .PSECT  USER_KERNEL_DISP2,BYTE,NOWRT,EXE,PIC
                                0000   151 .      RSB                             ; Return to reject out of
                                0001   152                                      ; range value
                                0001   153          .title  ussdcltbit      Declare TBIT Handler
                                0001   154          .ident  "V02"
```

TBITDISP.MAR File (Page 4 of 6)

```
SSDCLTBIT                Declare TBIT Handler                    14-MAY-1982 18:22:56  VAX-11 Macro V03-00
02                       Kernel Mode Dispatcher                  14-MAY-1982 17:54:52  WORK:[MUIZNIEKS.SYSPRG.USS]

                    0001   155
                    0001   156
                    0001   157 ;++
                    0001   158 ;
                    0001   159 ;  Facility:
                    0001   160 ;
                    0001   161 ;       This procedure allows a privileged process to declare a TBIT
                    0001   162 ;       handler that is accessed quickly, bypassing the usual VMS
                    0001   163 ;       exception dispatch mechanism. The procedure can either
                    0001   164 ;       be called through the SYS$CMKRNL system service or installed
                    0001   165 ;       as a user written system service.
                    0001   166 ;
                    0001   167 ;  Environment:
                    0001   168 ;
                    0001   169 ;       Kernel mode procedure that alters the CTL$GL_SITESPEC location.
                    0001   170 ;
                    0001   171 ;  Author:
                    0001   172 ;
                    0001   173 ;       Larry Kenah
                    0001   174 ;
                    0001   175 ;  Creation Date:
                    0001   176 ;
                    0001   177 ;       4 August 1980
                    0001   178 ;
                    0001   179 ;  Revisions:
                    0001   180 ;
                    0001   181 ;       Vik Muiznieks     8 Apr 1982
                    0001   182 ;
                    0001   183 ;               Added RUNDOWN routine, and updated privileged library
                    0001   184 ;               vector
                    0001   185 ;
                    0001   186 ;               Synchronized access to EXE$GL_SITESPEC
                    0001   187 ;--
                    0001   188 ;
                    0001   189 ;  Include Files:
                    0001   190 ;
                    0001   191
                    0001   192
                    0001   193          $prvdef                         ;define privilege bits
                    0001   194          $pcbdef                         ;define offsets into PCB
                    0001   195
                    0001   196 ;
                    0001   197 ;  Argument List Offset Definitions
                    0001   198 ;
                    0001   199
00000004            0001   200          addres = 4                      ;Address of new TBIT handler
00000008            0001   201          prvhnd = 8                      ;Address of longword to receive
                    0001   202                                          ; old handler address
                    0001   203
```

TBITDISP.MAR File (Page 5 of 6)

```
Declare TBIT Handler                    14-MAY-1982 18:22:56  VAX-11 Macro V03-00          Page   5
Declare TBIT Handler                    14-MAY-1982 17:54:52  WORK:[MUIZNIEKS.SYSPRG.USSJTBITDIS(1)

     0001    205          .subtitle       Declare TBIT Handler
     0001    206
     0001    207 ;+
     0001    208 ;  This procedure allows a process to specify a TBIT handler that will
     0001    209 ;  immediately receive control when a TBIT exception occurs, bypassing
     0001    210 ;  the normal VMS exception dispatching mechanism.
     0001    211 ;
     0001    212 ;  To avoid some tricky stack problems, the initial implementation of this
     0001    213 ;  service executes in kernel mode. For this reason, the procedure can
     0001    214 ;  either be called by means of the Change Mode to Kernel system service,
     0001    215 ;  or the procedure can be made a part of a privileged shareable image,
     0001    216 ;  accessed as a user written system service.
     0001    217 ;
     0001    218 ;  Input Parameters:
     0001    219 ;
     0001    220 ;       addres(ap)      Address of handler that is being declared
     0001    221 ;
     0001    222 ;       prvhnd(ap)      Address of longword that will receive the
     0001    223 ;                       address of a previous handler, if one existed.
     0001    224 ;
     0001    225 ;  Implicit Input:
     0001    226 ;
     0001    227 ;       r4              PCB address of caller
     0001    228 ;
     0001    229 ;       ctl$gl_sitespec Location in which to store handler address.
     0001    230 ;                       The symbol is defined (and unused) by VMS.
     0001    231 ;
     0001    232 ;       Note that this procedure does not test whether the fast TBIT
     0001    233 ;       dispatcher has been installed. Such a test could easily be added
     0001    234 ;       to this service.
     0001    235 ;
     0001    236 ;       No harm is done if the P1 space location is loaded without
     0001    237 ;       the dispatcher being installed because VMS does not use
     0001    238 ;       the P1 space location in question. However, the TBIT handler
     0001    239 ;       declared with this procedure will never be called until the TBIT
     0001    240 ;       dispatcher is installed.
     0001    241 ;
     0001    242 ;  Implicit Output:
     0001    243 ;
     0001    244 ;       ctl$gl_sitespec is loaded with the address of the new handler.
     0001    245 ;
     0001    246 ;  Status Codes:
     0001    247 ;
     0001    248 ;       R0 low bit set implies success.
     0001    249 ;
     0001    250 ;       R0 low bit clear implies an error.
     0001    251 ;
     0001    252 ;               SS$_ACCVIO      Previous handler address cannot be
     0001    253 ;                               written by caller's access mode
     0001    254 ;
     0001    255 ;               SS$_NOPRIV      The caller does not have CMKRNL privilege
     0001    256 ;-
     0001    257
  00000000   259          .psect  tbit_code       pic,shr,nowrt
     0000    259
001C 0000   260          .entry  ussdcltbit,^m<r2,r3,r4>
     0002   261
```

TBITDISP.MAR File (Page 6 of 6)

```
SSDCLTBIT                       Declare TBIT Handler                    14-MAY-1982 18:22:56  VAX-11 Macro V03-00
02                              Declare TBIT Handler                    14-MAY-1982 17:54:52  WORK:[MUIZNIEKS.SYSPRG.USS]

                                0002   262          ifnpriv cmkrnl,nopriv           ;does caller have CMKRNL privilege
            51    08 AC   D0    0007   263          movl    prvhnd(ap),r1           ;get previous handler address
                  0C      13    0009   264          beql    10$                     ;skip if none
                                000D   265          ifnowrt #4,(r1),accvio          ;is it accessible?
      61    00000000'GF     D0    0013   266          movl    G^ctl$gl_sitespec,(r1)  ;OK, so write old contents
00000000'GF     04 AC     D0    001A   267 10$:     movl    addres(ap),G^ctl$gl_sitespec ; and store new handler addre
        50    0000'8F   3C    0022   268          movzwl  #ss$_normal,r0          ;indicate success
              04        04    0027   269          ret                             ;and return
                                0028   270
                                0028   271 nopriv:
        50    0000'8F   3C    0028   272          movzwl  #ss$_nopriv,r0          ;caller does not have CMKRNL
              04        04    002D   273          ret
                                002E   274
                                002E   275 accvio:
        50    0000'8F   3C    002E   276          movzwl  #ss$_accvio,r0          ;previous handler address inaccess
              04        04    0033   277          ret
                                0034   278
                                0034   279 ;       This entry point is called at image rundown time, by the rundown
                                0036   280 ;       code, in KERNEL mode.  Control is transferred via JSB.
                                0036   281 ;
                                0034   282 ;       The routine clears the location containing the TBIT handler
                                0034   283 ;       address, so the next image can start "fresh".
                                0036   284
                                0034   285 RUNDOWN:                               ; Entered via JSB
 00000000'GF    04              0034   286          clrl    G^ctl$gl_sitespec       ; clear handler address for next i
                05              003A   287          rsb                             ; return to rundown code
                                0038   288          .end
```

PART 3 - Unloading TBIT Handler And Restoring SCB (REMOVTBIT.MAR)

This program needs to perform the following operations:

1. Include the _DYNDEF and _SCBDEF macros discussed in Part 1.

2. Test that the loader program has been run:

   - Avoid synchronization problems by running at IPL SYNCH
   - Examine EXE$GL_SITESPEC to find TBIT dispatcher address
   - Check type field of TBIT block for consistency. Should find DYN_K_TBIT.

3. Restore SCB to original state

   - Use EXE$GL_SCB as SCB base address
   - Use SCB_L_TBIT as offset to TBIT vector
   - Replace TBIT vector with address of EXE$TBIT

4. Deallocate TBIT dispatcher block

5. Clear EXE$GL_SITESPEC

You may want to use the following messages defined in the TBITMSG.MSG file:

TBIT__NOHANDLER	Site specific longword contains no data block address
TBIT__BADHANDLR	Data in block is inconsistent with LOADTBIT input

REMOVTBIT.MAR File (Page 1 of 3)

```
EMOVE_TBIT                Remove special TBIT exception handler    14-MAY-1982 18:22:50  VAX-11 Macro V03-00
)2                                                                 27-MAR-1982 17:10:13  WORK:[MUIZNIEKS.SYSPRG.U
                                                                                          REMOVTBIT.MAR

                          .title  remove_tbit     Remove special TBIT exception handler
                          .ident  "V02"

                          ;++
                          ;
                          ;  Facility:
                          ;
                          ;       This program unloads the special TBIT exception handler that was
                          ;       loaded by the LOADTBIT program.
                          ;
                          ;  Environment:
                          ;
                          ;       This program must execute in kernel mode in order to write
                          ;       protected locations.
                          ;
                          ;
                          ;  Author:
                          ;
                          ;       Larry Kenah
                          ;
                          ;  Creation Date:
                          ;
                          ;       19 May 1980
                          ;
                          ;
                          ;  Revisions:
                          ;
                          ;       Vik Muiznieks   27-May-1982
                          ;
                          ;       Remove patches to SYSRUNDWN
                          ;       Add synchronization for EXE$GL_SITESPEC
                          ;
                          ;--
                          ;
                          ;  Include Files:
                          ;

                          _dyndef                         ;define type field identifier
                          $ipldef                         ;define ipl constants
                          $rpbdef                         ;define offsets into Restart Par
                          _scbdef                         ;define system control block off
                          _tbitdef                        ;this macro is defined especiall
                                                          ; the set of programs in this ex

                          ;
                          ;  Local Symbols:
                          ;
```

REMOVTBIT.MAR File (Page 2 of 3)

```
T                Remove special TBIT exception handler    14-MAY-1982 18:22:50  VAX-11 Macro V03-00         Page   2
                 Remove special TBIT dispatcher           27-MAR-1982 17:10:13  WORK:[MUIZNIEKS.SYSPRG.USS]REMOVTB(1)

                          0000     52          .subtitle       Remove special TBIT dispatcher
                          0000     53
                          0000     54 ;++
                          0000     55 ;
                          0000     56 ;  Functional Description
                          0000     57 ;
                          0000     58 ;       The kernel mode procedure beginning at address 10$ locates the
                          0000     59 ;       address of the new dispatcher, performs a consistency check, and
                          0000     60 ;       removes the handler from the system.
                          0000     61 ;
                          0000     62 ;       1.      The SCB entry for the TBIT exception is restored to
                          0000     63 ;               its original contents, the address of the routine EXE$TBIT.
                          0000     64 ;
                          0000     65 ;       2.      The block of nonpaged pool that held the dispatcher and
                          0000     66 ;               other information is deallocated.
                          0000     67 ;
                          0000     68 ;  Completion Codes:
                          0000     69 ;
                          0000     70 ;       R0 low bit set => success
                          0000     71 ;
                          0000     72 ;               SS$_NORMAL      Normal Successful Completion
                          0000     73 ;
                          0000     74 ;       R0 low bit clear => failure
                          0000     75 ;
                          0000     76 ;               TBIT__NOHANDLER There is no handler currently in the system.
                          0000     77 ;                               This error occurs if the site specific longword
                          0000     78 ;                               contains a zero.
                          0000     79 ;
                          0000     80 ;               TBIT__BADHANDLR The data block pointed to by EXE$GL_SITESPEC
                          0000     81 ;                               contains an inconsistency. This is either the
                          0000     82 ;                               wrong value in the type field, or a
                          0000     83 ;                               handler address that does not agree with the
                          0000     84 ;                               the contents of the SCB vector.
                          0000     85 ;
                          0000     86 ;--
                          0000     87
                 00000000 0000     88          .psect  nonshared_data  pic,noexe,long
                          0000     89
                 00000029' 0000     90 range:  .address lock_begin
                 0000007F' 0004     91          .address lock_end
                          0008     92
                 00000000 0000     93          .psect  tbit_code       pic,shr,nowrt
                          0000     94
                     0000 0000     95          .entry  remove_tbit,0
                          0002     96          $cmkrnl_s       -
                          0002     97                  routin=10$
                       04 0011     98          ret
                          0012     99
                     003C 0012    100 10$:     .word   ^m<r2,r3,r4,r5>         ;save volatile registers
                          0014    101          $lkwset_s inadr=range           ;lock pages in working set
                01 50    E8 0025    102          blbs    r0,lock_begin           ;continue on success
                       04 0028    103          ret
                          0029    104 lock_begin:
                          0029    105          setipl  #ipl$_synch             ;prevent process deletion in the middle
                          002C    106                                          ;synchronize access to EXE$GL_SITESPEC
    52  00000000'GF    D0 002C    107          movl    g^exe$gl_sitespec,r2    ;get address of tbit block.
                   34   13 0033    108          beql    nohandler
```

REMOVTBIT.MAR File (Page 3 of 3)

```
REMOVE_TBIT                     Remove special TBIT exception handler    14-MAY-1982 18:22:50  VAX-11 Macro V03-00
V02                             Remove special TBIT dispatcher           27-MAR-1982 17:10:13  WORK:[MUIZNIEKS.SYSPRG.USS

                7F 8F    0A A2  91  0035   109          cmpb    tbit_b_type(r2),#dyn_k_tbit ;Correct type?
                           38   12  0038   110          bnequ   inconsistent
            51    00000000'GF   D0  003C   111          movl    g^exe$gl_scb,r1         ;get SCB address
                  62    28 A1   D1  0043   112          cmpl    scb_l_tbit(r1),tbit_l_handler(r2) ;are handler addresses
                           2E   12  0047   113          bnequ   inconsistent
                                     0049   114
                                     0049   115 ;  Consistency checks have succeeded. Now remove the handler from the sys
                                     0049   116
         28 A1    00000000'GF   DE  0049   117          moval   g^exe$tbit,scb_l_tbit(r1) ;Single instruction requires
                                     0051   118                                          ; no synchronization.
                      50    52   D0  0051   119          movl    r2,r0                   ;get tbit block address for
                                     0054   120                                          ; deallocation routine
                  00000000'GF   16  0054   121          jsb     g^exe$deanonpaged
                  00000000'GF   D4  005A   122          clrl    g^exe$gl_sitespec       ;clear site specific vector
                                     0060   123          setipl  #0                      ;OK to be deleted now
                50    0000'8F   3C  0063   124          movzwl  #ss$_normal,r0
                                  04 0068   125          ret
                                     0069   126
            50    00000000'8F   D0  0069   127 nohandler:       movl    #TBIT__NOHANDLER,r0
                                     0070   128                  setipl  #0
                                  04 0073   129                  ret
                                     0074   130
            50    00000000'8F   D0  0074   131 inconsistent:    movl    #TBIT__BADHANDLR,r0
                                     0078   132                  setipl  #0
                                  04 007E   133                  ret
                                     007F   134 lock_end:
                                     007F   135
                                     007F   136          .end    remove_tbit
```

PART 4 - Test Programs (TESTTBIT.MAR and TESTTBIT2.MAR)

Write a program that tests the USSDCLTBIT system service as follows:

1. Assign a channel to the terminal.

2. Display the contents of a location initially set blank.

3. Call the USSDCLTBIT system service, specifying a TBIT handler.

   - The handler should place some new data in the previously printed (blank) locations before exiting

   - Give some thought to which instruction should be used to exit handler

4. Set the T-Bit (bit 4) in the PSW (Hint: BISPSW instruction)

5. Issue a NOP instruction to cause the TBIT exception

   - The handler established above should be entered

6. Display the contents of the modified location to verify that the handler was entered.

The TESTTBIT2 program should be the same as the TESTTBIT program, except the call to the USSDCLTBIT system service should be removed. Enough spare bytes should be inserted so that the TBIT handler previously declared by the TESTTBIT program is still at the same virtual address (even though it should never be called).

If the RUNDOWN routine of the USSDCLTBIT system service has executed properly, when you run TESTTBIT2 you should get a TBIT error message. However, if you have not correctly cleared the CTL$GL_SITESPEC location as part of the RUNDOWN routine, the TBIT exception will be handled properly by the TBIT handler, and no error message will be displayed.

TESTTBIT.MAR File

```
.MAIN.                                                  14-MAY-1982 18:22:37  VAX-11 Macro V03-00
                                                        27-MAR-1982 14:07:08  WORK:[MUIZNIEKS.SYSPRG.US

                                                                                TESTTBIT.MAR
                                                
                                                ;       This program tests the fast TBIT dispatcher using the
                                                ;       USSDCLTBIT user-written system service.
                                                ;
                                                ;       NOTE -- The LOADTBIT program must be run before this
                                                ;       program will work
                                                ;
                                        00000000        .psect  nonshared_data  pic, noexe, long
                                                
6F 63 24 73 79 73 00000008'010E0000'            term:   .ascid  /sys$command/   ; to communicate with terminal
                     64 6E 61 6D 6D
                                0000            ttchan: .word   0
                                                
20 66 6F 20 73 74 6E 65 74 6E 6F 43             msg:    .ascii  /Contents of dummy location is /
69 74 61 63 6F 6C 20 79 6C 6D 75 64
                  20 73 69 20 6E 6F
                     20 20 20 20                dummy:  .ascii  /    /          ; four blank bytes initially
                              2E                        .ascii  /./
                        00000023                mslen = . - msg
                                                
43 44 53 53 55 20 66 6F 20 74 75 4F             out:    .ascii  /Out of USSDCLTBIT call/
      6C 6C 61 63 20 54 49 42 54 4C
                        00000016                outlen = . - out
                                                
                        00000000                prev:   .long   0               ; receive previous handler address
                                                arglist:                        ; argument list for USSDCLTBIT call
                        00000002                        .long   2               ; 2 parameters
                        00000000'                       .address newhand        ; address of new handler
                        0000004E'                       .address prev           ; address of old handler returned
                                                
                                        00000000        .psect  code    pic, shr, nowrt
                                    0000        start:  .word   0               ; save no registers
                                                        $assign_s chan=ttchan, devnam=term
                                 01 50      E8          blbs    r0, 5$
                                            04          ret
                                                5$:     $qiow_s chan=ttchan,func=#io$_writevblk,p1=msg,p2=#mslen,p4=#32
                                 01 50      E8          blbs    r0,10$
                                            04          ret
                00000000'GF     00000052'EF FA          10$:    callg   arglist, g^ussdcltbit   ; establish TBIT handler
                                 01 50      E8          blbs    r0, 20$
                                            04          RET
                                                20$:    $qiow_s chan=ttchan,func=#io$_writevblk,p1=out,p2=#outlen,p4=#32
                                    10      88          bispsw  #^X10   ; set T-bit in mask
                                            01          nop             ; causes t-bit exception to happen
                                                        $qiow_s chan=ttchan,func=#io$_writevblk,p1=msg,p2=#mslen,p4=#32
                                            04          RET
                                                
                                                ;       TBIT handler --- indicates being invoked by updating
                                                ;                        location that is part of msg buffer
                                                
                                                NEWHAND:                        ; entered via dispatch through SCB
                00000033'EF     00000038'EF     D0          movl    out, dummy      ; update value in field
                                            02          rei                     ; dismiss T-BIT exception
                                                
                                                        .end start
```

TESTTBIT2.MAR File (Page 1 of 2)

```
                                                    14-MAY-1982 18:22:40  VAX-11 Macro V03-00          Page   1
                                                     7-APR-1982 17:18:25  WORK:[MUIZNIEKS.SYSPRG.USS]TESTTBI(1)

                                                                                    TESTTBIT2.MAR
                                                
                                                ;       This program tests to make sure that the TBIT handler
                                                ;       has been removed by the RUNDOWN routine
                                                ;
                                                ;       NOTE -- The TESTTBIT program must be run before this
                                                ;       program will work
                                                ;
                                                ;       To work properly, this program should generate a TBIT
                                                ;       exception that is not handled by the TBIT handler
                                                
                                                        .psect  nonshared_data  pic, noexe, long
                                                
73 79 73 00000008'010E0000' 0000 term:  .ascid  /sys$command/   ; to communicate with terminal
            64 6E 61 6D 6D  000E
                      0000  0013 ttchan: .word  0
                            0015
20 73 74 6E 65 74 6E 6F 63  0015 msg:   .ascii  /Contents of dummy location is /
63 6F 6C 20 79 6D 6D 75 64  0021
         20 73 69 20 6E 6F  002D
               20 20 20 20  0033 dummy:  .ascii  /    /          ; four blank bytes initially
                         2E 0037         .ascii  /./
                   00000023 0038 mslen = . - msg
                            0038
53 55 20 66 6F 20 74 75 4F  0038 out:   .ascii  /Out of USSDCLTBIT call/
6C 61 63 20 54 49 42 54 4C  0044
                   00000016 004E outlen = . - out
                            004E
                   00000000 004E prev:   .long   0               ; receive previous handler address
                            0052 arglist:                        ; argument list for USSDCLTBIT call
                   00000002 0052        .long   2               ; 2 parameters
                   000000A7' 0056       .address newhand        ; address of new handler
                   0000004E' 005A       .address prev           ; address of old handler returned
                            005E
                         00000000       .psect  code    pic, shr, nowrt
                        0000 0000 start:  .word   0               ; save no registers
                            0002        $assign_s chan=ttchan, devnam=term
                  01 50    E8 0017      blbs    r0, 5$
                           04 001A      ret
                            0019 5$:    $qiow_s chan=ttchan,func=#io$_writevblk,p1=msg,p2=#mslen,p4=#32
                  01 50    E8 0042      blbs    r0,10$
                           04 0045      ret
                            0046
                            0046 ;      Make changes form TESTTBIT so that no handler is declared
                            0046 ;10$:  callg   arglist, g^ussdcltbit   ; establish TBIT handler
                            0046 ;      blbs    r0, 20$
                            0046 ;      RET
                            0046
                            0046 10$:   $qiow_s chan=ttchan,func=#io$_writevblk,p1=out,p2=#outlen,p4=#32
                     10     B8 006D     bispsw  #^X10   ; set T-bit in mask
                           01 006F      nop             ; causes t-bit exception to happen
                            0070        $qiow_s chan=ttchan,func=#io$_writevblk,p1=msg,p2=#mslen,p4=#32
                           04 0097      RET
                            0098
                            0098 ;      TBIT handler --- indicates being invoked by updating
                            0098 ;                       location that is part of msg buffer
                            0098
```

TESTTBIT2.MAR File (Page 2 of 2)

```
MAIN.                                                    14-MAY-1982 18:22:40  VAX-11 Macro V03-00
                                                          7-APR-1982 17:18:25  WORK:[MUIZNIEKS.SYSPRG.USS]

                        000000A7  0098     54 FILLER: .BLKB   15          ; make sure handler at same address as in
                                  00A7     55                             ; TESTTBIT case
                                  00A7     56
                                  00A7     57 ; SHOULD NOT BE ENTERED IF RUNDOWN WORKS PROPERLY
                                  00A7     58
                                  00A7     59 NEWHAND:                    ; entered via dispatch through SCB
    00000033'EF   00000028'EF     00  00A7     60          movl    out, dummy      ; update value in field
                                  02  00B2     61          rei                     ; dismiss T-BIT exception
                                      00B3     62
                                      00B3     63          .end start
```

PART 5 - Assembling and Linking Programs (TBIT.COM)

You will want to write a command procedure that assembles and links all the programs used by this example. In particular you need to:

1. Create a macro library from the TBITDEF.MAR file for use by the other programs.

2. Assemble all the macro programs, including the debugger, the macro library from step 1 (where appropriate), and the system macro library (where appropriate). Also, generate listing files to aid in debugging.

3. Compile the TBIT-specific error message file (TBITMSG) using the MESSAGE compiler.

4. Link all the programs

   - Taking special actions with the system service dispatcher (/PROTECT qualifier)

   - Including the debugger and system symbol table file, where appropriate

   - Generating map files to help with debugging

5. Enabling the necessary privileges to run the programs (e.g., CMKRNL)

6. Defining DELTA as the debugger to use

7. Installing the user-written system service file (/SHARE/PROTECT).

TBIT.COM File

```
$!                                                  TBIT.COM
$!
$!  This command procedure builds all components for the modified TBIT
$!  exception dispatcher, system service, and sample test programs.
$!
$!  The following components are included:
$!
$!  1.  A program that loads the new dispatcher into the system.
$!
$!  2.  A procedure that illustrates its use.
$!
$!  3.  A program that removes the modified handler from the system.
$
$!      Create the macro library used by the various programs
$
$  SET VERIFY
$
$ LIBRARY /CREATE=(BLOCKS:10,MODULES:10) /MACRO -
                        TBITLIB.MLB TBITDEF.MAR
$
$!      Assemble all components (include debugger support)
$  MACRO/ENABLE=DBG/LIST TESTTBIT
$  MACRO/ENABLE=DBG/LIST TESTTBIT2
$  MACRO/ENABLE=DBG/LIST LOADTBIT+TBITLIB/LIBRARY+SYS$LIBRARY:LIB/LIB
$  MACRO/ENABLE=DBG/LIST REMOVTBIT+TBITLIB/LIBRARY+SYS$LIBRARY:LIB/LIB
$  MACRO/LIST TBITDISP+TBITLIB/LIBRARY+SYS$LIBRARY:LIB/LIB
$
$!      Compile image specific message codes
$  MESSAGE/LIST TBITMSG
$
$!      LINK ALL PROGRAMS
$  LINK/PROTECT/NOSYSSHR/SHARE=TBITDISP/MAP=TBITDISP/FULL SYS$INPUT/OPTIONS
!
!       Options file for the link of User System Service example.
!
        SYS$SYSTEM:SYS.STB/SELECTIVE
!
!       Create a separate cluster for the transfer vector.
!
CLUSTER=TRANSFER_VECTOR,,,SYS$DISK:[]TBITDISP
!
GSMATCH=LEQUAL,1,1
$  LINK/DEBUG/MAP/FULL TESTTBIT,SYS$INPUT/OPTIONS
!
!       Options file for TBITTEST
        TBITDISP.EXE/SHARE
$  LINK/DEBUG/MAP/FULL TESTTBIT2
$  LINK/DEBUG/MAP/FULL LOADTBIT+TBITMSG+SYS$SYSTEM:SYS.STB/SEL
$  LINK/DEBUG/MAP/FULL REMOVTBIT+TBITMSG+SYS$SYSTEM:SYS.STB/SEL
$
$!      Prepare to test programs
$  DEFINE LIB$DEBUG DELTA
$  SET PROCESS/PRIV=(CMKRNL,SYSPRV)
$  COPY TBITDISP.EXE SYS$SHARE:*.*
$  PURGE *.OBJ, *.MAP, *.LIS, *.EXE, *.MLB, SYS$SHARE:TBITDISP.EXE
$  RUN SYS$SYSTEM:INSTALL
SYS$SHARE:TBITDISP.EXE/SHARE/PROTECT
$  SET NOVERIFY
```

Sample Run

```
$ RUN/NODEBUG TESTTBIT
Contents of dummy location is      .
Out of USSDCLTBIT call
%SYSTEM-F-TBIT, T-bit pending trap at PC=0000047F, PSL=03C00010
%TRACE-F-TRACEBACK, symbolic stack dump follows
module name     routine name                     line       rel PC    abs PC

.MAIN.          CODE                                        0000007F  0000047F
$
$ RUN/NODEBUG TESTTBIT2
Contents of dummy location is      .
Out of USSDCLTBIT call
%SYSTEM-F-TBIT, T-bit pending trap at PC=00000470, PSL=03C00010
%TRACE-F-TRACEBACK, symbolic stack dump follows
module name     routine name                     line       rel PC    abs PC

.MAIN.          CODE                                        00000070  00000470
$
$ RUN/NODEBUG LOADTBIT
$
$ RUN/NODEBUG TESTTBIT
Contents of dummy location is      .
Out of USSDCLTBIT call
Contents of dummy location is Out .
$
$ RUN/NODEBUG TESTTBIT2
Contents of dummy location is      .
Out of USSDCLTBIT call
%SYSTEM-F-TBIT, T-bit pending trap at PC=00000470, PSL=03C00010
%TRACE-F-TRACEBACK, symbolic stack dump follows
module name     routine name                     line       rel PC    abs PC

.MAIN.          CODE                                        00000070  00000470
$
$ RUN/NODEBUG REMOVTBIT
$
$ RUN/NODEBUG TESTTBIT
Contents of dummy location is      .
Out of USSDCLTBIT call
%SYSTEM-F-TBIT, T-bit pending trap at PC=0000047F, PSL=03C00010
%TRACE-F-TRACEBACK, symbolic stack dump follows
module name     routine name                     line       rel PC    abs PC

.MAIN.          CODE                                        0000007F  0000047F
$
$ RUN/NODEBUG TESTTBIT2
Contents of dummy location is      .
Out of USSDCLTBIT call
%SYSTEM-F-TBIT, T-bit pending trap at PC=00000470, PSL=03C00010
%TRACE-F-TRACEBACK, symbolic stack dump follows
module name     routine name                     line       rel PC    abs PC

.MAIN.          CODE                                        00000070  00000470
$
```

TEST

PART 1

1. Write your own program that outputs a message to the terminal. Add a verb to your own DCL tables that activates the program.

2. Rewrite the program to test for one parameter and one qualifier. Modify the CLD file such that the parameter is required but the qualifier has a default value if not given.

3. Remove the verbs MOUNT, ASSIGN and DELETE from your DCL tables.

4. Alter the DCL commands in your DCL tables in the manner described below. To accomplish this, select CLD files from the directory [COURSE.SYSPRG.CLI].

   a. force the /CONFIRM qualifier on the DELETE command to be used unless turned off.

   b. alter the "normal" number of columns on a DIRECTORY command to be 1 (one).

5. Add the verb TOPCPU such that it has the same effect as the command:

```
$ MONITOR   PROCESS/TOPCPU
```

6. Alter the PRINT command such that it automatically places files in the queue LPA0 unless instructed otherwise.

Solution to Exercise 1

```
;                                                    NAME.MAR
;
;  This program will output a message
;  a command line and process it.
   .TITLE  message
   .PSECT  NONSHARED_DATA  PIC, NOEXE, LONG
MESSAGE:   .ASCID  /HI!!!/
   .PSECT  CODE    PIC, SHR, NOWRT, LONG
   .ENTRY  START, ^M<>

;  WRITE MESSAGE
   PUSHAQ  MESSAGE
   CALLS   #1,G^LIB$PUT_OUTPUT
   RET
   .END    START
```

VERB.CLD

```
DEFINE  VERB  TELLME
        IMAGE  your_disk:[your_directory]VERB.EXE
```

To set up the verb in your own DCL tables, execute the command:

```
$ SET COMMAND VERB
```

Solution to Exercise 2

```
;                                                       NAME.MAR
;  This program will obtain the information from
;  a command line and process it.
;
   .TITLE  NAME
   $DSCDEF
   $CLIDEF
;
   .PSECT  NONSHARED_DATA  PIC, NOEXE, LONG
FIRST_NAME:
   .BLKW   1
   .BYTE   DSC$K_DTYPE_T, DSC$K_CLASS_D
   .BLKL   1
LAST_NAME:
   .BLKW   1
   .BYTE   DSC$K_DTYPE_T, DSC$K_CLASS_D
   .BLKL   1
FIRST:     .ASCID  /FIRST/
LAST:      .ASCID  /LAST/
   .PSECT  CODE    PIC, SHR, NOWRT, LONG
   .ENTRY  BEGIN, ^M<>
;
;  Get values for parameters and qualifiers
   PUSHAQ  FIRST_NAME
   PUSHAQ  FIRST
   CALLS   #2,G^CLI$GET_VALUE
   PUSHAQ  LAST_NAME
   PUSHAQ  LAST
   CALLS   #2,G^CLI$GET_VALUE
;
;  Process paramters and qualifiers
   PUSHAQ  FIRST_NAME
   CALLS   #1,G^LIB$PUT_OUTPUT
   PUSHAQ  LAST_NAME
   CALLS   #1,G^LIB$PUT_OUTPUT
   RET
   .END    BEGIN
```

NOD.CLD Command Descriptor file

```
DEFINE  VERB    Nod
  IMAGE  your_disk::[your_directory]exer2.exe
  parameter P1,          label=last,prompt="Last Name"
                          value(required)
  qualifier first,        default,value(default="Mr")
```

To place this verb in your own DCL tables, execute the command:

```
$ SET COMMAND NOD.CLD
```

Solution to Exercise 3

To remove DCL verbs from your tables, execute the command:

```
$ SET COMMAND/DELETE=(MOUNT,ASSIGN,DELETE)
```

Solution to Exercise 4a
Altered DELETE.CLD File

```
define syntax delete_entry_or_queue
   image queman
   parameter p1,prompt="Queue",value(required)

define syntax delete_all_symbols
   noparameters

define syntax delete_symbol,mcrignore
   routine delsym
   prefix cli$k_dlsy_
   parameter p1,prompt="Symbol",value(required,type=$insym)
   qualifier all,          syntax=delete_all_symbols
   qualifier global
   qualifier local

define verb delete
   image delete
   prefix cli$k_dele_
   parameter p1,prompt="File",
                     value(required,list,impcat,type=$infile)
   qualifier created
   qualifier entry,
                     value(required,list),
                     syntax=delete_entry_or_queue
   qualifier modified
   qualifier queue,mcrignore,syntax=delete_entry_or_queue
   qualifier confirm,      default  <-- Added
   qualifier log
   qualifier since,        value(type=$datetime)
   qualifier before,       value(type=$datetime)
   qualifier expired
   qualifier symbol,mcrignore,syntax=delete_symbol
   qualifier erase

define verb purge
   image delete
   prefix cli$k_purg_
   parameter p1,prompt="File",value(list,impcat,type=$infile)
   qualifier keep,         value(required)
   qualifier log
   qualifier erase
```

Solution to Exercise 4b

```
define type date_options
   keyword all
   keyword created
   keyword expired
   keyword modified

define type size_options
   keyword all
   keyword allocation
   keyword used

define verb directory
   image directory
   prefix cli$k_dire_
   parameter p1,prompt="File",value(list,impcat,type=$infile)
   qualifier zzzz,          label=dummy1
   qualifier before,        value(default=today,type=$datetime)
   qualifier brief,         default
   qualifier column,        default,value(default=1)   <-- Changed
   qualifier creation                                      from
   qualifier date,          value(type=date_options)       default = 1
   qualifier exclude,       value(required,list)
   qualifier expiration
   qualifier full
   qualifier heading,       default
   qualifier modification
   qualifier output,        value(required,type=$outfile)
   qualifier owner
   qualifier printer
   qualifier protection
   qualifier since,         value(default=today,type=$datetime)
   qualifier size,          value(type=size_options)
   qualifier total
   qualifier trailing,      default
   qualifier versions,      value
   outputs(output)
```

Solution to Exercise 5

```
define     verb       topcpu  <-- Changed
   image      MONITOR
   parameter  P1,          label=CLASS_NAME, prompt="Class(es)",
                           value (list,default=process)  <-- Added
   qualifier  BEGINNING,   nonnegatable,
                           value (required)
   qualifier  ENDING,      nonnegatable,
                           value (required)
   qualifier  INTERVAL,    nonnegatable,
                           value (required)
   qualifier  VIEWING_TIME, nonnegatable,
                            value (required)
   qualifier  INPUT,       value
   qualifier  DISPLAY,     value, default
   qualifier  RECORD,      value
   qualifier  SUMMARY,     value
   qualifier  COMMENT,     value (required)

   qualifier  ALL,         nonnegatable, placement=local
   qualifier  CURRENT,     nonnegatable, placement=local
   qualifier  AVERAGE,     nonnegatable, placement=local
   qualifier  MINIMUM,     nonnegatable, placement=local
   qualifier  MAXIMUM,     nonnegatable, placement=local
                                  Added
   qualifier  TOPCPU,      default,nonnegatable, placement=local
   qualifier  TOPDIO,      nonnegatable, placement=local
   qualifier  TOPBIO,      nonnegatable, placement=local
   qualifier  TOPFAULT,    nonnegatable, placement=local

   qualifier  CPU,         placement=local

   qualifier  PERCENT,     placement=local
```

Solution to Exercise 6

```
define verb print
   image submit
   prefix cli$k_prin_
   parameter p1,prompt="File",
                     value(required,list,impcat,type=$infile)
   qualifier after,          value(required,type=$datetime)
   qualifier burst,          default,placement=positional
   qualifier copies,         value(required),placement=positional
   qualifier delete,         placement=positional
   qualifier device,         value(required,type=$device)
   qualifier flag,           default,placement=positional
   qualifier forms_type,     value(required)
   qualifier header,         default,placement=positional
   qualifier hold
   qualifier identify,       default
   qualifier job_count,      value(required)
   qualifier name,           value(required)
   qualifier lowercase
   qualifier page_count,     value(required),placement=local
   qualifier parameters,     value(required,list)
   qualifier priority,       value(required)
   qualifier queue,          default,value(default=lpa0)  <-- Altered
   qualifier space,          value(default=2),placement=positional
   qualifier feed,           default,placement=positional
   qualifier remote
   qualifier wsquota,        value(required)
   qualifier wsdefault,      value(required)
   qualifier cputime,        value(required)
   qualifier characteristics,value(required,list)
   qualifier log_file,       value
   qualifier printer,        value(default=sys$print)
   qualifier keep,
   qualifier notify
   qualifier wsextent,       value(required)
```

PART 2

1. The following problem has been found with the CLI discussed i
class. It appears that after some images are run, the BY
command (and control-Z) no longer log the user off (bu
running the LOGINOUT image does).

Sample Run Illustrating Problem With CLI

```
Username: MUIZNIEKS/CLI=MYCLI
Password:
        Welcome to VAX/VMS version V3.0 on node HARDY

                ### EXAMPLE CLI ###

ENTER IMAGE NAME SYS$SYSTEM:PIP *.EXE/FU


Directory DR0:[COURSE.SYSPRG.CLI]
31-MAY-82 21:30

MYCLI.EXE;1          (2416,4)        6./6.          31-MAY-82 21:27 [11,250] (RWED,RWED,RE,)
TODO.EXE;28          (2410,2)        18./18.        31-MAY-82 21:25 [11,250] (RWED,RWED,RE,)

Total of 24./24. blocks in 2. files

ENTER IMAGE NAME BYE
%RMS-E-FNF, file not found
ENTER IMAGE NAME ^Z
%RMS-E-FNF, file not found
ENTER IMAGE NAME SYS$SYSTEM:LOGINOUT
  MUIZNIEKS     logged out at 31-MAY-1982 21:31:01.36
```

Your assignment will be to alter the CLI so that the DELTA debugger can be used to locate the error, and then identify and solve the problem. In order to do this, you will have to link the CLI with the file containing the DELTA debugger (SYS$LIBRARY:DELTA.OBJ). This file is distributed as a standard part of the VMS system.

You should try to imitate the scheme used by DCL to invoke the debugger. The scheme used by DCL is shown in the following partial listings of DCL modules DCXSTART and INITIAL. Note that calling the routine XDT$START invokes the DELTA debugger from a program. (You will probably find it convenient to have R11 contain the starting address of the CLI, as done by DCL.)

You may find that you have some problems receiving control at the breakpoints you set. If so, you will need to examine the listings for DELTA (see your instructor), and take appropriate actions to solve that problem in your CLI.

Partial Listing of DCXSTART Module

```
)CXSTART                    - DCL DEBUG VERSION START MODULE          26-APR-1982 22:50:42  VAX-11 Macro V03-00
/03-000                     DEBUGGER START UP                         10-MAR-1982 20:15:04  _DBB0:[DCL.SRC]DCXSTART.MAI

                                 0000     57          .SBTTL  DEBUGGER START UP
                                 0000     58 ;+
                                 0000     59 ; START-UP WITH DEBUGGER
                                 0000     60 ;
                                 0000     61 ; THIS ENTRY POINT IS JUMPED TO AT THE CONCLUSION OF LOGGING A USER ONTO
                                 0000     62 ; THE SYSTEM. ALL INPUT AND OUTPUT FILES ARE OPEN AND THE PROCESS PERMANE
                                 0000     63 ; DATA AREA (PPD) HAS BEEN INITIALIZED.
                                 0000     64 ;-
                                 0000     65
                            00000000     66          .PSECT  DCL$$BASE,BYTE,RD,NOWRT
                                 0000     67
                                 0000     68 BASE_OF_CLI:
03 00000002'GF   01    E1        0000     69          BBC     #PPD$V_MODE,G^CTL$AG_CLIDATA+PPD$W_FLAGS,10$ ;BR IF NOT B
                    FFF7'  31    0005     70          BRW     DCL$STARTUP+2           ; IF BATCH, SKIP DEBUGGER ENTRY P
   5E   00000009'GF    00  DD    0008     71 10$:     MOVL    G^CTL$AL_STACK+8,SP     ; RESET SUPERVISOR MODE STACK POI
                        00  DD    0012     72          PUSHL   #0                      ; ALLOCATE SPACE FOR XFER VECTOR
          18'AF     01    FB    0014     73          CALLS   #1,B^20$                ; MAKE DUMMY CALL FRAME (HANDLER=
                            0000  0019     74 20$:     .WORD   0
   50   00000000'EF    9E    0014     75          MOVAB   XFER_ARRAY,R0           ; GET ADDRESS OF TRANSFER VECTOR
    04 A0    0000'CF    9E    0021     76          MOVAB   W^DCL$STARTUP,4(R0)     ; SET SECOND TRANFER ADDR TO HERE
          04 AC    50    D0    0027     77          MOVL    R0,4(AP)                ; SET TRANSFER ARRAY FOR DEBUGGER
          5B    02 AF    9E    0029     78          MOVAB   BASE_OF_CLI,R11         ; R11 = BASE OF CLI FOR DEBUGGING
   00000000'GF    6C    FA    002F     79          CALLG   (AP),G^XDT$START        ; CALL DEBUGGER INITIALIZATION
                                 0036     80          $EXIT_S                         ; EXIT IF ANY DEBUG INIT PROBLEMS
                                 003F     81
                            00000000     82          .PSECT  DCL$DEBUG,WRT
                                 0000     83 XFER_ARRAY:
                       00000009  0000     84          .LONG   9                       ; PRIMARY TRANSFER (NOT USED)
                       00000000  0004     85          .LONG   0                       ; SECONDARY = DCL INITIALIZATION
                                 0009     86
                                 0009     87          .END
```

Partial Listing of INITIAL Module

```
                        - COMMAND INTERPRETER INITIALIZATION     26-APR-1982 22:32:41  VAX-11 Macro V03-00          Page   4
                        COMMAND INTERPRETER START UP             24-APR-1982 17:07:14  _DBB0:[OCL.SRC]INITIAL.MAR;1       (3)

                             0021   134          .SBTTL  COMMAND INTERPRETER START UP
                             0021   135 ;+
                             0021   136 ; OCL$STARTUP - COMMAND INTERPRETER START UP
                             0021   137 ;
                             0021   138 ; THIS ENTRY POINT IS JUMPED TO AT THE CONCLUSION OF LOGGING A USER ONTO
                             0021   139 ; THE SYSTEM. ALL INPUT AND OUTPUT FILES ARE OPEN AND THE COMMAND LANGUAGE
                             0021   140 ; INDEPENDENT DATA AREA HAS BEEN INITIALIZED.
                             0021   141 ;-
                             0021   142
                         00000000   143          .PSECT  OCL$$BASE,BYTE,RD,NOWRT
                             0000   144
    5E   00000008'GF     00  0000   145          MOVL    G^CTL$AL_STACK+8,SP      ;RELOAD SUPERVISOR STACK POINTER
                         50  D4  0007   146          CLRL    FP                       ;INDICATE NO PREVIOUS FRAME
         0021'CF     6E  FA  0009   147          CALLG   (SP),W^OCL$STARTUP       ;SETUP INITIAL CALL FRAME
                             000E   148          $EXIT_S
                             0017   149
                         00000021   150          .PSECT  OCL$ZCODE,BYTE,RD,NOWRT
                             0021   151 OCL$STARTUP::                            ;COMMAND INTERPRETER START UP
                        0000 0021   152          .WORD   ^M<>                     ;ENTRY MASK
                    7E  D4  0023   153          CLRL    -(SP)                    ;SETUP DUMMY PSL (@PRC_L_SAVAP=PRVPSL)
           2A'AF    6E  FA  0025   154          CALLG   (SP),B^10$               ;CREATE DUMMY FP AFTER DUMMY AP
                        04  0029   155          RET
                        0000 002A   156 10$:     .WORD   0
         6D     0000'CF  9E  002C   157          MOVAB   W^OCL$COMMAND,(FP)       ;ESTABLISH CONDITION HANDLER
00000000'GF     0002'CF  9E  0031   158          MOVAB   W^OCL$UTLSERV+2,G^CTL$AL_CLICALBK ; SET CALL BACK VECTOR
     5A     00000000'GF  9E  003A   159          MOVAB   G^CTL$AG_CLIDATA,R10     ;GET ADDRESS OF PPD
                             0041   160 ;
                             0041   161 ; INITIALIZE CLI PROCESS WORK AREA
                             0041   162 ;
          5B     08 AA    D0  0041   163          MOVL    PPD$Q_CLIREG+4(R10),R11 ;GET ADDRESS OF CLI PRIVATE STORAGE
 04 AA    00     6B    00  2C  0045   164          MOVC5   #0,(SP),#0,PPD$Q_CLIREG(R10),(R11) ;ZERO ALL STORAGE
             6B     5C  7D  004C   165          MOVQ    AP,PRC_L_SAVAP(R11)      ;SAVE INITIAL ARGUMENT AND FRAME POINTERS
        50 A8    1E AA  B0  004F   166          MOVW    PPD$W_INPCHAN(R10),PRC_W_INPCHAN(R11)    ;COPY INPUT CHANNEL
        06 02 AA    01  E1  0054   167          BBC     #PPD$V_MODE,PPD$W_FLAGS(R10),20$         ;COPY JOB MODE
     54 A8    00C0 8F  A9  0059   168          BISW    #PRC_M_MODE!PRC_M_VERIFY,PRC_W_FLAGS(R11) ;AND TURN VERIFY ON
0098 CB     02000000 8F  C3  005F   169 20$:     BISL    #PRC_M_CTRLY,PRC_L_OUTOFBAND(R11)        ;ENABLE CTRL/Y
        06 02 AA    00  E1  0069   170          BBC     #PPD$V_NOCTLY,PPD$W_FLAGS(R10),25$       ;COPY NOCONTROLY MODE
                             0060   171          CLRBIT  PRC_V_CTRLY,PRC_L_OUTOFBAND(R11)
  6C A8     00000000'GF  9E  0073   172 25$:     MOVAB   G^OCL$AL_TAB_VEC,PRC_L_TAB_VEC(R11)      ;ADDRESS OF DATABASE
         0090 C3    04  B0  0079   173          MOVW    #4,PRC_B_EXMODEPWID(R11) ;SET EXAMINE MODE TO HEX,WIDTH TO 4
                             0080   174 ;
                             0080   175 ; FOR BATCH JOBS, SETUP TO EXIT ON ERRORS.  FOR INTERACTIVE JOBS,
                             0080   176 ; DO AN IMPLIED "SET NOON".
                             0080   177 ;
          56 A8    02  B0  0080   178          MOVW    #2,PRC_W_ONLEVEL(R11)    ;ASSUME "ON ERROR THEN EXIT"
        06 54 A8    06  E0  0084   179          BBS     #PRC_V_MODE,PRC_W_FLAGS(R11),30$ ;IF BATCH JOB, THIS IS OK
     56 A8    0208 8F  B0  0089   180          MOVW    #2081B,PRC_W_ONLEVEL(R11) ;IF INTERACTIVE, "SET NOON"
                             008F   181 ;
                             008F   182 ; INITIALIZE CLI SYMBOL TABLE
                             008F   183 ;
          50    28 AB    9E  008F   184 30$:     MOVAB   PRC_Q_GLOBAL(R11),R0     ;GET ADDRESS OF GLOBAL TABLE LISTHEAD
             60    50    D0  0093   185          MOVL    R0,(R0)                  ;INIT GLOBAL SYMBOL TABLE EMPTY
             80    80    D0  0096   186          MOVL    (R0)+,(R0)+
                             0099   187          ASSUME  PRC_Q_LABEL EQ PRC_Q_GLOBAL+8
             60    50    D0  0099   188          MOVL    R0,(R0)                  ;INIT LABEL TABLE EMPTY
             80    90    D0  009C   189          MOVL    (R0)+,(R0)+
                             009F   190          ASSUME  PRC_Q_LOCAL EQ PRC_Q_LABEL+8
```

Corrected CLI With Debugger Support (Page 1 of 7)

```
.MAIN.                                                  31-MAY-1982 21:09:05  VAX-11 Macro V03-00
                                                        31-MAY-1982 21:08:58  DRA0:[COURSE.SYSPRG.CLI]MY

                                                                                MYCLIDBG.MAR

                                        1 ;
                                        2 ;
                                        3         .TITLE  - MYCLIDBG - EXAMPLE CLI (COMMAND LANGUAGE INTERPRETER)
                                        4 ;
                                        5 ; Original author  John Weir - Training - Reading.
                                        6 ; Significantly rewritten/altered for V3 interfaces by Vik Muiznieks
                                        7 ;
                                        8 ; To use this CLI the file MYCLIDBG.EXE must be installed in SYS$SYSTEM,
                                        9 ; using the /CLI= option (or else set up the relevant default CLI with UA
                                       10 ; USERNAME: NAME/CLI=MYCLIDBG
                                       11 ;
                                       12 ; The CLI prompts for an image file name and runs the specified image (ei
                                       13 ; native mode or compatibility mode). Command lines can be passed to util
                                       14 ; such as PIP as follows (DCL utilities CANNOT be used):
                                       15 ; $ SYS$SYSTEM:PIP *.*/FU   (to get a full directory listing)
                                       16 ;
                                       17 ; CONTROL-Y aborts the current image.
                                       18 ;
                                       19 ; To logout, type BYE, use a CTRL-Z, or execute SYS$SYSTEM:LOGINOUT
                                       20 ;
                                       21 ; MACRO library calls
                                       22 ;
                                       23         $PSLDEF                 ; access mode symbols
                                       24         $IHDDEF                 ; image header symbols
                                       25         $CLIDEF                 ; command interpreter flags
                                       26         $CLIMSGDEF              ; CLI message codes
                                       27         $PPDDEF                 ; from own macro library
                                       28         PRCDEF                  ; from own macro library
                                       29         PRDDEF                  ; from own macro library
                                       30 ;
                                       31 ; CLI private work area - this will be created on the stack
                                       32 ;
                                       33         .PSECT  $ABS$,ABS
                                       34
                  00000050             35         MSGBUFSIZ=80
                  FFFFFF9C             36         WRK_K_LENGTH=-100
                  FFFFFF9C             37         .=WRK_K_LENGTH
                                       38 WRK_L_CMDLEN:                   ; user command length
                  FFFFFFA0             39         .BLKL   1
                                       40 WRK_L_CMDADR:                   ; address of user command
                  FFFFFFA4             41         .BLKL   1
                                       42 WRK_Q_MSGBUFDSC:                ; descriptor for user input
                  FFFFFFAC             43         .BLKQ   1
                                       44 WRK_T_MSGBUF:                   ; storage for user input
                  FFFFFFFC             45         .BLKB   MSGBUFSIZ
                                       46 WRK_L_SAVESP:                   ; saved stack pointer
                  00000000             47         .BLKL   1
                                       48 WRK_L_CONDHAND:                 ; address of condition handler
                  00000004             49         .BLKL   1
                                       50 ;
                                       51         .PSECT
                                       52 ;
                                       53 ; No entry mask - must start at first location of image
                                       54 ;
                                       55 SUPSSTART::
5E   00000000'CF   D0                  56         MOVL    G^CTL$AL_STACK+8,SP     ; reload supervisor stack pointer
                                       57
```

Corrected CLI With Debugger Support (Page 2 of 7)

```
                                                31-MAY-1982 21:09:05  VAX-11 Macro V03-00          Page   2
                                                31-MAY-1982 21:08:58  DRA0:[COURSE.SYSPRG.CLI]MYCLIDBG.M(1)

                                0007    58 ;**** New stuff for debugging ****
                      00    DD  0007    59          PUSHL   #0                      ; all, space for transfer vector addr
          00000018'EF   01    FB  0009    60          CALLS   #1, SS                  ; make dummy call frame (handler=0)
                              0000  0010    61 SS:      .WORD   0
        50    00000000'EF       9E  0012    62          MOVAB   XFER_ARRAY,R0           ; get address of transfer vector
     04 A0    00000039'EF       9E  0019    63          MOVAB   GO,4(R0)                ; set second transfer address
           04 AC    50          D0  0021    64          MOVL    R0,4(AP)                ; set transfer array for debugger
        5B    D8 AF             9E  0025    65          MOVAB   SUPSSTART,R11           ; R11 = base of CLI for debugging
          00000000'GF    6C     FA  0029    66          CALLG   (AP),G^XDTSSTART        ; call debugger initialization
                                0030    67          $EXIT_S                         ; exit if any debug init problems
                                0039    68
                              00000000  69          .PSECT  MAKE_WRT,WRT            ; needed since writable area
                                0000    70 XFER_ARRAY:
                        00000000  0000    71          .LONG   0               ; primary transfer (not used)
                        00000000  0004    72          .LONG   0               ; secondary = CLI initialization
                                0008    73 BPTHAND:
                        00000000  0008    74          .LONG   0               ; address of DELTA primary exc. vec.  handler
                                000C    75
                              00000039  76          .PSECT
                            0000  0039    77 GO:      .WORD   ^M<>                    ; entry from debugger
                                0038    78          $SETEXV_S       ACMODE=#PSL$C_USER,PRVHND=BPTHAND ; save DELTA handler
                                004E    79
                                004E    80 ;****    End of stuff for debugging
                                004E    81
           5D    FC AE       DE  004E    82          MOVAL   -4(SP),FP               ; set a good FP
                                0052    83          $RUNDWN_S       #PSL$C_USER     ; run down LOGINOUT image
                                005B    84
                                0058    85 ;***     More stuff for debugging
                                005B    86          $SETEXV_S ADDRES=@BPTHAND,ACMODE=#PSL$C_USER ; establish primary
                                006E    87                                          ; exc. vector for user mode to
                                006E    88                                          ; transfer control to DELTA handler
                                006E    89          $SETEXV_S ADDRES=@BPTHAND,ACMODE=#PSL$C_SUPER ; same for super mode
                                0081    90 ;***     End of debugging additions
                                3081    91
                                0081    92          $DELLOG_S       #PSL$C_SUPER    ; delete all supervisor mode process
                                008E    93                                          ; logical names. Specifically gets rid
                                008E    94                                          ; of initial SYS$INPUT. Leaving the
                                008E    95                                          ; correct exec. mode logical name.
                          7E    D4  008E    96          CLRL    -(SP)               ; set up dummy zero arg. block
                    94'AF       6E  0090    97          CALLG   (SP),B^10$          ; create initial call frame
                              0000  0094    98 10$:     .WORD   0                   ; entry mask
           5A    00000000'GF       9E  0096    99          MOVAB   G^CTL$AG_CLIDATA,R10    ; R10 = Address of PPD area from LOGIN
                 5B    08 AA       D0  009D   100          MOVL    PPD$Q_CLIREG+4(R10),R11 ; R11 = Address of CLI private storage
B    04 AA       00    6E    00    2C  00A1   101          MOVC5   #0,(SP),#0,PPD$Q_CLIREG(R10),(R11)    ; zero all storage
              50 A8     1E  AA    B0  00A8   102          MOVW    PPD$W_INPCHAN(R10),PRC_W_INPCHAN(R11) ; save TTY channel number
                    68    5C    7D  00AD   103          MOVQ    AP,PRC_L_SAVAP(R11)     ; save initial arg and frame pointers
     00000000'GF    0372'CF      9E  00B0   104          MOVAB   W^SUPSUTILSERV+2,G^CTL$AL_CLICALBK ; CLI callback routine
                                00B9   105          $QIOW_S #1,PRC_W_INPCHAN(R11),#IO$_SETMODE!IO$M_CTRLYAST=
                                00B9   106                  P1=#SUPSCTRLY=
                                00B9   107                  P3=#PSL$C_SUPER         ; set up CONTROL-Y AST
                      035C    30  00D0   108          BSBW    ERROR
                                00E8   109          $DCLCMH_S       HAND            ; set up CHMS handler
                      0348    30  00F1   110          BSBW    ERROR
       18 AA    00000000'8F    D0  00F8   111          MOVL    #SS$_NORMAL,PPD$L_LSTSTATUS(R10) ; establish normal success
                                00FC   112                                          ; for exit to LOGINOUT
                                00FC   113 ;        Initialize process RMS structures
              50    00C4 CB     9E  00FC   114          MOVAB   PRC_C_LENGTH(R11),R0    ; set address of RMS structures
```

Corrected CLI With Debugger Support (Page 3 of 7)

```
.MAIN.                                                  31-MAY-1982 21:09:05  VAX-11 Macro V03-00
                                                        31-MAY-1982 21:08:58  DRA0:[COURSE.SYSPRG.CLI]

          1C AB    68   9E  0101   115          MOVAB   PRD_G_FAB(R8),PRC_L_INDFAB(R11) ; addr. of gen. purp. FA
       59    0000 C8   9E  0105   116          MOVAB   PRD_G_INPRAB(R8),R9       ; set address of input RAB
       57    017C C8   9E  010A   117          MOVAB   PRD_G_OUTRAB(R8),R7       ; set address of output RAB
       68    0000'8F   B0  010F   118          MOVW    #FAB$C_BID+<FAB$C_BLN>8>,PRD_G_FAB(R8) ; set FAB ID/Lenc
    0000'C8    50 A8    9E  0114   119          MOVAB   PRD_G_NAM(R8),FAB$L_NAM(R8) ; set address of NAM block
    50 A8    0000'8F    B0  011A   120          MOVW    #NAM$C_BID+<NAM$C_BLN>8>,PRD_G_NAM(R8) ; set NAM ID/Lenc
  0000'C9    0000'8F    B0  0120   121          MOVW    #RAB$C_BID+<RAB$C_BLN>8>,RAB$B_BID(R9) ; set RAB ID/Lenc
    0000'C9    22 AA    B0  0127   122          MOVW    PPDSW_INPISI(R10),RAB$W_ISI(R9) ; set input ISI
  0000'C7    0000'C9    B0  012D   123          MOVW    RAB$B_BID(R9),RAB$B_BID(R7)       ; set RAB ID/Length
    0000'C7    26 AA    B0  0134   124          MOVW    PPDSW_OUTISI(R10),RAB$W_ISI(R7) ; set output ISI
       0000'C9    58    D0  013A   125          MOVL    R8,RAB$L_FAB(R9)                  ; set address of FAB
       0000'C7    58    D0  013F   126          MOVL    R8,RAB$L_FAB(R7)                  ; set address of FAB
  0000'C9    0000'8F    AA  0144   127          BICW    #RAB$M_PPF_IND,RAB$W_ISI(R9)      ; set PPF direct access
  0000'C7    0000'8F    AA  014B   128          BICW    #RAB$M_PPF_IND,RAB$W_ISI(R7)      ; disable user-mode EOF
  00F4 C8    0000'C9    D0  0152   129          MOVL    RAB$B_BID(R9),PRD_G_ALTINPRAB(R8) ; set RAB ID/Len/ISI
  0138 C8    0000'C7    D0  0159   130          MOVL    RAB$B_BID(R7),PRD_G_ALTOUTRAB(R8) ; set RAB ID/Len/ISI
    0000'C9    44 AA    D0  0160   131          MOVL    PPDSL_INPDEV(R10),RAB$L_CTX(R9) ; store input device cha
    0000'C7    64 AA    D0  0166   132          MOVL    PPDSL_OUTDEV(R10),RAB$L_CTX(R7) ; store output device ch
       0000'C9    01    90  016C   133          MOVB    #1,RAB$B_MBC(R9)                  ; allocate 1 block/buffe
    0000'C9    FF 8F    90  0171   134          MOVB    #-1,RAB$B_MBF(R9)                 ; allocate 1 buffer/stre
  0000'C7    0000'C9    B0  0177   135          MOVW    RAB$B_MBF(R9),RAB$B_MBF(R7)       ; set same MBC/MBF for o
0000'C9    00000000'8F    C8  017E   136          BISL    #RAB$M_PMT,RAB$L_ROP(R9)          ; allow read with prompt
          0C AB    57   D0  0187   137          MOVL    R7,PRC_L_OUTRAB(R11)              ; set address of output
          08 AB    59   D0  018B   138          MOVL    R9,PRC_L_INPRAB(R11)              ; set address of input R
                        018F   139
                        018F   140 ;       Display CLI running message to user
          5A    0C AB    D0  018F   141          MOVL    PRC_L_OUTRAB(R11),R10             ; get address of output
0000'CA    00000462'EF    9E  0193   142          MOVAB   MSG8,RAB$L_RBF(R10)       ; set message address
    0000'CA    0019'8F    B0  019C   143          MOVW    #LEN8,RAB$W_RSZ(R10)              ; set record size
                        01A3   144          $PUT    RAB=(R10)                         ; display CLI running me
                  028D  30  01AC   145          BSBW    ERROR                             ; check for errors
                        01AF   146                                                    ; and drop through to ma
                        01AF   147 ;
                        01AF   148 ; Main CLI loop entered once from the initialize routine, then
                        01AF   149 ; subsequently from the exit handler to process next command after
                        01AF   150 ; image exit.
                        01AF   151 ;
                        01AF   152 SUPSRESTART:
       6D    0000034E'EF    9E  01AF   153          MOVAB   SUPSEXCEPT,(FP)           ; set condition handler address
                        0186   154
                        0186   155 ;***    More stuff for debugging
                        0186   156          $SETEXV_S ADDRESS=#SPTHAND,ACMODE=#PSL$C_USER ; establish primary
                        01C9   157                                                    ; exc. vector for user mode to
                        01C9   158                                                    ; transfer control to DELTA hand
                        01C9   159          $SETEXV_S ADDRESS=#SPTHAND,ACMODE=#PSL$C_SUPER ; same for super m
                        01DC   160 ;***    End of debugging additions
                        01DC   161
          5E    8C AD    9E  01DC   162          MOVAB   WRK_K_LENGTH-16(FP),SP    ; reserve CLI work area
   A4 AD    0000050 8F    D0  01E0   163          MOVL    #MSGBUFSIZ,WRK_Q_MSGBUFDSC(FP) ; size of RMS MSG buffer
       A8 AD    AC AD    9E  01E8   164          MOVAB   WRK_T_MSGBUF(FP),WRK_Q_MSGBUFDSC+4(FP) ; address of buff
          5A    08 AB    D0  01ED   165          MOVL    PRC_L_INPRAB(R11),R10      ; address of input RAB
0000'CA    00000496'EF    9E  01F1   166          MOVAB   MSG2,RAB$L_PBF(R10)       ; set prompt address
    0000'CA    13'8F    90  01FA   167          MOVB    #LEN2,RAB$B_PSZ(R10)      ; set prompt size
    0000'CA    AC AD    9E  0200   168          MOVAB   WRK_T_MSGBUF(FP),RAB$L_UBF(R10) ; input buffer address
  0000'CA    0050 8F    B0  0206   169          MOVW    #MSGBUFSIZ,RAB$W_USZ(R10)         ; input buffer size
                        020D   170          $GET    RAB=(R10)                         ; get next record
          52    0000'CA    3C  0216   171          MOVZWL  RAB$W_RSZ(R10),R2         ; size of input line
```

Corrected CLI With Debugger Support (Page 4 of 7)

```
                                                31-MAY-1982 21:09:05  VAX-11 Macro V03-00          Page   4
                                                31-MAY-1982 21:08:58  DRA0:[COURSE.SYSPRG.CLI]MYCLIDBG.M(1)

          53   8000'CA   D0  0215   172          MOVL    RABSL_RBF(R10),R3       ; address of input line
                    8F   BB  0220   173          PUSHR   #^M<R0,R1,R2,R3>        ; save registers across CMPC3
!'EF   AC AD   0003'8F   29  0222   174          CMPC3   #BYE_LEN,WRK_T_MSGBUF(FP),BYE   ; check for BYE command
                    11   13  022D   175          BEQL    19$                     ; if so, log out
                    8F   BA  022F   176          POPR    #^M<R0,R1,R2,R3>        ; restore registers
      50   00000000'8F   D1  0231   177          CMPL    #RMS$_EOF,R0            ; was it end-of-file
                    06   13  0238   178          BEQL    19$                     ; if so, logout
                 13 50   E8  023A   179          BLBS    R0,20$                  ; valid GET?
                   FF6F   31  023D   180          BRW     SUPSRESTART             ; if not, try again
           52   13'8F   9A  0240   181 19$:      MOVZBL  #LOGOSZ,R2              ; if EOF = logout
      53   00000049'EF   9E  0244   182          MOVAB   LOGO,R3                 ; set up for LOGINOUT
                         0248   183
                         0248   184 ;***       Fix problem with BYE and control-Z commands not working
                 54   52   D0  0248   185          MOVL    R2,R6                   ; store command line length
                    1E   11  024E   186          BRB     23$                     ; join common code
                         0250   187 ;***       End of fix----  also add label 23$: below
                         0250   188
                         0250   189 20$:      TSTL    R2                      ; blank line?
                    03   12  0252   190          BNEQ    18$                     ; if not, continue
                 FF58   31  0254   191          BRW     SUPSRESTART             ; if blank - get another
              54   52   D0  0257   192 18$:      MOVL    R2,R6                   ; length of command
           55   AC AD   DE  025A   193          MOVAL   WRK_T_MSGBUF(FP),R5     ; address of command
00000048'EF   03   85   3A  025E   194 21$:      LOCC    (R5)+,#3,SEP            ; is this char. in separator list
                    03   12  0266   195          BNEQ    22$                     ; if NEQ = yes
                 F3 54   F5  0268   196          SOBGTR  R4,21$                  ; else try next char.
              52   54   C2  026B   197 22$:      SUBL2   R4,R2                   ; reset image name length
                         026E   198
                         026E   199 ;***       Added label 23$ to this statement to fix bug from above
           9C AD   54   D0  026E   200 23$:      MOVL    R4,WRK_L_CMDLEN(FP)     ; save user command length
                         0272   201 ;***       End of bug fix
                         0272   202
        A0 AD   6342   9E  0272   203          MOVAB   (R3)[R2],WRK_L_CMDADR(FP) ; save user command address
         00000286'EF   16  0277   204          JSB     SUPSIMGACT              ; go run the selected image
               03 50   E8  027D   205          BLBS    R0,24$                  ; skip if ok
                01C0   30  0280   206          BSBW    ERRPRT                  ; output error message
                FF29   31  0283   207 24$:      BRW     SUPSRESTART
                         0286   208 ;
                         0286   209 ; Image activation
                         0286   210 ;
                         0286   211 SUPSIMGACT:
        1F 54 AB   03   E2  0286   212          BBSS    #PRC_V_EXIT,PRC_W_FLAGS(R11),40$ ; skip if handler active
  74 AB   00000397'EF   DE  0288   213          MOVAL   SUPSEXIT,PRC_L_EXTHND(R11) ; set exit handler address
        78 AB   01   D0  0293   214          MOVL    #1,PRC_L_EXTARG(R11)    ; set count of arguments
     7C AB   0000 CB   DE  0297   215          MOVAL   PRC_L_EXTCOD(R11),PRC_L_EXTPRM(R11) ; address of parameter
                         029D   216          $DCLEXH_S       PRC_L_EXTBLK(R11) ; set up exit handler
                 0192   30  02A7   217          BSBW    ERROR
     55   0000000A'GF   DE  02AA   218 40$:      MOVAL   G^MMG$IMGHDRBUF,R5      ; R5 = Address of image header buffer
              65   52   7D  02B1   219          MOVQ    R2,(R5)                 ; pointers to image file desc.
  08 A5   0000004A'8F   D0  02B4   220          MOVL    #DEFLEN,8(R5)           ; pointers to default image file desc.
  0C A5   0000048C'EF   9E  02BC   221          MOVAB   DEF,12(R5)
                         02C4   222          SIMGACT_S-                      ; activate image
                         02C4   223                  NAME=(R5)-              ; image file name
                         02C4   224                  DFLNAM=8(R5)-           ; default file name
                         02C4   225                  HDRBUF=(R5)             ; image header buffer
                 0F 50   E8  02DC   226          BLBS    R0,44$                  ; if set = activation ok
                    50   DD  02DF   227          PUSHL   R0                      ; save error code
                         02E1   228          $RUNDWN_S       #PSL$C_USER     ; run down bad image
```

Corrected CLI With Debugger Support (Page 5 of 7)

```
MAIN.                                                    31-MAY-1982 21:09:05  VAX-11 Macro V03-00
                                                         31-MAY-1982 21:08:58  DRA0:[COURSE.SYSPRG.CLI]MY(

                  50 8ED0  02EA   229          POPL    R0                      ; restore error code
                     05    02ED   230          RSB                             ; return to main loop
        FC AD     5E   D0  02EE   231 443$:    MOVL    SP,WRK_L_SAVESP(FP)     ; save current SP
     7E   0F      16   78  02F2   232          ASHL    #PSL$V_PRVMOD,#PSL$C_USER02+PSL$C_USER,-(SP)
                          02F6   233                                          ; set up user PSL on stack
           FA'AF  9F       02F6   234          PUSHAB  B^50$                   ; set up user PC on stack
                  02       02F9   235          REI                             ; switch to user mode
                  5C   7C  02FA   236 50$:     CLRQ    AP                      ; clear AP,FP
        00'AF     00   FB  02FC   237          CALLS   #0,B^60$                ; set top level call frame
                  0000     0300   238 60$:     .WORD   0
6D   00000000'GF     9E   0302   239          MOVAB   G^EXESCATCH_ALL,(FP)    ; set exception to catch all
                          0309   240          $SETEXV_S #2,G^EXESCATCH_ALL    ; last chance vector
                          031C   241          $IMGFIX_S                       ; perform address relocation
              22 50   E9  0323   242          BLBC    R0,65$                  ; exit if error
54   00000000'GF     7D   0326   243          MOVQ    G^MMG$IMGHDRBUF,R4      ; addresses of image header & file
                          0320   244 ; CLI argument list
              7E      D4  032D   245          CLRL    -(SP)                   ; CLI flags
           28 A4      DD  032F   246          PUSHL   IHD$L_LNKFLAGS(R4)      ; link flags from image header
        7E    54      7D  0332   247          MOVQ    R4,-(SP)                ; image file name & image header
7E   00000378'EF     9E  0335   248          MOVAB   $UPSUTILSERV,-(SP)      ; CLI callback address
     50   02 A4      3C  033C   249          MOVZWL  IHD$W_ACTIVOFF(R4),R0   ; offset to transfer vectors
        50   54      C0  0340   250          ADDL    R4,R0                   ; address of transfer vector array
             60      DF  0343   251          PUSHAL  (R0)                    ; save address of transfer vector
          08   06     FB  0345   252          CALLS   #6,8(R0)+               ; call image entry
     00000000'GF     17  0348   253 65$:     JMP     G^EXESEXIT_IMAGE        ; go do $EXIT_S
                         034E   254 ;
                         034E   255 ; Condition handler for CLI errors. Not called for user errors as these
                         034E   256 ; are caught by EXESCATCH_ALL which prints error dump and does an exit.
                         034E   257 ; CLI errors are special - reset exit handler and jump to EXESCATCH_ALL.
                         034E   258 ;
                  0000   034E   259          .ENTRY  SUPSEXCEPT,^M<R11>
58   00000000'GF     9E  0350   260          MOVAB   G^CTL$AG_CLIDATA,R11    ; get address of PPD
     58   08 A8      D0  0357   261          MOVL    PPD$Q_CLIREG+4(R11),R11 ; get address of process work area
  78 A8   66'AF      9E  035B   262          MOVAB   B^10$,PRC_L_EXTHND(R11) ; reset exit handler address
     00000002'GF     17  0360   263          JMP     G^EXESCATCH_ALL+2       ; take special error exit path
                  0000   0366   264 10$:     .WORD   0                       ; entry mask for special error han
50   00000000'8F     D0  0368   265          MOVL    #SS$_NORMAL,R0          ; set success
                     04   036F   266          RET
                          0370   267 ;
                          0370   268 ; CLI service routine to pass command line to utilities
                          0370   269 ; as for RSX type GMCRS.  Note that will NOT handle requests from DCL
                          0370   270 ; utilities like DIRECTORY.  Assumes callback request of proper type.
                          0370   271 ;
                  0C00    0370   272          .ENTRY  SUPSUTILSERV,^M<R10,R11>
58   00000000'GF     9E  0372   273          MOVAB   G^CTL$AG_CLIDATA,R11    ; address of PPD
     58   08 A8      D0  0379   274          MOVL    PPD$Q_CLIREG+4(R11),R11 ; address of process work area
     58   04 A8      D0  037D   275          MOVL    PRC_L_SAVFP(R11),R11    ; address of saved FP
     5A   04 AC      D0  0381   276          MOVL    4(AP),R10               ; address of CLI request block
  08 AA   9C A8      D0  0385   277          MOVL    WRK_L_CMDLEN(R11),CLI$W_RQSIZE(R10) ; return line length
  0C AA   A0 A8      D0  038A   278          MOVL    WRK_L_CMDADR(R11),CLI$A_RQADDR(R10) ; return line address
50   00030001 8F     D0  038F   279          MOVL    #CLI$_NORMAL,R0         ; set success return
                     04   0396   280          RET
                          0397   281 ;
                          0397   282 ; Exit handler, called after image exit to rundown image. Handler does
                          0397   283 ; not return (as this would delete process), but resets the stack so that
                          0397   284 ; the RSB returns to the main loop to get the next command for processing.
                          0397   285 ;
```

Corrected CLI With Debugger Support (Page 6 of 7)

```
                                                        31-MAY-1982 21:09:05  VAX-11 Macro V03-00          Page   6
                                                        31-MAY-1982 21:08:58  DRA0:[COURSE.SYSPRG.CLI]MYCLIDBG.M(1)

                        0004  0397   286          .ENTRY  SUPSEXIT,^M<R2,R11>
    5B   00000000'GF    9E  0399   287          MOVAB   G^CTL$AG_CLIDATA,R11    ; R11 = address of PPD
         5B    08 AB    D0  039E   288          MOVL    PPD$Q_CLIREG+4(R11),R11 ; address of process work area
         54 AB   08     AA  03A4   289          BICW    #PRC_M_EXIT,PRC_W_FLAGS(R11) ; exit handler no longer active
         5D    04 AB    D0  03A8   290          MOVL    PRC_L_SAVFP(R11),FP     ; FP = address of CLI work area
         52    A8 AD    9E  03AC   291          MOVAB   WRK_Q_MSGBUFDSC(FP),R2  ; R2 = RMS msg buffer desc.
         62    5A 8F    9A  03B0   292 10$:     MOVZBL  #MSGBUFSIZ,(R2)         ; reset size of message buffer
               00       DD  03B4   293          PUSHL   #0                      ; run down only image files
               62       9F  03B6   294          PUSHAB  (R2)                    ; address of message buffer desc.
    00000000'GF    02     FB  03B8   295          CALLS   #2,G^SYS$RMSRUNDWN      ; run down RMS-32 files
             EE 50        E9  03BF   296          BLBC    R0,10$                  ; if error = try next file
                             03C2   297          $RUNDWN_S       #PSL$C_USER     ; run down image
         50    04 BC    D0  03C8   298          MOVL    @4(AP),R0               ; retrieve reason for exit
         5E    FC AD    D0  03CF   299          MOVL    WRK_L_SAVESP(FP),SP     ; get saved SP
               05       05  03D3   300          RSB                             ; return to original caller
                            03D4   301                                          ; i.e. JSB SUPSIMGACT in main loop
                            03D4   302 ;
                            03D4   303 ; CONTROL-Y AST routine. Prints out a message and forces image to exit.
                            03D4   304 ; It does not get involved in command processing as DCL does.
                            03D4   305 ;
                       3C00 03D4   306          .ENTRY  SUPSCTRLY,^M<R10,R11>
    5B   00000000'GF    9E  03D6   307          MOVAB   G^CTL$AG_CLIDATA,R11    ; R11 = address of PPD
         5B    08 AB    D0  03DD   308          MOVL    PPD$Q_CLIREG+4(R11),R11 ; address of process work area
                            03E1   309          $QIOW_S #1,PRC_W_INPCHAN(R11),#IO$_SETMODE!IO$M_CTRLYAST=
                            03E1   310                  P1=SUPSCTRLY=
                            03E1   311                  P3=#PSL$C_SUPER         ; re-activate CTRL-Y AST
                  0037      30  03E2   312          BSBW    ERROR
         5A    0C AB    D0  03E5   313          MOVL    PRC_L_OUTRAB(R11),R10   ; address of output RAB
0000'CA    00000078'EF    9E  03E9   314          MOVAB   MSG1,RAB$L_RBF(R10)     ; set message address
    0000'CA    0018'8F    B0  03E2   315          MOVW    #LEN1,RAB$W_RSZ(R10)    ; set record size
                            03E9   316          $PUT    RAB=(R10)               ; output in CTRL/Y AST message
                  0017      30  03F2   317          BSBW    ERROR                   ; check for errors
        11 54 AB    03      E1  03F5   318          BBC     #PRC_V_EXIT,PRC_W_FLAGS(R11),10$ ; any image active?
                            03FA   319          $FORCEX_S CODE=#SS$_NORMAL      ; force user to exit with success code
                        04  03FB   320 10$:     RET                             ; return from AST
                            03FC   321 ;
                            03FC   322 ; Error test routine
                            03FC   323 ;
                  01 50     E9  03FC   324 ERROR:  BLBC    R0,10$                  ; skip on error
                            03FF   325          RSB                             ; return ok
                     01     10  0400   326 10$:     BSBB    ERRPRT                  ; go print the error message
                            00  0402   327          HALT
                            0403   328 ;
                            0403   329 ; Error message output routine
                            0403   330 ;
                        50  DD  0403   331 ERRPRT: PUSHL   R0                      ; status code
                        01  DD  0405   332          PUSHL   #1                      ; argument count
                  51    5E  D0  0407   333          MOVL    SP,R1
                            040A   334          $PUTMSG_S       (R1)            ; output error message
                        8E  D5  0409   335          TSTL    (SP)+                   ; pop arg count off stack
                        50 8ED0 040B   336          POPL    R0                      ; restore error code
                            05  040E   337          RSB
                            040F   338 ;
                            040F   339 ; CHMS handler - for this CLI is a no-op
                            040F   340 ;
                        8E  D5  040F   341 HAND::  TSTL    (SP)+                   ; remove change mode code from stack
                            02  0411   342          REI                             ; return after CHMS call
```

Corrected CLI With Debugger Support (Page 7 of 7)

```
.MAIN.                                                  31-MAY-1982 21:09:05  VAX-11 Macro V03-00
                                                        31-MAY-1982 21:08:58  DRA0:[COURSE.SYSPRG.CLI]M1

                                        0462    343 ;
                                        0462    344 ;       Messages displayed at terminal
                                        0462    345 ;
                            00000020    0462    346         SPACE = 32
                            0000000D    0462    347         CR = 13
                            0000000A    0462    348         LF = 10
                            00000009    0462    349         TAB = 9
4D 41 58 45 20 2A 2A 2A 09 09 0A 0D     0462    350 MSG0:   .ASCII  <CR><LF><TAB><TAB>/*** EXAMPLE CLI ***/<CR><LF>
0D 2A 2A 2A 20 49 4C 43 20 45 4C 58
                                0A      047A
                            00000019    0478    351         LEN0=.-MSG0
54 4E 4F 43 20 2A 2A 2A 09 09 0A 0D     0478    352 MSG1:   .ASCII  <CR><LF><TAB><TAB>/*** CONTROL-Y AST ***/<CR><LF>
2A 2A 20 54 53 41 20 59 2D 4C 4F 52
                            0A 0D 2A    0493
                            00000018    0496    353         LEN1=.-MSG1
47 41 4D 49 20 52 45 54 4E 45 0A 0D     0496    354 MSG2:   .ASCII  <CR><LF>/ENTER IMAGE NAME /
                        20 45 4D 41 4E 20 45    04A2
                            00000013    04A9    355         LEN2=.-MSG2
                                        04A9    356 ;
4C 3A 4D 45 54 53 59 53 24 53 59 53     04A9    357 LOGO:   .ASCII  /SYS$SYSTEM:LOGINOUT/   ; Image name for LOGOUT
                        54 55 4F 4E 49 47 4F    04B5
                            00000013    04BC    358         LOGOSZ=.-LOGO
                               45 58 45 2E      04BC    359 DEF:    .ASCII  /.EXE/                  ; defaults for image file name
                            00000004    04C0    360         DEFLEN=.-DEF
                                        04C0    361 ;
                               2F 09 20 04C0    362 SEP:    .ASCII  <SPACE><TAB>"/"         ; separators
                                        04C3    363 ;
                               45 59 42 04C3    364 BYE:    .ASCII  /BYE/                   ; command to leave system
                            00000003    04C6    365         BYE_LEN=.-BYE                   ; length of command
                                        04C6    366 ;
                                        04C6    367         .END    SUPSSTART
```

MYCLIDBG.COM Procedure

```
$1                                                  MYCLIDBG.COM
$1
$ SET VERIFY
$ LIBRARY/CREATE=(BLOCKS:18,MODULES:10)/MACRO DEFS.MLB PRODEF.MAR,DCLDEF.MAR
$ MAC/LIST MYCLIDBG+DEFS/LIB+SYS$LIBRARY:LIB/LIB
$ LINK/NOTRACE/NOSYSSHR/MAP MYCLIDBG,SYS$LIBRARY:DELTA,SYS$SYSTEM:SYS.STB/SEL
$ SET PROCESS/PRIV=(SYSPRV,CMKRNL,PRMGBL)
$ COPY MYCLIDBG.EXE SYS$SYSTEM:*.*
$ RUN SYS$SYSTEM:INSTALL
SYS$SYSTEM:MYCLIDBG.EXE/SHARE
$ SET NOVERIFY
```

Sample Run

```
Username: MUIZNIEKS/CLI=MYCLIDBG
Password:
        Welcome to VAX/VMS version V3.0 on node HARDY
DELTA Version X2.2

7FFD1E3B/PUSHAL  7FFD22CE        RB/7FFD1E00

7FFD1E00;1;X
7FFD1E00 X1+21B!MOVL     0028(R10),R3

X1+21B;B;P


                *** EXAMPLE CLI ***

ENTER IMAGE NAME SYS$SYSTEM:PIP *.EXE/FU
1 BRK AT 7FFD201B
X1+21B/MOVL     0028(R10),R3      R2/00000017

;P


Directory DR0:[COURSE.SYSPRG.CLI]
31-MAY-82 21:33

MYCLI.EXE;1          (2416,4)         6./6.            31-MAY-82 21:27 [11,250] [RWED,RWED,RE,]
MYCLIDBG.EXE;1       (2436,5)         26./26.          31-MAY-82 21:32 [11,250] [RWED,RWED,RE,]
TODO.EXE;28          (2410,2)         18./18.          31-MAY-82 21:25 [11,250] [RWED,RWED,RE,]

Total of 50./50. blocks in 3. files

ENTER IMAGE NAME BYE
1 BRK AT 7FFD201B
X1+21B/MOVL     0028(R10),R3      ;P

  MUIZNIEKS     logged out at 31-MAY-1982 21:33:48.48
```

TEST

In writing a symbiont, it will be necessary to eventually test it out under the control of the Job Controller. At the same time it would be very helpful if that subprocess was also under the control of the DELTA debugger. That way it would be possible to step through the program under actual conditions. Your assignment is to alter the standard VMS print symbiont such that when it starts up, it will be under the control of the DELTA debugger and you control the DELTA debugger input.

To accomplish this, you will need the following information:

1. The source files for the print symbiont are in the directory [COURSE.SYSPROG.SYMB] along with a command procedure (listed below) for creating the PRTSMB.EXE file.

```
$SET VERIFY
$ASSIGN  SYS$LIBRARY:LIB.MLB   EXECML$
$MACRO/ENABLE=DBG/OBJ=SMBCHRGEN   SMBPRE+SMBCHRGEN
$MACRO/ENABLE=DBG/OBJ=SMBFLGPAG   SMBPRE+SMBFLGPAG
$MACRO/ENABLE=DBG/OBJ=SMBGET      SMBPRE+SMBGET
$MACRO/ENABLE=DBG/OBJ=SMBINIT     SMBPRE+SMBINIT
$MACRO/ENABLE=DBG/OBJ=SMBMAIN     SMBPRE+SMBMAIN
$MACRO/ENABLE=DBG/OBJ=SMBMBAST    SMBPRE+SMBMBAST
$MACRO/ENABLE=DBG/OBJ=SMBHANDLE   SMBPRE+SMBHANDLE
$MACRO/ENABLE=DBG/OBJ=SMBSUBR     SMBPRE+SMBSUBR
$ LINK/NOSYSSHR/NOTRACE/EXE=PRTSMB/MAP=PRTSMB/FULL/CROSS -
           SMBINIT,SMBFLGPAG,FIDTONAME,SMBCHRGEN,SMBMAIN,-
           SMBGET,SMBSUBR,SMBMBAST,SMBHANDLE,-
           SYS$SYSTEM:SYS.STB/SELECT
$SET NOVERIFY
```

Listing 1 MAKESYMB.COM

2. The DELTA debugger directs it I/O through the logical name DBG$DELTA

3. To invoke the DELTA debugger rather than the normal Symbolic Debugger, you must use the logical name LIB$DEBUG

Solution

1.

The necessary change is to force the new symbiont to generate an SS$_DEBUG signal. The listing at the end of this section shows the symbiont initialization section generating the signal.

2.

The command procedure [COURSE.SYSPROG.SYMB.SOLUTION]MYSYMB.COM (listed below)/is used to create the executible file but with the name MYSYMB.EXE

```
$SET VERIFY
$! This logical name is needed by the MACRO assembler
$ASSIGN  SYS$LIBRARY:LIB.MLB   EXECML$
$MACRO/ENABLE=DBG/OBJ=SMBCHRGEN    SMBPRE+SMBCHRGEN
$MACRO/ENABLE=DBG/OBJ=SMBFLGPAG    SMBPRE+SMBFLGPAG
$MACRO/ENABLE=DBG/OBJ=SMBGET       SMBPRE+SMBGET
$!
$!Note I used a different filename for the INIT routine
$! that includes the LIB$SIGNAL
$!
$MACRO/ENABLE=DBG/OBJ=MYINIT      SMBPRE+MYINIT
$MACRO/ENABLE=DBG/OBJ=SMBMAIN      SMBPRE+SMBMAIN
$MACRO/ENABLE=DBG/OBJ=SMBMBAST     SMBPRE+SMBMBAST
$MACRO/ENABLE=DBG/OBJ=SMBHANDLE    SMBPRE+SMBHANDLE
$MACRO/ENABLE=DBG/OBJ=SMBSUBR      SMBPRE+SMBSUBR
$!
$! I altered the name of the final executible file
$!
$ LINK/NOSYSSHR/DEBUG/EXE=MYSYMB/MAP=PRTSMB/FULL/CROSS -
           MYINIT,SMBFLGPAG,FIDTONAME,SMBCHRGEN,SMBMAIN,-
           SMBGET,SMBSUBR,SMBMBAST,SMBHANDLE,-
           SYS$SYSTEM:SYS.STB/SELECT
$SET NOVERIFY
```

Listing 2 MYSYMB.COM

3. The final step is to set up the logical names and 'load' in the symbiont. This is done by the command procedure [COURSE.SYSPROG.SYMB.SOLUTION]LOADSYMB.COM which is listed below.

```
$SET VERIFY
$!
$! Make sure you have the necessary priviliges
$SET PROCESS/PRIV=(OPER,CMKRNL,GRPNAM)
$!
$! Reset the protection on the terminal
$! So it can be allocated for I/O
$SET PROTECTION=(W:RW)/DEV    terminal
$!
$! Copy the symbiont file to SYS$SYSTEM
$COPY [MARSH.SYMB]MYSYMB.EXE  sys$system
$!
$! Alter the UIC and set up the logical
$! names for the symbiont to use
$SET UIC [1,4]
$DEFINE/GROUP  DBG$DELTA  terminal
$DEFINE/GROUP  LIB$DEBUG  DELTA
$!
$!Create the proper queue forcing the
$! Job Controller to use your file
$! for the symbiont
$INIT/QUEUE/PROCESS=[MARSH.SYMB]MYSYMB.EXE  terminal
$!
$! Start the queue. This should cause the
$! symbiont to startup with the DELTA debugger
$START/QUEUE  terminal
$SET NOVERIFY
```

Listing 3 LOADSYMB.COM

Listing 4 of MYINIT.MAR (page 1 of 4)

```
        .TITLE  SMBINIT - SYMBIONT INITIALIZATION
        .IDENT  'V03-000'

;
;*****************************************************************************
;*                                                                           *
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;*                                                                           *
;*                                                                           *
;*****************************************************************************
;

;++
; FACILITY:     VAX/VMS PRINT SYMBIONT
;
; ABSTRACT:     ONCE ONLY INITIALIZATION ROUTINE AND DATA
;
;
; ENVIRONMENT:  NATIVE/USER MODE NON-PRIVILEGED CODE
;
; AUTHOR:       H.B.BOSWELL + LEN KAWELL, CREATION DATE: 21-APR-77
;
; MODIFIED BY:
;
;       V02-004 MLJ0068         Martin L. Jack, 14-Jan-1982  22:54
;               Delete unnecessary initialization of RAB$L_UBF.
;
;       V02-003 GWF0087         Gary W. Fowler          23-Jul-1981
;               Set addresses of 2 user buffers.
;
;       V02-002 GWF0003         Gary W. Fowler          11-Sep-1980
;               Change protection on mailbox to remove write access to WORLD
;--
        .PAGE
        .SBTTL  DECLARATIONS

        PURE_SECTION    NAME=SMB_INITCODE

;
; INCLUDE FILES:
;
        [PRTSMB.SRC]SMBPRE.MAR

;
; MACROS:
```

Listing 4 of MYINIT.MAR (page 2 of 4)

```
TED SYMBOLS:

  $JBCMSGDEF                        ;JOB CONTROLLER MESSAGES

TORAGE:

BOX:                                ;NAME FOR JOB CONTROLLER MAILBOX
  .LONG   20$-10$
  .LONG   10$
  .ASCII  /_/
  .LONG   SYS$C_JOBCTLMB
  .ASCII  /:/


  .PAGE
  .SBTTL  SYMBIONT INITIALIZATION ROUTINE

IONAL DESCRIPTION:

  THIS ROUTINE PERFORMS ALL ONE TIME FUNCTIONS FOR THE
  PRINT SYMBIONT.

NG SEQUENCE:

  MAIN ENTRY POINT OF SYMBIONT

  PARAMETERS:

  NONE

IT INPUTS:

  NONE

 PARAMETERS:

  R11 CONTAINS THE ADDRESS OF THE IMPURE DATA BLOCK
  INIT DONE MESSAGE SENT TO SYMBIONT MANAGER

IT OUTPUTS:

  CHANNEL ASSIGNED TO SYMBIONT MANAGER MAILBOX
  MAILBOX CREATED FOR RECEIPT OF MANAGER MESSAGES

  TION CODES:

  NONE

  FFECTS:

  THIS ROUTINE DISPATCHES DIRECTLY TO THE SYMBIONT IDLE LOOP
```

Listing 4 of MYINIT.MAR (page 3 of 4)

```
SMB_START:                              ;SYMBIONT INITIAL ENTRY
        .WORD   0                       ;ENTRY MASK
;***************************************************************
        pushl   #ss$_debug
        calls   #1,G^lib$signal
;***************************************************************
        MOVAL   W^SMB$HANDLER,(FP)      ;SET CONDITION HANDLER ADDRESS

;
; DISABLE ASTS UNTIL MESSAGE IS SENT
;
        $SETAST_S       #0              ;DISABLE ASTS

        MOVAL   W^SMB$G_DATA,R11        ;SET ADDR OF IMPURE DATA BLOCK

;
; RUN-TIME INITIALIZATION OF DATA FIELDS
;
        MOVW    #SIM$K_SIZE,SD_W_MBREADLEN(R11) ;SET INITIAL MB READ LENGTH

        MOVW    #SMB$K_TBUFSIZ,SD_W_TBUFCNT(R11) ;SET LENGTH OF TEMP BUFFER
        MOVW    #SMB$K_TBUFSIZ,SD_W_TBUFSIZ(R11) ;SET LENGTH OF TEMP BUFFER
        MOVAL   SD_T_TBUF(R11),SD_A_TBUFADR(R11) ;SET ADDRESS OF TEMP BUFFER

        MOVAL   SD_G_FAB(R11),R6        ;GET ADDRESS OF FAB
        MOVAL   SD_G_RAB(R11),R7        ;GET ADDRESS OF RAB
        MOVAL   SD_G_NAM(R11),R8        ;GET ADDRESS OF NAM BLK

        ASSUME  FAB$B_BID+1 EQ FAB$B_BLN
        MOVW    #FAB$C_BID+<FAB$C_BLN&^X3F>,FAB$B_BID(R6) ;CREATE FAB
        ASSUME  RAB$B_BID+1 EQ RAB$B_BLN
        MOVW    #RAB$C_BID+<RAB$C_BLN&^X3F>,RAB$B_BID(R7) ;CREATE RAB
        ASSUME  NAM$B_BID+1 EQ NAM$B_BLN
        MOVW    #NAM$C_BID+<NAM$C_BLN&^X3F>,NAM$B_BID(R8) ;CREATE NAM BLK

        MOVL    R8,FAB$L_NAM(R6)        ;SET NAME BLOCK ADDRESS IN FAB
        MOVL    R6,RAB$L_FAB(R7)        ;SET FAB ADDRESS IN RAB
        MOVW    #SMB$K_LBUFSIZ,RAB$W_USZ(R7) ;SET RECORD BUFFER SIZE
        SETBIT  RAB$V_RAH,RAB$L_ROP(R7) ;USE READ-AHEAD

        MOVZBL  #QIO$_NARGS,SD_G_QIOBLK(R11) ;SET QIO BLOCK LENGTH
        MOVZWL  #IO$_WRITELBLK,SD_G_QIOBLK+QIO$_FUNC(R11) ;SET I/O FUNCTION
        CLRW    SD_B_ERR_FLAGS(R11)     ;CLEAR BOTH SETS OF FLAGS
        MOVAL   SD_T_LBUF(R11),SD_Q_BUFPNT(R11) ; SET FIRST ADDRESS
        MOVAL   SD_T_LBUF1(R11),SD_Q_BUFPNT+4(R11) ; SET SECOND ADDRESS

        ASSUME  STATE$_IDLE EQ 0

        CLRB    SD_B_STATE(R11)         ;SET INITIAL STATE TO IDLE

;
; ASSIGN THE SYMBIONT MANAGERS MAILBOX
;
        $ASSIGN_S       JBCMAILBOX,-    ;ASSIGN CHANNEL TO THE JOB CONTROLLER'S
                SD_W_JBCCHAN(R11)       ;MAILBOX-CHANNEL NUMBER STORED HERE
        BLBS    R0,10$                  ;BR IF NO ERROR
        SIGNAL  JBC$_MBASGN,#0,R0       ;SIGNAL THE ERROR
        BRB     20$                     ;EXIT
```

Listing 4 of MYINIT.MAR (page 4 of 4)

```
;
; CREATE SYMBIONT'S MAILBOX
;
10$:
        $CREMBX_S       -                       ;CREATE A MAIL BOX FOR COMMANDS
                PROMSK = #^X0FF0F,-             ; PROTECTION
                MAXMSG = #SIM$K_SIZE,-          ;MAXIMUM MESSAGE SIZE
                BUFQUO = #2*SIM$K_SIZE,-; 2 MESSAGES MAX
                CHAN   = SD_W_MBCHAN(R11) ; CHANNEL OF CREATED MAILBOX GOES HERE
        BLBS    R0,30$                          ;BR IF NO ERROR
        SIGNAL  JBC$_SYMBCRE,#0,R0              ;SIGNAL THE ERROR
20$:    $EXIT_S                                 ;FORCE IMAGE EXIT

;
; GET MAILBOX CHANNEL INFO
;
30$:
        MOVAL   SD_W_MBCHAN(R11),R0             ;SET ADDR OF CHANNEL
        BSBW    SMB$GETCHAN                     ;GET CHANNEL INFO

;
; SET UNSOLICITED AST FOR MY MAILBOX
;
        BSBW    SMB$SETMBAST                    ;SET THE MAILBOX AST
        MOVW    SD_T_TBUF+12(R11),R0            ;SET MAILBOX UNIT NUMBER FOR INIT MSG
        MOVW    R0,SD_W_MBUNIT(R11)             ;SAVE UNIT FOR $DELMBX
        BSBW    SMB$INIT_DONE                   ;SEND MGR THE INIT DONE MESSAGE

;
; ENABLE ASTS NOW
;
        $SETAST_S       #1                      ;ENABLE ASTS

        BRW     SMB$MAIN                        ;GOTO MAIN LOOP

        .END    SMB_START
```

TEST

Your instructor will supply you with a file containing th following MACRO-11 program (called RSXPROG.DAT):

Address (octal)	Opcodes (octal)		Instruction		
000000	012700	000004	START:	MOV	#4,R0
000004	012701	000005		MOV	#5,R1
000010	000004			IOT	
000012	012701	000024		MOV	#20.,R1
000016	012700	000012		MOV	#10.,R0
000022	000004			IOT	
	000000			.END	START

The file will contain only the opcodes (no image heade information normally placed in an EXE file by a task-builder c linker). The file was created running the FORTRAN progra MAKEFILE, and entering the octal opcodes as listed above. Not that an opcode of 0 was inserted as the last instruction in th file. Executing this opcode will generate a reserved instructic compatibility mode exception.

Your assignment is to write an AME that will allow the abov program to execute to completion. In particular, you should:

1. Choose whether you want to write an AME using the standard VM condition handler method, or the special compatibility mod handler method. (If you have time, try to write both types c handlers.)

2. If you choose to write a standard VMS condition handler then:

    1. Be sure to link your AME at a base address of 64K.

    2. Use $CRMPSC to establish the virtual address space for th compatibility mode program (starting at address 0).

    3. When a condition occurs, display the contents of th signal and mechanism arrays on your terminal (includir the contents of registers R0 and R1, and the exceptic code causing the handler to be entered).

    4. Check for the IOT compatibility mode exception. If tha was the condition causing the handler to be entered update the PC (by adding 2 to the value in the signa array), and return a success code in R0.

5. For any other exception, exit the program.

3. If you choose to write a customized compatibility mode handler then:

   1. Be sure to link your AME at a base address of 64K.

   2. Use $CRMPSC to establish the virtual address space for the compatibility mode program (starting at address Ø).

   3. Use $DCLCMH to establish the customized handler.

   4. Display the contents of RØ and R1 from the P1 space area.

   5. Check for the IOT compatibility mode exception. If that was the condition causing the handler to be entered, update the PC (by adding 2 to the value in the P1 space area), place the appropriate information on the stack, restore registers RØ-R6 from the P1 space area, and return control to the compatibility mode image via an REI instruction.

   6. If any other type of exception is encountered, exit the program.

Check the values of RØ and R1 after each exception, to verify that the AME is working properly. Remember that only the low-order word of those registers is valid on PDP-11 systems, for which registers are only 16-bits big.

Listing of MAKEFILE.FOR Program

```
C                                                MAKEFILE.FOR

C       This program allows you to enter the octal opcodes for
C       a program, and create a binary file with just those
C       opcodes stored.  You enter a word at a time.

C       The file is defined by the logical name RSXPROG, or
C       defaults to RSXPROG.DAT when no translation.

        INTEGER*2       NUMBER
        OPEN (UNIT=1, FILE='RSXPROG', STATUS ='NEW',
     1       RECORDTYPE='FIXED', RECORDSIZE=2)
1       READ (5,10,END=30) NUMBER
10      FORMAT (O6)
        WRITE (1,20) NUMBER
20      FORMAT (A2)
        GOTO 1
30      CLOSE (UNIT=1)
        END
```

Listing of MYAME.MAR Program (Page 1 of 2)

```
.MAIN.                                                  14-MAY-1982 13:35:18  VAX-11 Macro V03-00
                                                        14-MAY-1982 13:34:31  WORK:[MUIZNIEKS.SYSPRG.

                                                                                MYAME.MAR
                                        0000     1 ;
                                        0000     2
                                        0000     3 ;       This program runs the compatibility mode program
                                        0000     4 ;       RSXPROG.DAT, and responds to IOT instructions by
                                        0000     5 ;       updating the PC and continuing execution.
                                        0000     6
                                        0000     7 ;       Written by Vik Muiznieks    02-APR-1982
                                        0000     8
                                        0000     9         $CHFDEF                         ; Condition handling codes
                                        0000    10         $SECDEF                         ; Flags for $CRMPSC
                                        0000    11
                                        0000    12 ;       Local symbols
                              83C00000  0000    13 PSL = ^X83C00000                       ; PSL to enter Comp. Mode
                              00000020  0000    14 CR_LF = 32                             ; normal P4 for $QIO
                                        0000    15
                                    00000000    16         .PSECT  NONSHARED_DATA  PIC, NOEXE, LONG
                                        0000    17
                                        0000    18 ;       File control block: need channel to file for $CRMPSC
                                        0000    19 SECFAB: $FAB    FNM=<RSXPROG.DAT>, FOP=<UFO>, FAC=<GET, PUT>
                                        0050    20
                                        0050    21 ;       Arguments to $CRMPSC
                              00000000  0050    22 RANGE:  .LONG   0                      ; start at address 0
                              000001FF  0054    23         .LONG   511                    ; only need one page
                                        0058    24
                                        0058    25 ;       Describe terminal for I/O to user
4F 43 24 53 59 53 00000060'010E0000'    0058    26 TT:     .ASCID  /SYS$COMMAND/          ; identify terminal
                        44 4E 41 4D 4D  0066
                                0000    0068    27 TTCHAN: .WORD   0
                                        006D    28
                                        006D    29 ;       Messages generated by compatibity mode handler
62 69 74 61 70 6D 6F 63 20 6E 6F 4E     006D    30 NONCOMP:.ASCII  /Non-compatibility mode exception/
65 20 65 64 6F 6D 20 79 74 69 6C 69     0079
           6E 6F 69 74 70 65 63 78      0085
                              00000020  008D    31 NONCOMPLEN = . - NONCOMP
74 [illegible] 6C 69 62 69 74 61 70 6D 6F 43    32 COMP:   .ASCII  /Compatibility mode exception/
7      63 78 65 20 65 64 6F 6D 20 79    0099
                        6E 6F 69 74     00A5
                              0000001C  00A9    33 COMPLEN = . - COMP
                                        00A9    34
                                    00000000    35         .PSECT  CODE            PIC, SHR, NOWRT, LONG
                                0000    0000    36         .ENTRY  START,  ^M<>            ; no registers saved
                                        0002    37
                                        0002    38 ;       Establish condition handler
                6D   00000073'EF    0E  0002    39         MOVAL   MYHAND, (FP)
                                        0009    40
                                        0009    41 ;       Assign channel to terminal to communicate
                                        0009    42         $ASSIGN_S CHAN=TTCHAN, DEVNAM=TT
                          03 50     E8  001E    43         BLBS    R0, 5$
                           0046     31  0021    44         BRW     ERROR
                                        0024    45
                                        0024    46 ;       Open file containing CM image as private section
                                        0024    47 5$:     $OPEN   FAB=SECFAB
                          03 50     E8  0031    48         BLBS    R0, 10$
                           0033     31  0034    49         BRW     ERROR
                                        0037    50
                                        0037    51 ;       Create virtual address space and map CM image
                                        0037    52 10$:    $CRMPSC_S INADR=RANGE, FLAGS=#SEC$M_WRT, -
```

Listing of MYAME.MAR Program (Page 2 of 2)

```
                                                    14-MAY-1982 13:35:18  VAX-11 Macro V03-00          Page   2
                                                    14-MAY-1982 13:34:31  WORK:[MUIZNIEKS.SYSPRG.AME]MYAME.M(1)

                         0037    53                      CHAN=SECFAB+FAB$L_STV
            03 50    E8  0058    54          BLBS    R0, 20$
             0009    31  005E    55          BRW     ERROR
                         0061    56
                         0061    57 ;        Establish PSL and PC for compatibility mode image
       83C00000 8F   DD  0061    58 20$:     PUSHL   #PSL                ; PSL predefined
                7E   D4  0067    59          CLRL    -(SP)               ; PC = 0
                     02  0069    60          REI                         ; transfer control to image
                         006A    61
                         006A    62 ;        Error occurred in main part of AME
                         006A    63 ERROR:   $EXIT_S CODE=R0
                         0073    64
                         0073    65
                         0073    66 ;        Condition handler
                         0073    67
                   0004  0073    68          .ENTRY  MYHAND, ^M<R2>  ; save one register
                         0075    69
                         0075    70 ;        Get offset to signal array
         52   04 AC   D0  0075    71          MOVL    CHF$L_SIGARGLST(AP), R2
                         0079    72
                         0079    73 ;        Test for compatibility mode exception
00000000'8F   04 A2   D1  0079    74          CMPL    CHF$L_SIG_NAME(R2), #SS$_COMPAT
                  32  13  0081    75          BEQLU   30$
                         0083    76
                         0083    77 ;        Non-compatibility mode exception - resignal error
                         0083    78          $QIOW_S CHAN=TTCHAN, FUNC=#IO$_WRITEVBLK, P1=NONCOMP, -
                         0083    79                  P2=#NONCOMPLEN, P4=#CR_LF
            58 50    E9  00AA    80          BLBC    R0, ERR
   50   00000000'8F   D0  00AD    81          MOVL    #SS$_RESIGNAL, R0
                     04  00B4    82          RET
                         00B5    83
                         00B5    84 ;        Compatibility mode exception
                         00B5    85 30$:     $QIOW_S CHAN=TTCHAN, FUNC=#IO$_WRITEVBLK, P1=COMP, -
                         00B5    86                  P2=#COMPLEN, P4=#CR_LF
            26 50    E9  00DC    87          BLBC    R0, ERR
                         00DF    88
                         00DF    89 ;        Print contents of signal and mechanism arrays
            04 AC    DD  00DF    90          PUSHL   CHF$L_SIGARGLST(AP)
   00000000'EF   01    FB  00E2    91          CALLS   #1, OUTSIG
            08 AC    DD  00E9    92          PUSHL   CHF$L_MCHARGLST(AP)
   00000000'EF   01    FB  00EC    93          CALLS   #1, OUTMEC
                         00F3    94
                         00F3    95 ;        Check for IOT (CM code 2) in signal array (offset 8)
         08 A2   02  D1  00F3    96          CMPL    #2, 8(R2)
                 0C  12  00F7    97          BNEQU   ERR                 ; if not, exit
                         00F9    98
                         00F9    99 ;        Update PC so don't loop (IOT instruction uses 2 bytes)
         0C A2   02  C0  00F9   100          ADDL2   #2, 12(R2)          ; PC in signal array
                         00FD   101
                         00FD   102 ;        Return control to compatibility mode image
   50   00000000'8F   D0  00FD   103          MOVL    #SS$_CONTINUE, R0
                     04  0104   104          RET
                         0105   105
                         0105   106 ;        Error in Handler or Non-IOT Compatibility Mode Exception
                         0105   107 ERR:     $EXIT_S CODE=R0
                         010E   108
                         010E   109          .END    START
```

Listing of OUTSIG.FOR Program

```
C                                                       OUTSIG.FOR

C       This program outputs the contents of the signal array.
C       Of particular interest are the exception code, PC, PSL.

        SUBROUTINE OUTSIG(ARRAY)
        INTEGER ARRAY(10)
        CHARACTER*15 LABEL(4)
        DATA LABEL/'NUM. OF ARGS.:','CONDITION:','PC:','PSL:'/
        N = ARRAY(1)

C       Display heading for signal array
        CALL HEADING ('SIGNAL ARRAY')

C       Display elements in array
C       Always have number of args, exception code, PC, and PSL

        WRITE (6,1000) LABEL(1), (ARRAY(1), I=1,3)
        WRITE (6,1000) LABEL(2),(ARRAY(2), I=1,3)
1000    FORMAT (1X,A,I16,Z16,O16)

C       Variable number of arguments based on exception code
        IF (N .GT. 3) THEN
                DO 100 I=3,N-1
                WRITE (6,2000) 'ARGUMENT',I-2,(ARRAY(I),J=1,3)
2000            FORMAT (1X,A,I2,5X,I16,Z16,O16)
100             CONTINUE
        END IF

C       Display PC and PSL
        WRITE (6,1000) LABEL(3),(ARRAY(N),I=1,3)
        WRITE (6,1000) LABEL(4),(ARRAY(N+1), I=1,3)

        RETURN
        END
```

Listing of OUTMEC.FOR Program

```
C                                                       OUTMEC.FOR

C       This subroutine displays the contents of the mechanism
C       array in decimal, hex, and octal.

C       The input parameter is the address of the mech. array

        SUBROUTINE OUTMEC(ARRAY)
        INTEGER ARRAY(5)
        CHARACTER*16 LABEL(5)
        DATA LABEL/'M:','ESTAB. FRAME:','DEPTH:','R0:','R1:'/

C       Print heading identifying mechanism array
        CALL HEADING('MECHANISM ARRAY:')

C       Write elements of array (fixed arguments)
        WRITE (6,1000) LABEL(1), (ARRAY(1), I=1,3)
        WRITE (6,1000) LABEL(2), (ARRAY(2), I=1,3)
        WRITE (6,1000) LABEL(3), (ARRAY(3), I=1,3)
        WRITE (6,1000) LABEL(4), (ARRAY(4), I=1,3)
        WRITE (6,1000) LABEL(5), (ARRAY(5), I=1,3)
1000    FORMAT(1X,A16,I16,Z16,O16)

        RETURN
        END


C       This subroutine prints a heading for the signal or
C       mechanism array

        SUBROUTINE HEADING(HEAD)
        CHARACTER*(*) HEAD, LOC*16
        LOC = 'LOCATION'
        WRITE (6,3000) HEAD, LOC, 'DECIMAL', 'HEXADECIMAL', 'OCTAL'
3000    FORMAT(//1X,A,//1X,3A16,A16/)
        RETURN
        END
```

Listing of MYAME.COM Procedure

```
$!                                                      MYAME.COM
$!
$!      This command procedure assembles and links
$!      (at a base address of 64K), a user-written AME
$!
$ MAC/LIST MYAME
$ FOR OUTSIG, OUTMEC
$ LINK/MAP/FULL  MYAME,OUTSIG,OUTMEC,SYS$INPUT/OPTION
BASE=^X10000
```

Sample Run

```
$ RUN MYAME
Compatibility mode exception

SIGNAL ARRAY

LOCATION                  DECIMAL      HEXADECIMAL          OCTAL

NUM. OF ARGS.:                  4                4              4
CONDITION:                   1068              42C           2054 <--  SS$_COMPAT
ARGUMENT 1                      2                2              2 <--  IOT code
PC:                             8                8             10 <--  Matches program
PSL:                -2084569088        83C00000     20360000000 <--  Matches supplied
                                                                      PSL

MECHANISM ARRAY:

LOCATION                  DECIMAL      HEXADECIMAL          OCTAL

N:                              4                4              4
ESTAB. FRAME:          2147179908         7FFB5D84     17776656604
DEPTH:                          0                0              0
R0:                             4                4              4 <--  Correct R0
R1:                        -65531         FFFF0005     37777600005 <--  Correct R1
Compatibility mode exception                                          (low order
                                                                       word)

SIGNAL ARRAY

LOCATION                  DECIMAL      HEXADECIMAL          OCTAL

NUM. OF ARGS.:                  4                4              4
CONDITION:                   1068              42C           2054
ARGUMENT 1                      2                2              2
PC:                            18               12             22
PSL:                -2084569088        83C00000     20360000000

MECHANISM ARRAY:

LOCATION                  DECIMAL      HEXADECIMAL          OCTAL

N:                              4                4              4
ESTAB. FRAME:          2147179908         7FFB5D84     17776656604
DEPTH:                          0                0              0
R0:                            10                A             12
R1:                        -65516         FFFF0014     37777600024
Compatibility mode exception


SIGNAL ARRAY

LOCATION                  DECIMAL      HEXADECIMAL          OCTAL

NUM. OF ARGS.:                  4                4              4
CONDITION:                   1068              42C           2054
ARGUMENT 1                      0                0              0 <--  Reserved instruction
PC:                            20               14             24      CM code (A0)
PSL:                -2084569088        83C00000     20360000000

MECHANISM ARRAY:

LOCATION                  DECIMAL      HEXADECIMAL          OCTAL

N:                              4                4              4
ESTAB. FRAME:          2147179908         7FFB5D84     17776656604
DEPTH:                          0                0              0
R0:                            10                A             12
R1:                        -65516         FFFF0014     37777600024
%NONAME-W-NOMSG, Message number 00000000
$
```

Listing of MYCOMPAME.MAR Program (Page 1 of 3)

```
                                                6-JUN-1982 15:13:03  VAX-11 Macro V03-00          Page   1
                                                6-JUN-1982 15:12:56  DRA0:[COURSE.SYSPRG.AME]MYCOMPAME.(1)

                                0000     1 :                                                MYCOMPAME.MAR
                                0000     2
                                0000     3 :       This program runs the compatibility mode program
                                0000     4 :       RSXPROG.DAT, and responds to IOT instructions by
                                0000     5 :       updating the PC and continuing execution.
                                0000     6
                                0000     7 :       Written by Vik Muiznieks    02-APR-1982
                                0000     8
                                0000     9         $SECDEF                           ; Flags for $CRMPSC
                                0000    10
                                0000    11 :       Local symbols
                      83C00000  0000    12 PSL = ^X83C00000                          ; PSL to enter Comp. Mode
                      00000020  0000    13 CR_LF = 32                                ; normal P4 for $QIO
                                0000    14
                            00000000    15         .PSECT  NONSHARED_DATA  PIC, NOEXE, LONG
                                0000    16
                                0000    17 :       File control block: need channel to file for $CRMPSC
                                0000    18 SECFAB: $FAB     FNM=<RSXPROG.DAT>, FOP=<UFO>, FAC=<GET, PUT>
                                0050    19
                                0050    20 :       Arguments to $CRMPSC
                      00000000  0050    21 RANGE:  .LONG    0                        ; start at address 0
                      000001FF  0054    22         .LONG    511                      ; only need one page
                                0059    23
                                0059    24 :       Describe terminal for I/O to user
 53 59 53 00000060'010E0000'    0058    25 TT:     .ASCID  /SYS$COMMAND/            ; identify terminal
              44 4E 41 40 40    0065
                        0000    0068    26 TTCHAN: .WORD   0
                                0060    27
                                0060    28 :       Messages generated by compatibity mode handler
 69 62 69 74 61 70 60 6F 43     0060    29 COMP:   .ASCII  /Compatibility mode exception/
 78 65 20 65 64 6F 60 20 79     0079
                 6E 6F 69 74    0085
                   0000001C     0089    30 COMPLEN = . - COMP
                   00000017'    0089    31 CTR:    .LONG   STR_END - STR
                   00000091'    0080    32         .ADDRESS STR
 20 6E 69 20 65 75 6C 61 56     0091    33 STR:    .ASCII  /Value in R0 = !XW (hex)/
 65 68 28 20 57 58 21 20 20     0090
                                00A9    34 STR_END:
                   00000017'    00A9    35 CTR2:   .LONG   STR2_END - STR2
                   00000090'    00AC    36         .ADDRESS STR2
 20 6E 69 20 65 75 6C 61 56     00B0    37 STR2:   .ASCII  /Value in R1 = !XW (hex)/
 65 68 28 20 57 58 21 20 20     00C0
                                00C7    38 STR2_END:
                   00000000     00C7    39 FAOLEN: .LONG   0
                   00000050'    00C9    40 OUT:    .LONG   BUFF_END - BUFF
                   000000C8'    00CF    41         .ADDRESS BUFF
                   00000123     00D3    42 BUFF:   .BLKB   80
                                0123    43 BUFF_END:
                                0123    44
                                0123    45 :       Temporary storage of updated PC
                   00000000     0123    46 NEWPC:  .LONG   0
                                0127    47
                            00000000    48         .PSECT  CODE            PIC, SHR, NOWRT, LONG
                        0000    0000    49         .ENTRY  START,  ^M<>             ; no registers saved
                                0002    50
                                0002    51 :       Establish condition handler
                                0002    52         $DCLCMH_S ADDRES=MYHAND, TYPE=#1
```

Listing of MYCOMPAME.MAR Program (Page 2 of 3)

```
MAIN.                                                   6-JUN-1982 15:13:03  VAX-11 Macro V03-00
                                                        6-JUN-1982 15:12:56  DRA0:[COURSE.SYSPRG.AME]M

                03 50    E3  0013    53          BLBS    R0, 3$
                 0041    31  0016    54          BRW     ERROR
                             0019    55
                             0019    56 ;        Assign channel to terminal to communicate
                             0019    57 3$:      $ASSIGN_S CHAN=TTCHAN, DEVNAM=TT
                03 50    E8  0026    58          BLBS    R0, 5$
                 0046    31  0031    59          BRW     ERROR
                             0034    60
                             0034    61 ;        Open file containing CM image as private section
                             0036    62 5$:      $OPEN   FAB=SECFAB
                03 50    E8  0041    63          BLBS    R0, 10$
                 0033    31  0044    64          BRW     ERROR
                             0047    65
                             0047    66 ;        Create virtual address space and map CM image
                             0047    67 10$:     $CRMPSC_S INADR=RANGE, FLAGS=#SEC$M_WRT, -
                             0047    68                    CHAN=SECFAB+FAB$L_STV
                03 50    E8  0068    69          BLBS    R0, 20$
                 0009    31  006B    70          BRW     ERROR
                             0071    71
                             0071    72 ;        Establish PSL and PC for compatibility mode image
          83C00000 8F    DD  0071    73 20$:     PUSHL   #PSL                ; PSL predefined
                   7E    D4  0077    74          CLRL    -(SP)               ; PC = 0
                         02  0079    75          REI                         ; transfer control to image
                             007A    76
                             007A    77 ;        Error occurred in main part of AME
                             007A    78 ERROR:   $EXIT_S CODE=R0
                             0083    79
                             0083    80
                             0083    81 ;        Condition handler
                             0083    82
                             0083    83 ;        Compatibility mode exception had to occur to get here
                             0083    84 MYHAND::
                             0083    85          $QIOW_S CHAN=TTCHAN, FUNC=#IO$_WRITEVBLK, P1=COMP, -
                             0083    86                  P2=#COMPLEN, P4=#CR_LF
                03 50    E8  00AA    87          BLBS    R0, 10$
                 0000    31  00AD    88          BRW     ERR
                             00B0    89
                             00B0    90 ;        Display contents of P1 space area (registers R0 and R1)
5A    00000000'GF    DO    00B0    91 10$:     MOVL    G^SYS$GL_CMCNTX, R10    ; base of CM context area
         50    5A    3C    00B7    92          MOVZWL  (R10), R0               ; pick up R0
                             00BA    93          $FAO_S  CTRSTR=CTR, OUTLEN=FAOLEN, OUTBUF=OUT, P1=R0
                03 50    E8  00D5    94          BLBS    R0, 20$
                 00A5    31  00D8    95          BRW     ERR
                             00DB    96 20$:     $OUTPUT CHAN=TTCHAN, LENGTH=FAOLEN, BUFFER=BUFF
                79 50    E9  0104    97          BLBC    R0, ERR
          50    04 AA    3C  0107    98          MOVZWL  4(R10), R0              ; pick up R1
                             0108    99          $FAO_S  CTRSTR=CTR2, OUTLEN=FAOLEN, OUTBUF=OUT, P1=R0
                57 50    E9  0126   100          BLBC    R0, ERR
                             0129   101          $OUTPUT CHAN=TTCHAN, LENGTH=FAOLEN, BUFFER=BUFF
                23 50    E9  0152   102          BLBC    R0, ERR
                             0155   103
                             0155   104 ;        Check for IOT (CM code 2) in CM context area
          1C AA    02    D1  0155   105          CMPL    #2, 28(R10)
                   25    12  0159   106          BNEQU   ERR                     ; if not, exit
                             0159   107
                             0159   108 ;        Update PC so don't loop (IOT instruction uses 2 bytes)
          20 AA    02    C0  0159   109          ADDL2   #2, 32(R10)
```

Listing of MYCOMPAME.MAR Program (Page 3 of 3)

```
                                                    6-JUN-1982 15:13:03  VAX-11 Macro V03-00          Page   3
                                                    6-JUN-1982 15:12:56  DRA0:[COURSE.SYSPRG.AME]MYCOMPAME.(1)

00000123'EF   20 AA   D0  0155   110          MOVL    32(R10), NEWPC          ; save to push on stack
                          0167   111
                          0167   112 ;        Return control to compatibility mode image
                          0167   113 ;        after restoring registers R0-R6
              50   8A   7D  0167   114          MOVQ    (R10)+,R0
              52   8A   7D  016A   115          MOVQ    (R10)+,R2
              54   8A   7D  016D   116          MOVQ    (R10)+,R4
              56   6A   D0  0170   117          MOVL    (R10),R6
        03C00000 3F       D2  0173   118          PUSHL   #PSL
        00000123'EF       D2  0179   119          PUSHL   NEWPC
                          02  017F   120          REI
                          0180   121
                          0180   122 ;        Error in Handler or Non-IOT Compatibility Mode Exception
                          0180   123 ERR:     $EXIT_S CODE=R0
                          0189   124
                          0189   125          .END    START
```

Listing of MYCOMPAME.COM Procedure

```
$!                                                  MYCOMPAME.COM
$!
$!      This command procedure assembles and links a user
$!      written AME (at a base address of 64K)
$!
$ MAC/LIST MYCOMPAME
$ LINK/MAP/FULL  MYCOMPAME,SYS$INPUT/OPTION
BASE=%X10000
```

Sample Run

```
$ RUN MYCOMPAME
Compatibility mode exception
Value in R0 = 0004 (hex)
Value in R1 = 0005 (hex)
Compatibility mode exception
Value in R0 = 000A (hex)
Value in R1 = 0014 (hex)
Compatibility mode exception
Value in R0 = 000A (hex)
Value in R1 = 0014 (hex)
$
```