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Audit trail of IPLs

We use the following program to write an audit trail of IPLs for our systems.

It creates a record containing sysid, IPL date/time, and the unit and volser the system was IPLed from. This currently runs on an OS/390 2.10 system.

It is started from each system's COMMND*xx* member:

```
COM='S IPLLOG'
```

which starts an STC:

```
//IPLLOG  PROC
//S1      EXEC PGM=IPLLOG
//STEPLIB  DD  DISP=SHR,DSN=SYS2.LINKLIB
//IPLLOG   DD  DISP=MOD,DSN=SYS6.IPLLOG
```

SYS6.IPLLOG is a dataset (RECFM FB, LRECL 80) that is accessible to and shared by all systems. Records with the following format are written for each invocation:

```
*** MVS1 IPLED 2003.317 AT 13.27 FROM PRS2AS(409B)
*** MVS2 IPLED 2004.001 AT 10.24 FROM PRS2AA(4090)
*** MVS3 IPLED 2004.031 AT 12.30 FROM PRS2AS(409B)   etc
```

PROGRAM SOURCE

```
*********************************************************************
*         'IPLLOG' - CREATE A LOG OF IPL DATES                      *
*********************************************************************
IPLLOG   CSECT
*PLLOG   AMODE 31
*PLLOG   RMODE ANY
         BAKR  R14,0                  SAVE CALLER DATA ON STACK
         LR    R12,R15                GET ENTRY POINT
         USING IPLLOG,R12             ESTABLISH ADDRESSABILITY
         L     R15,16                 CVTPTR
         L     R2,196(,R15)           CVTSMCA
         MVC   OUTSYSID,16(R2)        SMFID INTO OUTPUT LINE
         LA    R3,340(,R2)            LOCATE IPL DATE (JULIAN)
         LA    R4,336(,R2)            LOCATE IPL TIME
         ED    JULIAN,1(R3)
         MVC   OUTYYDDD,JULIAN+1      JULIAN DATE INTO OUTPUT LINE
```

```
         L     R1,Ø(,R4)               LOAD IPL TIME
         SLR   RØ,RØ
         D     RØ,=F'36ØØØØ'           CALCULATE HH
         CVD   R1,DWORD
         OI    DWORD+7,X'ØF'
         UNPK  OUTHH,DWORD+6(2)
         LR    R1,RØ
         SLR   RØ,RØ
         D     RØ,=F'6ØØØ'             CALCULATE MM
         CVD   R1,DWORD
         OI    DWORD+7,X'ØF'
         UNPK  OUTMM,DWORD+6(2)
         L     R2,48(R15)              GET SYSRES UCB POINTER
         MVC   OUTVOLID,28(R2)         VOLID INTO OUTPUT LINE
         UNPK  UNPKFLD(5),4(3,R2)      UNPK BINARY CCUU + 1 BYTE
         TR    UNPKFLD(4),TRTAB-24Ø    MAKE IT DISPLAYABLE HEX
         MVC   OUTCCUU,UNPKFLD         GET UNIT ADDRESS
         OPEN  (IPLOUT,(OUTPUT))
         PUT   IPLOUT,OUTREC           WRITE THE INFO
         CLOSE (IPLOUT)
         XR    R15,R15                 SET RC=Ø
         PR    ,                       RETURN
*********************************************************************
*        WORKAREA                                                   *
*********************************************************************
OUTREC   DC    CL8Ø'*** XXXX IPLED 2ØYY.DDD AT HH.MM FROM VOLID (CCUU)'
OUTSYSID EQU   OUTREC+4,4
OUTYYDDD EQU   OUTREC+17,6
OUTHH    EQU   OUTREC+27,2
OUTMM    EQU   OUTREC+3Ø,2
OUTVOLID EQU   OUTREC+38,6
OUTCCUU  EQU   OUTREC+45,4
JULIAN   DC    XL7'FØ21Ø4B2Ø2Ø2Ø'     CONTAINS EDIT PATTERN
DWORD    DS    D
UNPKFLD  DS    CL5
*
IPLOUT   DCB   DDNAME=IPLLOG,                                       X
               DSORG=PS,                                            X
               RECFM=FB,                                            X
               LRECL=8Ø,                                            X
               MACRF=PM
*
TRTAB    DC    C'Ø123456789ABCDEF'
*
         YREGS
*
         END
```

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Boosting VSAM performance with SMB

Ever since its introduction some 30 years ago, VSAM has been a popular and reliable data storage construct on MVS systems. VSAM is still the cornerstone of on-line applications such as IMS and CICS, and is widely used in ISV packages and in-house-written batch applications. However, with 24x7 operation becoming a necessity, batch windows must shrink in order to lessen their impact on on-line systems. The most effective way to cut down the batch window is to optimize I/O, and this article examines the results of a sample tuning exercise. Of course, it is a well-known fact that the fastest I/O is the one that is never issued. That is to say, an application that is having I/O performance problems will perform better if we can cut down on the number of I/Os. The whole concept of SMS automatic blocksizes according to DASD device was to reduce the number of I/Os for that specific DASD device type. Similarly, for VSAM data, automatic effective buffering can significantly reduce the number of I/Os, response time, and elapsed job time, thereby improving application performance.

It is well known that VSAM is very important to most installations, yet it is rarely utilized optimally. One consequence of this is that jobs accessing VSAM files almost always run longer than necessary. Thus, tuning native VSAM datasets is still an important part of the overall tuning process at many installations. Almost certainly, the largest performance gains can be achieved with good VSAM buffering – it is in fact the single most important aspect of VSAM tuning and will achieve the biggest performance boost. If implemented correctly, these buffering methodologies will greatly reduce disk I/Os, reduce CPU time, and lead to better job turnaround time. Now, with the advent of System Managed Buffering (SMB), high performance can be achieved through standard OS/390 system interfaces, with virtually no application programmer effort, and with no JCL changes. System Managed Buffering is a feature of DFSMSdfp, directed at support for batch application processing, and is intended as a

means of achieving two things. The first one is to update the current defaults for processing VSAM datasets. This is necessary in order to utilize current hardware technology to effect the processing of VSAM data. The second one is to initiate a buffering technique, other than that specified by the application program, that would improve application performance.

SYSTEM MANAGED BUFFERING

Before we see how SMB works and how you can take advantage of it, it might be useful to understand the overall buffering picture for VSAM files. There are two ways of addressing buffering of VSAM data offered by OS/390 and z/OS. The first method uses Non-Shared Resources (NSR), where buffers are dedicated to the processing of a single VSAM file. NSR means that each VSAM file in a task will have its own dedicated buffers assigned within the program address space, and, hence, will not share them with any other VSAM file that is open within the task. NSR is also the automatic default type of VSAM buffering logic. On the other hand, using Logically Shared Resources (LSR) allows the sharing of buffer pools among multiple VSAM files. While both NSR and LSR can be defined within an application, there is a significant difference when it comes to how an application maximizes its use of these buffer pools to process data – sequential processing of data works best using NSR and random data processing works best using LSR. Does this mean that applications need to be changed? Sometimes they need changing. Moreover, sometimes it is necessary to understand the type, access method, format, and options of the file. For example, do dataset options call for key access (KEY), sequential access (SEQ), addresses access (ADR), or access to CI (CNV)?

System Managed Buffering (SMB) for VSAM datasets is a fairly new facility introduced with DFSMS Version 1.4 for KSDS files only. This was enhanced with DFSMS 1.5 to include all types of VSAM file. Basically, the system decides how many buffers to use for data and index portions (the case of NSR) or buffer

pools size (the case of LSR), with four basic buffer allocation algorithms that can be chosen or specified:

- Direct Optimized (DO) – SMB optimizes for totally random record access. This is appropriate for applications that access records in a dataset in totally random order. This technique will override the user specification for using NSR buffering with an LSR buffering implementation. Random-access VSAM processing is automatically directed to use LSR, which will eliminate buffer stealing, exploit look-aside processing, ESA hiperspaces, and in-core indexes. The DO technique is elected if the ACB specifies only the MACRF=(DIR) option for accessing the dataset. If either SEQ or SKP are specified, in combination with DIR or independently, DO is not selected. The selection can be overridden by the user specification of ACCBIAS=DO on the AMP=parameter of the associated DD statement. Note should be taken of the fact that the MACRF type of access is just an intention. The real type of access is declared per I/O operation in the RPL.
- Direct Weighted (DW) – SMB optimizes for mixed-mode processing (both direct and sequential), but 'weights' the buffer allocations for key-direct. This will provide minimum read-ahead buffers for sequential retrieval and maximum index buffers for direct requests. The size of the dataset is a minor factor in the storage that is required for buffering. This technique requires approximately 100KB of processor storage for buffers, with a default of 16MB.
- Sequential Optimized (SO) – SMB optimizes for sequential processing. It is appropriate for applications reading the entire dataset from the first to last record or a large percentage in sequential order. The size of the dataset is not a factor in the processor virtual storage that is required for buffering. Approximately 500KB of processor virtual storage, defaulted to above the 16MB line, is required for buffers for this technique.
- Sequential Weighted (SW) – SMB optimizes for mixed-

mode processing (both direct and sequential), but 'weights' the buffer allocations for sequential. It will use read-ahead buffers for sequential and provide additional index buffers for direct requests. The read-ahead will not be the large amount of data transferred as with SO. The size of the dataset is a minor factor in the amount of processor virtual storage that buffering requires. This technique requires approximately 100KB of processor virtual storage for buffers, with the default above 6MB.

General discussion and guidelines related to processing with each technique are fully documented in *VSAM Demystified* (SG24-6105).

The change-over to SMB is easy enough – it can be simply done by defining an extended format dataset through an SMS data class with RECORD_ACCESS_BIAS=SYSTEM/USER. Or, if you prefer JCL changes, it can be invoked in a specific job stream by specifying ACCBIAS on the AMP parameter for the dataset's DD statement.

In the first case, the technique that will be defaulted to by the system is based on the application specification for the type of access intention ACB MACRF=(DIR,SEQ,SKP) and influenced by the specifications in the associated Storage Class (SC) for direct millisecond response, direct bias, sequential millisecond response, and sequential bias.

In the second case, the technique is externally specified by using the ACCBIAS JCL subparameters of the AMP DD parameter – probably the easiest and best option is the ACCBIAS=SYSTEM option. You can specify ACCBIAS equal to one of the following values:

- USER – bypass SMB. This is the default if you code no specification for the ACCBIAS subparameter. This default is not used when the data class specifies RECORD_ACCESS_BIAS.
- SYSTEM – force the system to determine the buffering technique.

One can also explicitly request a specific buffer allocation algorithm by specify the SMB buffer processing as SO/SW/DO/DW. One of the problems with SMB arises in situations where you have a batch program that does skip-sequential, sequential, and random processing all in the same run. In many such cases, that we have seen it's often been a good compromise just to default to ACCBIAS=SYSTEM. For a detailed description of each AMP option see *MVS: JCL Reference* (SA22-7597).

During a testing phase we turned on Systems Managed Buffering (through DATACLASS) for a large VSAM file, but in order to see how SMB works, as well as to prevent production problems, we decided to bypass SMB processing by specifying RECORD_ACCESS_BIAS=USER and later on we used JCL's AMP parameter ACCBIAS=SO (see below):

```
                    VSAM file buffers & buffering management

                                                                  # of
Records        Access:         Buffers
Job    Run date    Elapsed time   Cluster/Component name   Records
ret'ved   Excp mode bias SMB   used   Format   Restriction
-------------------------------------------------------------------
-------------------------------------------------------------------
-----
MYJOB  17 Oct 2003 00:49:24:46    PROD.HISTFILE.DATA      68171123
68171123 365207  seq none none     4   Standard Extended format required
(1)
MYJOB  17 Oct 2003 00:49:24:46    PROD.HISTFILE.INDEX        12030
0  11868  seq none none     2   Standard Extended format required
MYJOB  18 Oct 2003 00:42:45:09    PROD.HISTFILE.DATA      68379107
68379107 366613  seq none none     4   Standard Extended format required
MYJOB  18 Oct 2003 00:42:45:09    PROD.HISTFILE.INDEX        11757
0  11596  seq none none     2   Standard Extended format required
MYJOB  19 Oct 2003 00:50:07:19    PROD.HISTFILE.DATA      68430562
68430562 367646  seq none none     4   Extended none
(2)
MYJOB  19 Oct 2003 00:50:07:19    PROD.HISTFILE.INDEX        10857
0  10696  seq none none     2   Extended none
MYJOB  21 Oct 2003 00:50:57:52    PROD.HISTFILE.DATA      68667511
68667511 368038  seq none none     4   Extended none
MYJOB  21 Oct 2003 00:50:57:52    PROD.HISTFILE.INDEX        11940
0  11779  seq none none     2   Extended none
MYJOB  22 Oct 2003 00:26:22:79    PROD.HISTFILE.DATA      68931080
68931080  21714  seq so   jcl     49   Extended none
(3)
```

```
MYJOB  22 Oct 2003 00:26:22:79    PROD.HISTFILE.INDEX        12234
0  12073  seq so   jcl      4   Extended none
MYJOB  23 Oct 2003 00:26:41:31    PROD.HISTFILE.DATA      69104677
69104677  21406  seq so   jcl     49   Extended none
MYJOB  23 Oct 2003 00:26:41:31    PROD.HISTFILE.INDEX        11683
0  11522  seq so   jcl      4   Extended none
```

Notes:

(1) Job access statistics before converting dataset to extended format.

(2) Dataset converted to extended format with Rec_Acc_Bias=USER (bypass SMB).

(3) JCL AMP parameter override of data class definition (ACCBIAS=SO).

The order of precedence for specifying values that decide if and how SMB will be invoked is this: JCL specifications, then the data class Record_Access_Bias parameter, then the storage class parameters, then the MACRF values. That is, whatever is specified in the JCL will always take precedence. This also means that one may wish to tell a lie to VSAM about intent (for example direct versus sequential processing) and SMB will be fooled. Because SMB is not taking any sample of behaviour, it relies on the access intent of the OPEN. However, telling a lie is not a wise thing to do: incorrect use of a buffering strategy will result in a significant increase in I/O, thus causing long-running batch jobs and poor performance (see below):

Buffering	EXCPs	Clock time (min)	CPU time (sec)	CONN (k)	Buffers (D/I)	
NSR - Default	402472	41.4	251.16	1099	4	2
ACCBIAS=SO	34991	26.0	233.66	918	49	4
ACCBIAS=DO	793868	45.0	294.28	1342	0	0
Gain using SMB (%):	91.3	37.19	9.96	13.73		
(DO vs. Default) :	- 97.2	- 8.7	- 17.16	- 22.11		

SMB RESTRICTIONS AND POTENTIAL PROBLEMS

There are two main restrictions to SMB. The first one is that

SMB support is currently limited to extended format VSAM files that use NSR buffering. To be in extended format, the dataset must be system managed (SMS) and use a data class defined with DSNTYPE=EXT. On the other hand, SMB will get involved only when NSR buffering is specified by the application program, ACB MACRF=(NSR). It will not get involved with the MACRF parameters RST (ACB reset option), UBF (USER buffering), GSR (Global Shared Resources), LSR (Local Shared Resources), RLS (Record Level Sharing), or ICI (Improved Control Interval processing). For releases prior to z/OS 1.3 DFSMS, processing the dataset through the alternate index of the path specified in the DDname is not supported. When the conditions above are not satisfied, the job does not abend, but the SMB services are not used and no messages are issued.

The second restriction is that SMB is invoked at dataset open processing only: after the initial decision is made during that process, SMB has no further involvement.

Thus far two basic storage-related problems have emerged, especially regarding the use of the ACCBIAS=DO option. SMB ACCBIAS=DO is in fact equivalent to BLSR in that, in both cases, VSAM LSR buffer pools are built for each dataset opened with this technique in a single application program. The size of the pool is based on the actual dataset size at the time the pool is created. A separate pool is built for both data and index components, if applicable, for each dataset. There is no capability for a single pool to be shared by multiple datasets. The index pool is sized to accommodate all records in the index component. The data pool is sized to accommodate approximately 20% of the user records in the dataset. This also means that the processor virtual storage requirement will increase with each OPEN after records have been added and the dataset has been extended beyond its previous size. Thus, for very large VSAM KSDS files, a program or job step might abend with ACCBIAS=DO because of storage problems unless SMB's default options regarding buffer pool allocations are overridden.

Again, two options are available to tackle this problem. Increasing the job's region size to support the buffers (think multiple megabytes just for the buffers) might avoid abends. Then again, it might not help, as was the case with a very large VSAM KSDS file we were testing, even though we had increased the job's region size to the maximum possible.

On the other hand, the use of the SMBVSP parameter on the AMP=parameter (not present in the data class specification) can alleviate the storage impact since it restricts the amount of virtual storage to be obtained for buffers when opening the dataset. It is used to override the default buffer space to be obtained, which is calculated assuming that 20% of the data accounts for 80% of the accesses. The buffer space acquired is split across two LSR pools – one for the index and one for the data.

There is also an additional AMP parameter that can be used in conjunction with the SMBVSP parameter, and it can help to reduce the storage problems. The SMBHWT parameter can be used to provide buffering in hiperspace in combination with virtual buffers for the data component. These buffers may be allocated for the base data component of the sphere. If the CI size of the data component is not a multiple of 4KB, both virtual space and hiperspace are wasted. It can be specified as an integer from 0 to 99. The value specified acts as a weighting factor for the number of hiperspace buffers to be established. This can reduce the size required for an application region, but does have implications related to processor cycle requirements. That is, all application requests must orient to a virtual buffer address. If the required data is in a hiperspace buffer, the data must be moved to a virtual buffer after 'stealing' a virtual buffer and moving that buffer to a Least Recently Used (LRU) hiperspace buffer.

Finally, if the optimum amount of storage required for this option is not available, SMB will reduce the number of buffers and retry the request. The retry capability for the DO technique was added in z/OS 1.3 DFSMS. For data, SMB will make two

attempts, with a reduced amount and a minimum amount. For an index, SMB reduces the amount of storage only once, to a minimum amount. If all attempts fail, the DW technique is used. The system issues an IEC161I message to advise that this has happened.

If you are running a 24-bit program (amode=rmode=24) be aware that the storage for buffers for SMB techniques are obtained above 16 megabytes (above the line), and in order to prevent problems IBM recommends that RMODE31=NONE be specified on the AMP= parameter for those datasets using SMB.

IDENTIFYING JOBS THAT MIGHT BENEFIT FROM SMB

The jobs that might benefit from SMB are those with certain application characteristics, most important of which are a data reference pattern and options specified by the application program (ACB MACRF). The best candidates are long-running jobs as well as jobs with a high execute channel program (EXCP) count.

SMF type 64 records are probably used more frequently than any other data source for tuning VSAM applications. Using these records you can identify the programs with the highest amount of VSAM activity (such as number of EXCPs, retrievals, inserts, deletes, CI and CA splits, insert strategy), analyse the effectiveness of buffer usage, and determine whether the dataset is being used concurrently by other jobs or tasks. To determine candidates for SMB, we have used SMF type 64 records to obtain information about the SMB candidate's processing characteristics, including jobname, cluster/ component name, change in number of EXCPs, and ACB MACRF fields. In addition, SMF type 64 records indicate whether a reduced or minimum amount of resource is being used for a data pool and whether DW is used. Bits 5–7 of SMF64RSC, which were previously reserved, are used to give more information about Direct Optimization (DO).

A detailed description of the layout of the SMF type 64 record

can be obtained from the *MVS System Management Facilities (SMF)* (SA22-7630) manual. One can also find the type 64 subtype descriptions in macro IDASMF64 in SYS1.MACLIB.

CODE

Based on record descriptions obtained from the above mentioned manual, a sample SMB report writer was written. The code is a two-part stream. In the first part (COPYSMF) selected SMF records (selection being defined by INCLUDE's condition) are copied from the SMF dataset to a file that can be used as a base of archived records. In the second part, SMB64, the captured records are formatted by invoking SMB EXEC and two reports are produced.

Each report consists of two sets of variables. The first set is a fixed one consisting of the variables that uniquely identify the VSAM file or job being monitored. This set is meant to be used across all reports. The pool of variables in this set contains generated observation number, job name, date stamp, dataset allocation elapsed time, cluster/component name, total number of records, number of records retrieved in a job run, and number of EXCPs. The second set of printed variables is area specific and pertains only to the VSAM file performance domain being monitored. Note should be taken of the fact that elapsed time in these reports is not the execution clock time (wall time) that we are accustomed to thinking of. This 'elapsed' time in fact represents the length of time the file was kept open (for details see APAR OW43854).

The first report shows standard VSAM file attributes and processing activity as well as the type of access to the record – key, rba (relative byte addresses) or cnv(access the dataset by control interval), dataset addressability, and format. As already stated, there are some restrictions when considering the use of SMB. This report shows whether there are any restrictions – user buffering, ICI processing, alternate index, NSR required, and/or if extended format is required.

The second report is a VSAM file buffer management report and it provides buffering-related information such as number of buffers used per component (system determined or user defined), buffer space, addressing mode for buffers (24/31 mode), as well as whether or not the buffers have been fixed in real storage. The more interesting part of the report provides answers to questions like: Is there any method to find out whether SMB gets invoked at all? Wouldn't it be nice not only to know that SMB is invoked but also how much (and what) it does to the job (or datasets). This report provides the answer to these two questions by means of SMB-related information. Was SMB invoked at all? (no, yes: by JCL or SYSTEM); which optimization technique was used? (DO, DW, SO, SW, or none); and in conjunction with that, what data reference pattern was used: sequential access (records were requested in either ascending or descending sequence), direct access (records were randomly requested), skip sequential (records were processed in sequence but some records may have been skipped), or a combination of these? In the case of the Direct Optimized (DO) technique, additional indicators are available, such as the amount of virtual storage set by the SMBVSP parameter, whether hiperspace buffers were used, whether insufficient virtual storage problems occurred, indicators of whether a reduced or minimum amount of resource is being used for a data pool, and whether DW is used (the case of retry technique).

SMBJOB

```
//DEL       EXEC PGM=IDCAMS
//SYSPRINT  DD SYSOUT=X
//SYSIN     DD *
    DELETE hlq.SMF64.DATA
    SET MAXCC=Ø
/*
//COPYSMF   EXEC PGM=ICETOOL
//TOOLMSG   DD SYSOUT=*
//DFSMSG    DD SYSOUT=*
//RAWSMF    DD DSN=your.smf.dataset,DISP=SHR
//SMF64     DD DSN=hlq.SMF64.DATA,
//          SPACE=(CYL,(x,y)),UNIT=SYSDA,
```

```
//         DISP=(NEW,CATLG,KEEP),
//         DCB=(RECFM=VB,LRECL=32756,BLKSIZE=3276Ø)
//TOOLIN   DD *
  COPY FROM(RAWSMF) TO(SMF64) USING(SMFI)
//SMFICNTL DD *
  OPTION SPANINC=RC4,VLSHRT
  INCLUDE COND=(6,1,BI,EQ,64,AND,43,1,BI,NE,X'2Ø') * copy SMF 64
/*
//SMB64    EXEC PGM=IKJEFT01,REGION=ØM
//SYSEXEC  DD DISP=SHR,DSN=your.rexx.library
//SMF64    DD DISP=SHR,DSN=hlq.SMF64.DATA
//SYSPRINT DD SYSOUT=*
//SYSTSPRT DD SYSOUT=*
//SYSTSIN  DD *
prof nopref
%SMB
/*
```

SMB EXEC

```
/* REXX EXEC to read SMF 64 records - VSAM Component/Cluster Status  */
signal ON ERROR
/*-------------------------------------------------------------------*/
/* Part 1: Handle file allocation & dataset existence and            */
/*         print report header and labels                            */
/*-------------------------------------------------------------------*/
Address TSO
  userid=SYSVAR(SYSUID)
  r64fa  =userid||'.r64fa.rep'          /* File processing/attribute*/
  r64bf  =userid||'.r64bf.rep'          /* Buffering report         */
x = MSG('OFF')
IF SYSDSN(r64fa) = 'OK'
THEN "DELETE "r64fa" PURGE"
IF SYSDSN(r64bf) = 'OK'
THEN "DELETE "r64bf" PURGE"
"ALLOC FILE(S64FA) DA("R64FA")",
   " UNIT(SYSALLDA) NEW TRACKS SPACE(9Ø,3Ø) CATALOG",
   " REUSE RELEASE LRECL(245) RECFM(F B)"
"ALLOC FILE(S64BF) DA("R64BF")",
   " UNIT(SYSALLDA) NEW TRACKS SPACE(9Ø,3Ø) CATALOG",
   " REUSE RELEASE LRECL(2Ø5) RECFM(F B)"
 fi.1  =left(' ',8,' '),
        ||'VSAM file processing & attribute report'||left(' ',15,' ')
 fi.2  ='  '
 fi.3  =left(' ',8,' ')||'Report produced on',
        ||left(' ',1,' ')||left(date(),11),
        ||left(' ',1,' ')||left('at ',3,' ')||left(time(),1Ø)
 fi.4 = '  '
 fi.5 = left(' ',83,' ')||left('# of',4)||left(' ',2,' '),
```

```
        ||left('Records in this run:',2Ø)||left(' ',1Ø,' '),
        ||left('Access by:',1Ø)||left(' ',16,' ')||left('CI',2),
        ||left(' ',5,' ')||left('Index',5),
        ||left(' ',6,' ')||left('-- Split -- Insert',2Ø),
        ||left(' ',8,' ')||left('Data set:',9),
        ||left(' ',9,' ')||left('Res.',4)
 fi.6 = left('obs',3) right('Job name',8) left('Run date',11),
        left('Elapsed time',14) left('Cluster/Component name',3Ø),
        right('Excp',6)        right('Records',9) right("ret'ved",8),
        left('delete  insert update',21)          right('Key',3),
        right('Rba',3)         right('Cnv',3)     right('ICI',3),
        left('Recl',4)         right('kl',3)      right('size',4),
        right('level',8)       right('CI',7)      right('CA',9),
        center('strategy',8)   right('ext.',5),
        left('Address.',8)     left('Format',8)   left('sharing',7),
        left('Restriction',12)
 fi.7 = left('-',242,'-')
     "EXECIO * DISKW s64fa (STEM fi.)"
 bf.1  =left(' ',8,' '),
        ||'VSAM file buffers & buffering management'||left(' ',15,' ')
 bf.2  ='  '
 bf.3  =left(' ',8,' ')||'Report produced on',
        ||left(' ',1,' ')||left(date(),11),
        ||left(' ',1,' ')||left('at ',3,' ')||left(time(),1Ø)
 bf.4 = left(' ',76,' ')||left('# of  Records',13),
        ||left(' ',8,' ')||left('Access:',8)||left(' ',8,' '),
        ||left('Buffers:',8)||left(' ',3Ø,' ')||left('RS',2),
        ||left(' ',5,' ')||left("Direct Optimized (DO) SMB parms:",32)
 bf.5 = left('obs',3) right('Job name',8) left('Run date',11),
        left('Elapsed time',14) left('Cluster/Component name',3Ø),
        right('Records',9)      right("ret'ved",8),
        right('Excp',6)         left('mode',4),
        left('bias',4)          left('SMB',5),
        left('used  user  space  data index',31),
        left('bit fixed',1Ø)    right('vsp',5),
        right('hwt',5)          right('b31',5),
        right('cb31',5)         right('ivs',5),
        right('rer',5)          right('mer',5) right('hyp',5)
 bf.6 = left('-',2Ø5,'-')
     "EXECIO * DISKW s64bf (STEM bf.)"
/*-----------------------------------------------------------------*/
/* Part 2: read and decode SMF 64 records                          */
/*-----------------------------------------------------------------*/
'EXECIO * DISKR SMF64 ( STEM x. FINIS'
numeric digits 1Ø
do i = 1   to x.Ø
/*-----------------------------------------------------------------*/
/* Header/Self-defining Section                                    */
/*-----------------------------------------------------------------*/
   rty = c2d(substr(x.i,2,1))
```

```
   if rty <> '40'x then do                    /* record type         */
   smfdate = substr(c2x(substr(x.i,7,4)),3,5) /* unpack smf date     */
   smftime = smf(c2d(substr(x.i,3,4)))        /* decode smf time     */
   term= c2d(substr(x.i,3,4))                 /* termination time    */
   jbn = substr(x.i,15,8)                     /* jobname             */
   rst = smf(c2d(substr(x.i,23,4)))           /* decode rst time     */
   init= c2d(substr(x.i,23,4))                /* initiate time       */
   rsd = substr(c2x(substr(x.i,27,4)),3,5)    /* unpack rsd date     */
/*--------------------------------------------------------------------*/
/* Situation indicator                                                */
/*--------------------------------------------------------------------*/
   rin = x2b(c2x(substr(x.i,39,1)))
    z1 =  substr(rin,1,1)
    z2 =  substr(rin,2,1)
    z3 =  substr(rin,3,1)
    z4 =  substr(rin,4,1)
    z5 =  substr(rin,5,1)
    z6 =  substr(rin,6,1)
    z7 =  substr(rin,7,1)
    if  z1 =1 & z6 =1 then sit='Close on Abend  '
    else if z1 =1     then sit='Component closed'
    else if z2 =1     then sit='Vol switched    '
    else if z3 =1     then sit='No space avail  '
    else if z4 =1     then sit='Cat or CRA rec  '
    else if z5 =1     then sit='Closed type=t   '
    else if z6 =1     then sit='Abend process   '
    else if z7 =1     then sit='Close VVDS or ICF'
    else                   sit='logic error'
/*--------------------------------------------------------------------*/
/* Indicator of component being processed                             */
/*--------------------------------------------------------------------*/
   dty = x2b(c2x(substr(x.i,40,1)))          /* dataset attributes  */
    w1 =  substr(dty,1,1)                    /* component type      */
    w2 =  substr(dty,2,1)                    /* component type      */
    w3 =  substr(dty,3,1)                    /* file format         */
    w4 =  substr(dty,4,1)                    /* file compession     */
    w5 =  substr(dty,5,1)                    /* rls                 */
    w6 =  substr(dty,6,1)                    /* rls : mmf           */
    w7 =  substr(dty,7,1)                    /* file addressibility */
  select
   when w1 =1 then comp = 'Data'
   when w2 =1 then comp = 'Index'
  end
  select
   when w3 =1 then form = 'Extended format'
   otherwise       form = 'Standard format'
  end
  select
   when w4 =1 then com  = 'Compressed   '
   otherwise       com  = 'Non compressed'
```

```
  end
  select
   when w5 =1 then rls  = 'RLS in effect             '
   when w6 =1 then rls  = 'RLS in effect MMF disabled'
   otherwise       rls  = 'Non rls       '
  end
  select
   when w7 =1 then addr = 'Extended addressable ds'
   otherwise       addr = 'Standard addressibility'
  end
   dnm = strip(substr(x.i,85,44))           /* dataset name         */
   hlq = substr(dnm,1,3)                    /* ds hlq construct     */
   hlqt= substr(dnm,1,11)                   /* test  ds hlq         */
   chr = c2d(substr(x.i,131,4))             /* current high rba/ci  */
   esl = c2d(substr(x.i,135,2))             /* extent segment length*/
   #extents = esl / 26                      /* no. of extents       */
   offset = 135 + 2 + esl
   sln = c2d(substr(x.i,offset,4))          /*  stat.segment length */
/*-------------------------------------------------------------------*/
/*  Selection filtering by: dsn or job name (sample)                 */
/*-------------------------------------------------------------------*/
/*  IF (hlq ¬= "SYS") & (hlq ¬= "DFH") & (hlq ¬= "BET") & ,
   (hlq ¬= "QMF") & (hlq ¬= "CIC") & ,
   (hlq ¬= "CAT") & (hlq ¬= "BK.") & ,
   (jbn ¬= "CICSPROD") &  (jbn ¬= "CICSTEST") & ,
   (jbn ¬= "CICSDEV")  &  (comp = 'Data')                           */
/*-------------------------------------------------------------------*/
/* Figure 1 selection filters used: dsn, job name, close status     */
/*-------------------------------------------------------------------*/
   IF hlqt="PROD.HISTFI" &  jbn = "MYJOB   "  & (z1 =1)
Then do
select ;
 when sln > 28Ø
           then do ;
/*-------------------------------------------------------------------*/
/*  Statistics Section at OPEN Time                                  */
/*-------------------------------------------------------------------*/
     nil = c2d(substr(x.i,offset+4,4))    /* # of index levels       */
     nex = c2d(substr(x.i,offset+8,4))    /* # of extents            */
     nlr = c2d(substr(x.i,offset+12,4))   /* # of records            */
     nde = c2d(substr(x.i,offset+16,4))   /* # of deletes            */
     nin = c2d(substr(x.i,offset+2Ø,4))   /* # of inserts            */
     nup = c2d(substr(x.i,offset+24,4))   /* # of updates            */
     nre = c2d(substr(x.i,offset+28,4))   /* # of retrieves          */
     ncs = c2d(substr(x.i,offset+36,4))   /* # of ci splits          */
     nas = c2d(substr(x.i,offset+4Ø,4))   /* # of ca splits          */
     nep = c2d(substr(x.i,offset+44,4))   /* # of excp count         */
/*-------------------------------------------------------------------*/
/* Change in Statistics from OPEN to time of EOV and CLOSE          */
/*-------------------------------------------------------------------*/
```

```
     dil = c2d(substr(x.i,offset+48,4))   /* # of index levels chg.  */
     dex = c2d(substr(x.i,offset+52,4))   /* # of extents chg.       */
     drl = c2d(substr(x.i,offset+56,4))   /* # of records chg.       */
     dde = c2d(substr(x.i,offset+60,4))   /* # of deleted chg.       */
     din = c2d(substr(x.i,offset+64,4))   /* # of insert  chg.       */
     dup = c2d(substr(x.i,offset+68,4))   /* # of update  chg.       */
     dre = c2d(substr(x.i,offset+72,4))   /* # of retrieve chg.      */
     dcs = c2d(substr(x.i,offset+80,4))   /* # of ci splits chg.     */
     das = c2d(substr(x.i,offset+84,4))   /* # of ca splits chg.     */
     dep = c2d(substr(x.i,offset+88,4))   /* # of excp chg.          */
/*-----------------------------------------------------------------*/
/*  Dataset Characteristics Section                                */
/*-----------------------------------------------------------------*/
     dbs = c2d(substr(x.i,offset+92,4))   /* physical blocksize      */
     dci = c2d(substr(x.i,offset+96,4))   /* control interval size   */
     dls = c2d(substr(x.i,offset+100,4))  /* max. logical rec length */
     dkl = c2d(substr(x.i,offset+104,2))  /* key length              */
     ddn = substr(x.i,offset+106,8)       /* dd name                 */
     str = c2d(substr(x.i,offset+114,1))  /* string number           */
     plh = c2d(substr(x.i,offset+168,2))  /* # of concurrent strings */
     bno = c2d(substr(x.i,offset+115,1))  /* # of buffers requested  */
     bsp = c2d(substr(x.i,offset+116,4))  /* buffer space            */
     bfd = c2d(substr(x.i,offset+120,2))  /* data buffers            */
     bfi = c2d(substr(x.i,offset+122,2))  /* index buffers           */
/*-----------------------------------------------------------------*/
/* First ACB MACRF flag byte                                       */
/*-----------------------------------------------------------------*/
mc1 = x2b(c2x(substr(x.i,offset+170,1)))
  acbkey =  substr(mc1,1,1)    /* access data via index? key_access  */
  acbadr =  substr(mc1,2,1)    /* access without index?' rba_access  */
  acbcnv =  substr(mc1,3,1)    /* control interval processing?       */
  acbseq =  substr(mc1,4,1)    /* sequential processing?             */
  acbdir =  substr(mc1,5,1)    /* direct processing?                 */
  acbin  =  substr(mc1,6,1)    /* input/get/read ?                   */
  acbout =  substr(mc1,7,1)    /* output/put/write ?                 */
  acbubf =  substr(mc1,8,1)    /* user buffers?                      */
if (acbout= 1)  & (acbin= 1)   then open='inout '
   else if acbout= 1           then open='output'
   else                        open='input '
/*-----------------------------------------------------------------*/
/* Second ACB MACRF flag byte                                       */
/*-----------------------------------------------------------------*/
mc2 = x2b(c2x(substr(x.i,offset+171,1)))
  acbskp  = substr(mc2,4,1)           /* skip sequential processing */
  acblogon= substr(mc2,5,1)           /* logon indicator            */
  acbrst  = substr(mc2,6,1)           /* dataset to empty state     */
  acbdsn  = substr(mc2,7,1)           /* shared_control_blocks'     */
  acbaix  = substr(mc2,8,1)           /* path_aix                   */
if (acbdir= 1)  & (acbseq= 1)  then mode='mix'
   else if acbdir= 1           then mode='dir'
```

```
   else if acbskp= 1           then mode='skp'
   else                        mode='seq'
/*-----------------------------------------------------------------*/
/* Third ACB MACRF flag byte                                       */
/*-----------------------------------------------------------------*/
mc3 = x2b(c2x(substr(x.i,offset+172,1)))
  acblsr  = substr(mc3,2,1)           /* local shared resource      */
  acbgsr  = substr(mc3,3,1)           /* global shared resource     */
  acbici  = substr(mc3,4,1)           /* improved ci processing     */
  acbdfr  = substr(mc3,5,1)           /* deferred write             */
  acbsis  = substr(mc3,6,1)           /* sequential insert strategy */
  acbncfx = substr(mc3,7,1)           /* fixed_control_blocks       */
  acbmode = substr(mc3,8,1)           /* vsam 31 bit addressing     */
select
  when acblsr = 1 then shr='lsr'
  when acbgsr = 1 then shr='gsr'
  otherwise            shr='nsr'
end
select
  when acbncfx= 1 then fix='yes'         /* cont. blocks & buffers   */
  otherwise            fix='no '         /* fixed in real storage    */
end
select
 when acbmode = 1 then bufa='31'         /*   buffer addressing mode */
  otherwise            bufa='24'
end
select
 when ACBSIS = '1' then ins='SIS'        /* insert strategy used     */
  otherwise             ins='nis'
end
/*-----------------------------------------------------------------*/
/* Fourth ACB MACRF flag byte                                      */
/*-----------------------------------------------------------------*/
mc4 = x2b(c2x(substr(x.i,offset+173,1)))
  acbrls  = substr(mc4,1,1)           /*  rls processing            */
  acbsnp  = substr(mc4,2,1)           /*  snp option                */
  mc43    = substr(mc4,3,1)           /*  reserved                  */
  mc44    = substr(mc4,4,1)           /*  reserved                  */
  mc45    = SUBSTR(mc4,5,1)           /*  reserved                  */
  mc46    = SUBSTR(mc4,6,1)           /*  reserved                  */
  mc47    = SUBSTR(mc4,7,1)           /*  reserved                  */
  mc48    = SUBSTR(mc4,8,1)           /*  reserved                  */
/*-----------------------------------------------------------------*/
/* SMB Restrictions                                                */
/* MACRF parameters not supported are:                             */
/* UBF(USER buffering), ICI(Improved Control Interval processing),   */
/* GSR(Global Shared Resources), LSR(Local Shared Resources),      */
/* RLS(Record Level Sharing), AIX(Alternate Index)- pre z/OS 1.3 rel.*/
/* non-extended format VSAM files.                                 */
/*-----------------------------------------------------------------*/
```

```
  if acbubf = 1            then note='USER buffering'
     else if  acbici = 1   then note='ICI processing'
     else if  acbaix = 1   then note='Alternate Index'
     else if shr ¬= 'nsr'  then note='NSR required'
     else if acbrls =1     then note='RLS processing'
     else if w3 =Ø         then note='Extended format required'
     else                  note='none'
/*-------------------------------------------------------------------*/
/* SMB ACCESS BIAS Information                                       */
/*-------------------------------------------------------------------*/
smb = x2b(c2x(substr(x.i,offset+174,1)))
  s1 = substr(smb,1,1)                          /* accbias via jcl*/
  s2 = substr(smb,2,1)                          /* accbias via smb*/
  s3 = substr(smb,3,1)                          /* bias=do used   */
  s4 = substr(smb,4,1)                          /* bias=so used   */
  s5 = substr(smb,5,1)                          /* bias=sw used   */
  s6 = substr(smb,6,1)                          /* bias=dw used   */
  s7 = substr(smb,7,1)                          /* bias=co used   */
  s8 = substr(smb,8,1)                          /* bias=cr used   */
/*-------------------------------------------------------------------*/
/* The way of SMB invocation  ?                                      */
/*-------------------------------------------------------------------*/
select
  when s1 ='1' then smb='jcl'
  when s2 ='1' then smb='sys'
  otherwise         smb='none'
end
/*-------------------------------------------------------------------*/
/* Kind of SMB optimization technique used ?                         */
/*-------------------------------------------------------------------*/
select
  when s3 ='1' then bia='do'
  when s4 ='1' then bia='so'
  when s5 ='1' then bia='sw'
  when s6 ='1' then bia='dw'
  when s7 ='1' then bia='co'
  when s8 ='1' then bia='cr'
  otherwise         bia='none'
end
/*-------------------------------------------------------------------*/
/* SMB DO Information                                                */
/*-------------------------------------------------------------------*/
rsc = x2b(c2x(substr(x.i,offset+175,1)))
 vsp = substr(rsc,1,1)                    /* do with smbvsp         */
 hwt = substr(rsc,2,1)                    /* do with smbhwt         */
 b31 = substr(rsc,3,1)                    /* remode31=buff used     */
 cb31= substr(rsc,4,1)                    /* rmode31=cb used        */
 ivs = substr(rsc,5,1)                    /* do: insufficient vs    */
 rer = substr(rsc,6,1)                    /* do: reduced resource   */
 mer = substr(rsc,7,1)                    /* do: minimum resource   */
```

```
 hyp = substr(rsc,8,1)           /* do:some or all hyperspace buffers*/
 if comp="Index"  then buf  =bfi
   else if compont="Data" then buf  =bfd
  elapstm = smf(term-init)
/*-------------------------------------------------------------------*/
/* File processing & attribute report                                */
/*-------------------------------------------------------------------*/
fa=right(i,3,'Ø')    right(jbn,8)    right(date('n',rsd,'j'),11),
   left(elapstm,14)  left(dnm,3Ø)    right(DEP,6),
   right(nlr,9)      right(dre,8)    right(dde,6),
   right(din,6)      right(dup,6)    right(acbkey,3),
   right(acbadr,3)   right(acbcnv,3) right(acbici,3),
   right(dls,5)      right(dkl,3)    right(DCI,5),
   right((nil + dil),4),           /* index levels at the end of run */
   right((ncs + dcs),1Ø),          /* ci splits at the end of run    */
   right((nas + das),1Ø),          /* ca splits at the end of run    */
   right(ins,5),
   right((nex + dex),5),           /* extents at the end of run      */
   left(' ',1' ')    left(addr,8)    left(form,8)   right(shr,4),
   left(' ',2' ')    left(note,24)
 PUSH fa
   "EXECIO 1 DISKW s64fa"
/*-------------------------------------------------------------------*/
/* File buffers & & buffering management report                      */
/*-------------------------------------------------------------------*/
bff= right(i,3,'Ø')   right(jbn,8)    right(date('n',rsd,'j'),11),
     left(elapstm,14) left(dnm,3Ø)    right(nlr,9),
     right(dre,8)     right(dep,6)    right(mode,4),
     left(bia,4)      left(smb,4),
     right(bno,5)     right(acbubf,5) right(bsp,6),
     right(bfd,5)     right(bfi,5)    right(bufa,5),
     right(fix,5)     right(vsp,5)    right(hwt,5),
     right(b31,5)     right(cb31,5)   right(ivs,5),
     right(rer,5)     right(mer,5)    right(hyp,5)
 PUSH bff
   "EXECIO 1 DISKW s64bf"
        end
    otherwise do ;
    say 'REXX program logic in error !'
    exit
       end
      end
     end
    end
  end
drop x.
/* Close & free all allocated files  */
 "EXECIO Ø DISKW s64fa(FINIS "
 "EXECIO Ø DISKW s64bf(FINIS "
 say
```

```
 say 'VSAM file processing & attribute report dsn ...:'r64fa
 say 'VSAM file buffers & buffering management dsn ..:'r64bf
 say
 "free FILE(SMF64 s64fa s64bf)"
exit
/*-------------------------------------------------------------------*/
/* Error exit routine                                                */
/*-------------------------------------------------------------------*/
ERROR: say 'The following command produced non-zero RC =' RC
       say SOURCELINE(SIGL)
       exit
SMF: procedure
/* REXX - convert an SMF time to hh:mm:ss:hd format   */
arg time
    time1    = time % 100
    hh       = time1 % 3600
    hh       = RIGHT("0"||hh,2)
    mm       = (time1 % 60) - (hh * 60)
    mm       = RIGHT("0"||mm,2)
    ss       = time1 - (hh * 3600) - (mm * 60)
    ss       = RIGHT("0"||ss,2)
    fr       = time //  1000
    fr       = RIGHT("0"||fr,2)
    rtime  = hh||":"||mm||":"||ss||":"||fr
    return rtime
```

CONCLUSION

It is true that SMB may not be the answer to all application program buffering requirements. Its main purpose is to provide a system capability for improving performance buffering options for batch application processing beyond those provided by the standard defaults. However, if you haven't implemented System Managed Buffering yet, the recommendations in this article can be applied to any VSAM file type, and the performance improvements for batch processing will be remarkable. If your datasets are currently in EXTENDED format, or will be converted to EXTENDED in the near future, you should be able to implement System Managed Buffering, and you will be able to achieve even better performance than is available with NSR buffering. As in all other cases, one shouldn't make significant changes in a production dataset's allocation unless they have been thoroughly tested.

REFERENCES

z/OS DFSMS: Using Data Sets (SC26-7410)

z/OS V1R3: DFSMS Technical Guide (SG24-6569-00)

VSAM Demystified (September 2003 edition) (SG24-6105)

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JCL tips – part 2

In this article I will concentrate on how we use datasets in our jobs and show which are the useful JCL statements and the parameters and/or options we can use to make our lives easier. Therefore, I will give some general tips for datasets, as well as tips for datasets that reside on tape, and special ones such as Generation Data Group (GDG) datasets.

DD STATEMENTS IN GENERAL

Often we just want to test our jobs without actually processing any data. Sometimes we want to test different scenarios, like what will happen if some of our input files are empty. For that we can use dummy files.

A file can be assigned dummy status by coding either DUMMY as the first parameter in the DD statement or by changing the real DSN to DSN=NULLFILE. Personally, I prefer the first choice, because then I keep the real DSN value in the JCL. After testing, I just need to delete all occurrences of the word 'dummy'.

Here are some situations where one can use a dummy file.

A dummy file is always accepted from the JCL as an empty file, so to test the program flow to see whether it recognizes empty files, we can use something like this:

```
//RUNJCL   JOB (ACCOUNT),CLASS=B,MSGCLASS=Z,NOTIFY=&SYSUID
//*
//STEP1    EXEC PGM=PROG1
//INPFILE1 DD DSN=APPLID.INPFILE1.TST,DISP=SHR
//INPFILE2 DD DUMMY,DSN=APPLID.INPFILE2.TST,DISP=SHR
//OUTFILE1 DD DSN=APPLID.OUTFILE1.TST,DISP=(NEW,CATLG),
//            SPACE=(CYL,(10,5),RLSE),
//            DCB=(LRECL=80,RECFM=FB,BLKSIZE=0)
//REPORT   DD SYSPRINT=A
//SYSPRINT DD SYSPRINT=*
//*
```

By coding DUMMY for INPFILE2, that file becomes empty.

In another situation, you could have several files concatenated in one logical file for your program. You might want to test your program with just some of them. Using DUMMY status you can do something like this:

```
//RUNJCL   JOB (ACCOUNT),CLASS=B,MSGCLASS=Z,NOTIFY=&SYSUID
//*
//STEP1    EXEC PGM=PROG1
//INPFILE1 DD DSN=APPLID.INPFILE1.TST,DISP=SHR
//         DD DSN=APPLID.INPFILE2.TST,DISP=SHR
//         DD DUMMY,DSN=APPLID.INPFILE3.TST,DISP=SHR
//         DD DSN=APPLID.INPFILE4.TST,DISP=SHR
//         DD DSN=APPLID.INPFILE5.TST,DISP=SHR
//OUTFILE1 DD DSN=APPLID.OUTFILE1.TST,DISP=(NEW,CATLG),
//            SPACE=(CYL,(10,5),RLSE),
//            DCB=(LRECL=80,RECFM=FB,BLKSIZE=0)
//REPORT   DD SYSPRINT=A
//SYSPRINT DD SYSPRINT=*
//*
```

By coding the third file as a DUMMY file, you not only make that file empty but also create EOF status for INPFILE1, so file 4 and file 5 will not be processed.

So, note that putting DUMMY for a file will not only cause that file to be skipped, as perhaps you expected, but will also terminate the set of files being read in.

DUMMY files can also be used for output files as well as for input files, although the usage is a little different.

Let's say that while we are testing we do not want to save some of the output files, or if our report is too long, and we already

know the content, we do not want to save it; here is what we do:

```
//RUNJCL   JOB (ACCOUNT),CLASS=B,MSGCLASS=Z,NOTIFY=&SYSUID
//*
//STEP1    EXEC PGM=PROG1
//INPFILE1 DD DSN=APPLID.INPFILE1.TST,DISP=SHR
//INPFILE2 DD DSN=APPLID.INPFILE2.TST,DISP=SHR
//OUTFILE1 DD DUMMY,DSN=APPLID.OUTFILE1.TST,
//            DISP=(NEW,CATLG),
//            SPACE=(CYL,(10,5),RLSE),
//            DCB=(LRECL=80,RECFM=FB,BLKSIZE=0)
//REPORT   DD DUMMY,SYSPRINT=A
//SYSPRINT DD SYSPRINT=*
//*
```

Any output produced for REPORT or OUTFILE1 is suppressed. It means that no file is created and device and space allocations are ignored.

DISP PARAMETER MOD STATUS FOR FILES

We all know that by using the MOD value for the status of a file we can add new records to an existing file. Personally, I do not like to use MOD in that way because improper usage can be very difficult to resolve. For instance, the order in which jobs are run is very important, and you must be very careful that new cycles always start with the job that created the file. But there are some situations where I find MOD status very useful.

Let's say that you have a job with file dependency – your job cannot start if some files are not defined on the system. In other words, you expect some file to come before your job can proceed. It can be from some other application. If that file never comes, your batch stream is stopped; it cannot continue.

Even if your job is time triggered – meaning it must start at some specific time – without checking on the existence of the file, the job itself will abend if the file is not there when the job starts.

We can overcome this problem. Prior to your job, you can have a step using IEFBR14 and a list of the files you expect – something like the following:

```
//RUNJCL   JOB (ACCOUNT),CLASS=B,MSGCLASS=Z,NOTIFY=&SYSUID
```

```
//*
//STEP1    EXEC PGM=IEFBR14
//DEPFILE1 DD DSN=APPLID.DEPFILE1.TST, DISP=(MOD,CATLG),
//            SPACE=(CYL,(10,5),RLSE),
//            DCB=(LRECL=80,RECFM=FB,BLKSIZE=0)
//DEPFILE2 DD DSN=APPLID.DEPFILE2.TST,DISP=(MOD,CATLG),
//            SPACE=(CYL,(10,5),RLSE),
//            DCB=(LRECL=80,RECFM=FB,BLKSIZE=0)
//*
//STEP2    EXEC PGM=PROG1
//DEPFILE1 DD DSN=APPLID.DEPFILE1.TST,DISP=SHR
//DEPFILE2 DD DSN=APPLID.DEPFILE2.TST,DISP=SHR
//INPFILE1 DD DSN=APPLID.INPFILE1.TST,DISP=SHR
//INPFILE2 DD DSN=APPLID.INPFILE2.TST,DISP=SHR
//OUTFILE1 DD DUMMY,DSN=APPLID.OUTFILE1.TST,DISP=(NEW,CATLG),
//            SPACE=(CYL,(10,5),RLSE),
//            DCB=(LRECL=80,RECFM=FB,BLKSIZE=0)
//REPORT   DD DUMMY,SYSPRINT=A
//SYSPRINT DD SYSPRINT=*
//*
```

Your job will first check whether the expected files are defined. If yes, then nothing happens, but if the files are not defined then using DISP=(MOD,CATLG) will create empty files, so subsequent steps will run correctly.

This is specially important if we process data in cycles based, for example, on dates. If we miss some of the dates this causes problems for other jobs too (eg report jobs that assume all files already exist).

TAPES

There are several reasons to use tapes instead of disks as data storage media. Let's list some of them:

1 Data is coming from outside of your data centre and it is the only possible way for your customers to supply you with data.

2 Your application produces output files that you need to keep from every cycle for some time and you have limited disk space.

3 Files you create are very big, so it is much better to keep

them on tape than on disks, since you do not have enough disk space.

4 Security reasons can also be very important. Maybe your data must be protected, and one way to keep it safe is to keep it out of the system.

There are some others, I am sure, but let's stop here. To use tapes as your storage medium you must be familiar with some of the parameters that JCL uses.

Number of tapes for output file

If you have an output file and you do not know how big it will be, you can find that your job returns unexpected results and you will be wondering why. Well, the most likely reason is that your output file spreads over more than the default value of five tapes. If you already know that you have a file that needs more than five tapes, or you think that it is possible, you need to use the volume-count subparameter in the VOLUME parameter of the DD statement.

Code a volume count when a new dataset will reside on six or more volumes. If you omit the volume count or if you specify 1 to 5, the system allows up to five volumes; if you specify 6 to 20, the system allows 20 volumes; if you specify a count greater than 20, the system allows 5 plus a multiple of 15 volumes. Here is an example:

```
//OUTFILE  DD DSNAME=APPL.OUTFILE.TST,DISP=(NEW,CATLG,KEEP),
//            UNIT=TAPE,VOLUME=(,,,6,SER=(11111,22222))
```

The DD statement defines a new file, which will reside on two tapes, serial numbers 11111 and 22222. The VOLUME volume-count subparameter requests six volumes, if required. Thus, if more space is required, the system can assign a third and fourth volume. Without the volume-count value, the system will stop allocating new tapes after finishing with tape 5.

De-allocating files from a job

Once we submit our job, the first thing to be done by the system

is to allocate all the required resources (files, devices, programs, etc). All of these resources have a status of 'in use' until the end of the job. Some of them are shareable, some of them are not. Files that reside on tapes cannot be shareable. So it can be very important to make these files available as soon as possible. As an example, if there are several steps in the job and our file on tape is used in just the first one, it is not available to other jobs until the currently-running job ends.

In addition, if we have several files on tapes in our job, there can be a problem with the number of tape drives available to the others. As soon as we de-allocate a tape drive, it is available to the other jobs.

De-allocating can be done using the FREE parameter of the DD statement. By coding FREE=CLOSE, once the file has been used and closed, the system will dynamically de-allocate the dataset.

```
//TAPE1  DD DSNAME=APPL.TAPE1.TST,DISP=OLD,FREE=CLOSE,
//          UNIT=TAPE
```

In this example, the FREE=CLOSE parameter makes JES de-allocate the dataset, de-queue it, and make it available to other jobs as soon as it is closed.

This can be especially useful if the same file is used in an on-line environment like CICS or IMS.

Allocating the same tape drives to more than one file

It is not a rare situation for your application to receive data from several other applications. If input files from them are on tape and you need to process them as one file, you can append all of them into one, or you can process them all together using concatenation of files in the DD statement. If you choose the first approach you will lose both time and as many tapes as all these files occupy. Sometimes you will need as many tape drives as there are files, because the system allocates all the necessary drives at the beginning of the job. In addition, there can be other requests for drives that you have in your system and that can create a problem for all jobs, not just yours.

Well, it doesn't need to happen if you use the AFF value for the UNIT parameter. What AFF does is request the system to allocate different files residing on different removable volumes on the same device during the execution of the step. Let's see it in an example:

```
//INFILE DD DSN=APPLID.TAPE1.TST,DISP=SHR
//       DD DSN=APPLID.TAPE2.TST,DISP=SHR,UNIT=AFF=INFILE
//       DD DSN=APPLID.TAPE3.TST,DISP=SHR,UNIT=AFF=INFILE
//       DD DSN=APPLID.TAPE4.TST,DISP=SHR,UNIT=AFF=INFILE
//       DD DSN=APPLID.TAPE5.TST,DISP=SHR,UNIT=AFF=INFILE
```

All five tapes (SMS catalogued) will use the same tape drive unit as the first one, and therefore they will be mounted one at a time. Without using AFF, the system will try to allocate five units.

Mounting tapes when we need them

Mounting and de-mounting tapes from tape drives takes some time. If we want to save every single second, we can avoid mounting the tape before we know we need it in our program. So if we know that the logic in our program needs data from tape, but in very specific and rare situations, we should have something like the example below. It will save time for us and tape drives for other jobs.

To delay a tape mount, there is another value for the UNIT parameter. It is DEFER. It asks the system to assign the dataset to a device(s), but it requests that the volume(s) not be mounted until the dataset is opened. To defer mounting, DEFER must be specified or implied for all DD statements that reference the volume.

```
//INFILE DD DSNAME=APPL.INFILE.TST,DISP=OLD,
//          VOLUME=SER=1Ø95,UNIT=(TAPE,,DEFER)
```

This DD statement defines an existing dataset that resides on a tape volume, and requests that the system assign a tape device. Because DEFER is coded, the volume will not be mounted until the dataset is opened.

GDG files can be very useful. If we have an application that needs to keep several old versions of files, perhaps for some weekly or monthly processing, it is a good option to use GDG files. But when we use them we need to be careful how we use them. Here are some tips.

Allocating a new generation in a multiple-step job

If you have one job with several steps and during that job you allocate a new generation in your GDG you need to be careful about using that GDG in subsequent job steps. Maybe it does not looks so obvious, but the rules for using relative numbers within GDG are changed in that situation. After we allocate a new generation (by saying (+1) in that step) we need to continue to use (+1) if want to keep processing that generation. This is because it is a new generation if we look from the beginning of the job. In the same way, if we want to process the previous generation to the one just created, we need to use (0) and so on.

If a job fails after the step that creates a new generation and we want to resubmit the job, we need to change all steps after that one before we resubmit. Now (+1) must be changed to (0), (0) to (-1), and so on.

Contention

The next situation we need to think about is when we have a GDG defined in a multi-programming environment. The rule is that as long as one job wants to create a new GDG generation, no other job can use it or create any other because the system does not know what is the current generation. The system does not know the result of the already-running job – will it fail, will it delete the last generation, or something else? – so the system cannot establish which would be the generation to use in some other job.

The solution is to use absolute generation and version numbers, but by doing that we lose all the benefits of GDG files.

The other solution, if files are not too big and if the design allows it, is to copy the last generation to some temporary file, and then we can continue to process it and release the GDG for other jobs.

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IXFP Snapshot performance tips

In an earlier article I have provided a brief summary of gains obtained by implementing Snapshot into batch production (see *The effects of implementing Snapshot copy*, *MVS Update,* issue 183, December 2001). The main benefits of implementing Snapshot were only implicitly noted – Snapshot saves time (by replacing traditional dump and image copy techniques, and cutting hours from your back-up window), saves money (savings in media, CPU, and channel resources), improves business productivity (better application availability, disaster protection), as well as improving quality (more thorough applications testing by allowing you to re-engineer your test processes to achieve greater efficiency and reduce costs).

To get the most out of Snapshot as quickly as possible, I would recommend that a planning session be held in order to analyse your existing data duplication processes to identify those areas where Snapshot will deliver the greatest initial benefit. Use a team of experts from application programming, data management, job scheduling, and systems programming who know the time-critical applications, the possible timing problems with the dataset back-up procedures, the most time-consuming jobs, and whether those jobs are in the critical path of batch processing. There are a number of areas in which Snapshot is being used. Here are some of the most typical examples:

- Deferring back-ups – as all of us have noted, demands for

increased system availability mean that the back-up window is shrinking and consequently the time slot when system back-ups are performed gets shorter. Snapshot is a great tool that helps alleviate this problem by taking a point-in-time copy of all data to be backed up.

- Improving batch processing – Snapshot can be used to replace existing checkpoint processing in batch job streams. The benefit of this is twofold – the batch will run faster because the Snapshot back-ups will be extremely quick; on the other hand, if the batch job fails and backout must be performed, then the original datasets can be restored by snapping back over the original datasets.
- Application testing – when performing testing at application level Snapshot can be used to replicate an entire application within minutes. If testing destroys any data, it can quickly be recreated.
- Data warehousing – Snapshot's ability to replicate large volumes of data quickly means that data archive copies of production databases can be produced very efficiently.

The *Implementing SnapShot* (SG24-2241) Redbook provides detailed technical and operational guidance for implementing Snapshot in a variety of workloads and environments. It makes recommendations on the different ways you can implement Snapshot and positions Snapshot against current data duplication techniques and tools.

After you introduce Snapshot, you can try to identify Snapshot candidates. You may ask your IBM representative for a copy of the SNAPAID program (available on the IBM MKTTOOLS disk). This program identifies the potential benefits in terms of CPU and elapsed time savings that would accrue from replacing data copying programs with Snapshot. The program has a built-in list of standard copying programs. Other programs can be specified through input parameters. It uses SMF data as input and therefore accurately calculates the data. Parameters are used to limit the time analysed or to limit the analysis to specific jobs.

What makes Snapshot unique and not just another copying tool, such as DFDSS, is that Snapshot is a virtual data duplicator that enables you to make a copy of data by copying the logical pointers to the data. Because no data movement takes place, it is a very fast process and uses no additional disk space to make the copy.

SNAPSHOT PERFORMANCE TIPS

Indeed, Snapshot is extremely quick, as advertised. The performance relates to the number of extents being snapped, and depends very little on the number of tracks involved. If you are snapping an entire volume, it actually does take only a fraction of a second. There are a lot of factors that go into this time, such as the model/speed of the RVA, type of channels, other I/O and CPU activity, so it is difficult to quote any useful numbers. As we did a lot of testing of Snapshot performance when we were building Snapshot support for batch production job streams we realized that Snapshot performance can be improved by following IBM's recommendations. These recommendations were as follows:

1 Performance of Snapshot can be improved if an alternative SIBSTK*xx* PARMLIB member is used (as described in the *IXFP Installation for MVS* manual, Step 19) and the SET DEST and SET ECAMDEV commands are not used for Snapshot jobs only. IBM's resolution: Snapshot does not require an ECAM device. If the SET DEST command is specified, it can act as a bottleneck on allocation and slow the Snap process down.

2 When using the Snapshot product to make a copy of a dataset, the copy that results shares data in common with the original. This shared data is pointed to by both the original and the copy. It is reflected in the REPORT SPACEU under the SHARED column. When the original or the copy gets updated, less of the data is 'shared' because the new data is rewritten to another location. For VSAM or any pre-formatted dataset, the share will not decrease as we

expected because of the structure of those datasets being pre-defined at allocation time. If release is not specified in the JCL, even though we no longer have access to the data, the space it occupied is still defined as belonging to both the original and the Snap. The SHARED STORAGE column in the REPORT SPACEU is not updated unless RLSE is specified inside the SPACE parameter. The SHARED statistic may also not be correct until an INTERVAL DDSR job has released the space in some cases. Recommendation: use the RLSE parameter.

3 The performance of Snapshot jobs can be improved with the use of the STKPARMS DD card. The STKPARMS DD permits Snapshot to access modules it needs more quickly than by searching for them. Without the STKPARMS DD, Snapshot has to allocate and read SYS1.PARMLIB as part of the Snap process. With it, it is already allocated before the Snap starts. Recommendation: use the STKPARMS DD card.

4 Although it is convenient to use a standard control card for all Snap jobs by using the INDD card, it is also slower than using the SOURCE parameter. Using SOURCE and TARGET will take more effort to program, but it will reduce Snap job time. Recommendation: use the SOURCE and TARGET parameters.

5 Defect support does not handle performance issues, but IBM has noticed the following: if running concurrent Snap jobs, there is an entry in the SIBSTK00 parmlib member for command SET DEST. If this command is used, there can be a performance impact because multiple jobs attempt to update the same logging file as specified in SET DEST. Recommendation: remove the entry in SIBSTK00 for SET DEST.

COLLECTING SNAPSHOT PERFORMANCE DATA AND REPORTING

At user-defined intervals, IXFP requests performance and space utilization statistics from the RVA. This data is written as

SMF records to the host MVS system. Through the use of SAS procedures supplied with IXFP (or user-written routines) this information can be processed to produce trend analysis reports. To use XSA/Reporter, you may need additional software: SAS if you want to use SAS to produce reports or to summarize the data with XSA/Reporter; SAS/GRAPH if you want to produce graphic displays of the reported data. If you do not have SAS installed, you can use other utilities to produce reports from the collected data.

To enable SMF to collect IXFP data, you must identify the SMF record type and subtype for IXFP in the SMFPRM*xx* member of SYS1.PARMLIB. An example of an SMFPRM*xx* member, where 250 is the record type selected for IXFP data (default) , and XSA/Reporter, DDSR and space utilization are to be written, is as follows:

```
SYS(TYPE(0:104, 250))
SUBSYS(STC,TYPE(0:55, 08:104, 250))
SUBPARM(IXFP(250, 2, 5, 7,8))
```

The IXFP SMF record can contain eight different subtypes, depending on the event that took place in the RVA subsystem. IXFP Version 2 introduces a new IXFP SMF record subtype 8 and an updated record subtype 7.

Snapshot events are recorded in the original subtype 6. With Snapshot 1.2, the Snapshot events recorded in subtype 6 are left unchanged. However, the new IXFP SMF subtype 8 record, the extended event record, is designed for VSAM dataset support. All information in SMF record subtype 6 is copied to SMF record subtype 8, and additional information is added for VSAM, new keywords, and additional extents. If you are running Snapshot for the first time you should specify only subtype 8 – there is no need to use both 6 and 8.

The subtype 8 record is a segmented SMF record. Each record consists of the SMF record header, the basic segment, and one of four segments attached to it. The four segments are:

- Cluster Definition Segment, which contains the names of

the source and target VSAM clusters, the cluster organization, and the path name.

- Data Set Name Segment, which contains the snapped dataset names, and the DSNTYPE from the catalog if the command is SNAP DATASET.
- Snapped Extents List Segment, which contains information from the Snap event, such as timing, return codes, data mover return codes, device addresses, and extents.
- DDSR Extents List Segment, which contains information about the extent.

I recommend that you start by using the subtype 8 record instead of the original subtype 6 record. To start by using the new subtype 8 record, you must update your SMPPRM*xx* member in SYS1.PARMLIB so that SMF will record subtype 8 of the IXFP SMF user record. The layout and contents of the record are documented in *IBM RAMAC SnapShot for MVS/ESA: Using SnapShot Version 1 Release 2* (SC26-7173-06).

Based on record descriptions obtained from the above mentioned manual, a sample Snapshot performance report writer was written. The code is a two-part stream. In the first part (COPYSMF), selected SMF records (selection being defined by INCLUDE's condition) are copied from an SMF dataset to a file, which can be used as a base for archived records. In the second part, RSNAP, the captured records are formatted by invoking SNAPREPT EXEC and three reports are produced.

The Snapshot summary report shows date and time of the Snapshot, jobname and user id of the Snapshot requestor, total time used to Snap (in ms), Snap completion RC, Snapshot options used (defined or defaulted), and dataset name (or VSAM component) being snapped.

The two additional reports deal with Snapshot performance of VSAM and non-VSAM files.

VSAM FILE SNAPSHOT REPORT

```
Job summary: Snap
Snap date   Snap time   Job name User ID  time   RC   SnapShot options
-------------------------------------------------------------------------
--------------
14 Dec 2003 00:24:06:34 ACCNTNPG ITOPER3  6039    0   CAT(YES)
HCPYMODE(SHR) REPL(YES)

Source cluster: ACCNT.HISTORY.CI29
Target cluster: ACCNT.HISTORY.CI29.#COPY
Source Data   : ACCNT.HISTORY.CI29.DATA
Target Data   : ACCNT.HISTORY.CI29.#COPY.DATA
Source Index  : ACCNT.HISTORY.CI29.INDEX
Target Index  : ACCNT.HISTORY.CI29.#COPY.INDEX
Extent #:  1 (Data)  Ext. Snap:1706 Source Vol: PSR4C0   Target Vol:
PSR4CD
Extent #:  2 (Data)  Ext. Snap:1374 Source Vol: PSR464   Target Vol:
PSR485
Extent #:  3 (Data)  Ext. Snap:2157 Source Vol: PSR4C4   Target Vol:
PSR469
Extent #:  4 (Data)  Ext. Snap:1087 Source Vol: PSIS58   Target Vol:
PSR488
Extent #:  5 (Data)  Ext. Snap: 733 Source Vol: PSR46B   Target Vol:
PSR4C2
Extent #:  6 (Data)  Ext. Snap: 442 Source Vol: PSR48B   Target Vol:
PSR4C5
Extent #:  7 (Data)  Ext. Snap:1853 Source Vol: PSIS61   Target Vol:
PSR48F
Extent #:  8 (Data)  Ext. Snap:   0 Source Vol: PSIS61   Target Vol:
PSR48F
Extent #:  9 (Index) Ext. Snap:1853 Source Vol: PSR481   Target Vol:
PSR4C9
Extent #: 10 (Index) Ext. Snap:   0 Source Vol: PSR481   Target Vol:
PSR4C9
```

NON-VSAM FILE SNAPSHOT REPORT

```
Job summary:                                Snap
Snap date   Snap time   Job name User ID  time   RC   SnapShot options
-------------------------------------------------------------------------
--------------
13 Dec 2003 14:01:38:31 ACCNPRPN ITOPER9   916    0   CAT(YES)
HCPYMODE(SHR) REPL(YES)

Source Dsn: ACCNT.FORREV.STAL
Target Dsn: BK.ACCNT.FORREV.STAL.T1401.DPRPD
Extent #:  1 Ext. Snap:  68 Source Vol:   PSPR61 Target Vol:   PSR444
                            Source dev.:    1201 Target dev.:    1092
```

```
                            Extent beg.: 1179648 Extent beg.: 2097152
                            Extent end.: 1179662 Extent end.: 2097166


Job summary:                                  Snap
Snap date   Snap time   Job name User ID  time   RC   SnapShot options
-------------------------------------------------------------------------
14 Dec 2003 08:22:12:65 ACCNTT7  ITOPER4  1994    0   CAT(YES)
HCPYMODE(SHR) REPL(YES)

Source Dsn: ACCNT.REP.STAL
Target Dsn: BK.ACCNT.REP.STAL.T0822.DAV07
Extent #:  1 Ext. Snap: 300 Source Vol :  PSPR70 Target Vol :  PSR44D
                            Source dev.:    1210 Target dev.:    1101
                            Extent beg.:37486592 Extent beg.:21954560
                            Extent end.:39780366 Extent end.:24248334
Extent #:  2 Ext. Snap:   0 Source Vol :  PSPR70 Target Vol :  PSR44D
                            Source dev.:    1210 Target dev.:    1101
                            Extent beg.:69140480 Extent beg.:24313856
                            Extent end.:68493070 Extent end.:23666446
Extent #:  3 Ext. Snap:   0 Source Vol :  PSPR70 Target Vol :  PSR44D
                            Source dev.:    1210 Target dev.:    1101
                            Extent beg.:82779904 Extent beg.:23731968
                            Extent end.:18759182 Extent end.:59711246
```

JCL

```
//JOBCARD  JOB ...
//COPYSMF EXEC PGM=ICETOOL,REGION=0M
//TOOLMSG  DD SYSOUT=X
//DFSMSG   DD SYSOUT=X
//OUT      DD SYSOUT=X
//SMF      DD DISP=SHR,DSN=your.smf.vbs.file
//SMFC     DD DSN=uid.SMF2508.file,SPACE=(CYL,(15,15)),
//         DISP=(NEW,CATLG,KEEP),UNIT=SYSDA,
//         DCB=(RECFM=VB,LRECL=32756,BLKSIZE=32760)
//TOOLIN   DD *
  COPY FROM(SMF) TO(SMFC) USING(SMFI)
/*
//SMFICNTL DD *
   OPTION COPY,VLSHRT
   INCLUDE COND=(6,1,BI,EQ,X'FA',AND,23,2,BI,EQ,X'0008')
/*
//RSNAP    EXEC PGM=IKJEFT01,REGION=0M
//SYSEXEC  DD DISP=SHR,DSN=your.rexx.library
//SMF      DD DISP=SHR,DSN=uid.SMF2508.file
//SYSTSPRT DD SYSOUT=*
//SYSTSIN  DD *
PROF NOPREF
```

```
%SNAPREPT
/*
```

SNAPREPT EXEC

```
/* REXX EXEC to read and format SMF Snapshot 250.8 record             */
/*                                                                    */
/* SIBSMFHD: IXFP Subsystem SMF Record Header                         */
/*           Version 2 Release 1 Modification level 1                 */
/*           Map the SMF header for the IXFP SMF record subtypes.     */
/* see: hlq.SIBMAC(SIBSMFHD)                                          */
/*--------------------------------------------------------------------*/
signal ON ERROR
Address TSO
/*--------------------------------------------------------------------*/
/* Part 1: Handle file allocation & dataset existence                 */
/*--------------------------------------------------------------------*/
  userid=SYSVAR(SYSUID)
  vsam   =userid||'.vsam.rep'             /* VSAM file Snap report    */
  nvsam  =userid||'.nvsam.rep'            /* Non VSAM Snap report     */
  summ   =userid||'.summ.rep'             /* Summary  Snap report     */
x = MSG('OFF')
IF SYSDSN(vsam) = 'OK'
   THEN "DELETE "vsam" PURGE"
IF SYSDSN(nvsam) = 'OK'
   THEN "DELETE "nvsam" PURGE"
IF SYSDSN(summ) = 'OK'
   THEN "DELETE "summ" PURGE"
"ALLOC FILE(SSUMM) DA("SUMM")",
   " UNIT(SYSALLDA) NEW TRACKS SPACE(1,1) CATALOG",
   " REUSE RELEASE LRECL(135) RECFM(F B)"
"ALLOC FILE(SVSAM) DA("VSAM")",
   " UNIT(SYSALLDA) NEW TRACKS SPACE(1,1) CATALOG",
   " REUSE RELEASE LRECL(90) RECFM(F B)"
"ALLOC FILE(SNVSAM) DA("NVSAM")",
   " UNIT(SYSALLDA) NEW TRACKS SPACE(1,1) CATALOG",
   " REUSE RELEASE LRECL(90) RECFM(F B)"
/*--------------------------------------------------------------------*/
/* Part 2: Print report header and labels                             */
/*--------------------------------------------------------------------*/
 tit.1  =left(' ',8,' ')||'Snapshot Record Summary Report '
 tit.2  =left(' ',2,' ')
 tit.3  =left(' ',8,' ')||'Report produced on',
       ||left(' ',1,' ')||left(date(),11),
       ||left(' ',1,' ')||left('at ',3,' ')||left(time(),10)
 tit.4 = left(' ',42)||left('Snap',4)
 tit.5 = left('Snap date',12)||left('Snap time',12),
        ||left('Job name',9)||left('User ID',9),
        ||left('time',7)||left('RC',5),
```

```
       ||right('Snapshot options',16)||left(' ',16),
       ||left('Data set name/component',26)
 tit.6 = left('-',110,'-')
 "EXECIO * DISKW SSUMM (STEM tit.)"
 vst.1  ='VSAM file Snapshot Report '
 vst.2  =left(' ',2,' ')
 "EXECIO * DISKW SVSAM (STEM vst.)"
 dst.1  ='Non VSAM file Snapshot Report '
 dst.2  =left(' ',2,' ')
 "EXECIO * DISKW SNVSAM (STEM dst.)"
/*-------------------------------------------------------------------*/
/* Part 3: Read and decode SMF Snapshot (250.8) records              */
/*-------------------------------------------------------------------*/
   'EXECIO *  DISKR SMF ( STEM x. FINIS'
   numeric digits 10
     Do i = 1 to x.0
 SMFRTY   = c2d(substr(x.i,2,1))             /* SMF record number    */
 RECTYPE  = c2d(substr(x.i,19,2))            /* SMF record subtype   */
    IF SMFRTY  = '250'  Then
     Do
 SMFTIME  = smf(c2d(substr(x.i,3,4)))        /* TOD record written   */
 SMFDATE  = substr(c2x(substr(x.i,7,4)),3,5) /* Date rec.written     */
 SMFSID   = substr(x.i,11,4)                 /* System ID            */
 SMFSSI   = substr(x.i,15,4)                 /* Subsystem id for SMF */
/*-------------------------------------------------------------------*/
/* source: hlq.SOAMAC(SIBSMF08)                                      */
/*         SIBSMF08: Snapshot SMF Record Subtype 08 Mapping Macro    */
/*         Maps the SMF record subtype 08 for the Snapshot           */
/*         Snap Dataset and Snap Volume functions.                   */
/*         This SMF record type is generated to record a             */
/*         Snap dataset or Snap volume event.                        */
/*-------------------------------------------------------------------*/
/*    SMF Record Subtype 08 Basic Segment                            */
/*-------------------------------------------------------------------*/
 REQTYPE  = c2d(substr(x.i,21,1))        /* Snapshot request type     */
 VERSION  = c2d(substr(x.i,22,1))        /* Version of this subtype   */
 SEGTYPE  = c2d(substr(x.i,23,2))        /* Segment type              */
 RES01    =     substr(x.i,25,4)         /* Reserved                  */
 RECTOKEN = c2x(substr(x.i,29,8))        /* SMF record 8 token        */
 COMPCODE = c2d(substr(x.i,37,4))        /* Snap completion RC        */
 STRTIME  = smf(c2d(substr(x.i,41,4)))   /* Snap start TOD            */
 STRTDATE = substr(c2x(substr(x.i,45,4)),3,5)  /* Date rec.written    */
 SNAPTIME = c2d(substr(x.i,49,4))        /* Total time to Snap        */
 FLAG1    = X2B(c2x(substr(x.i,53,1)))   /* Snap flag one             */
 FLAG2    = X2B(c2x(substr(x.i,54,1)))   /* Snap flag two             */
/*-------------------------------------------------------------------*/
/* First Snapshot flag byte                                          */
/*-------------------------------------------------------------------*/
     f1 =  substr(flag1,1,1)
     f2 =  substr(flag1,2,1)
```

```
     f3 =  substr(flag1,3,1)
     f4 =  substr(flag1,4,1)
     f5 =  substr(flag1,5,1)
     f6 =  substr(flag1,6,1)
     f7 =  substr(flag1,7,1)
     f8 =  substr(flag1,8,1)
  select
    when f1 = 1 then op1="COPYVOLID(YES) ";
    otherwise        op1= " " ;
  end
  select
    when f2 = 1 then op2="BYPASSACS(YES) ";
    otherwise        op2=" " ;
  end
  select
    when f3 = 1 then op3="CAT(YES) " ;
    otherwise        op3=" " ;
  end
  select
    when f4 = 1 then op4="TOLENQ(YES) " ;
    otherwise        op4=" " ;
  end
  select
    when f5 = 1 then op5="HCPYMODE(SHR) " ;
    otherwise         op5=" " ;
  end
  select
    when f6 = 1 then op6="REPL(YES) " ;
    otherwise         op6=" " ;
  end
  select
    when f7 = 1 then op7="DELETE(YES) ";
    otherwise         op7=" " ;
  end
  select
    when f8 = 1 then op8="FORCE(YES)" ;
    otherwise        op8=" " ;
  END
 option =op1||op2||op3||op4||op5||op6||op7||op8
/*-------------------------------------------------------------------*/
/* Second Snapshot flag byte                                         */
/*-------------------------------------------------------------------*/
     g1 =  substr(flag2,1,1)
     g2 =  substr(flag2,2,1)
     g3 =  substr(flag2,3,1)
     g4 =  substr(flag2,4,1)
     g5 =  substr(flag2,5,1)
     g6 =  substr(flag2,6,1)
  select
    when g1 ='1' then ot1="DEBUG(ON)";
```

```
    otherwise         ot1= " " ;
  end
  select
    when g2 ='1' then ot2="TRACE(ON)";
    otherwise         ot2= " " ;
  end
  select
    when g3 ='1' then ot3="VOLUME ";
    otherwise         ot3= " " ;
  end
  select
    when g4 ='1' then ot4="ESOTERIC ";
    otherwise         ot4= " " ;
  end
  select
    when g5 ='1' then ot5="TRUNCATION ";
    otherwise         ot5= " " ;
  end
  select
    when g6 ='1' then ot6="CONDVOL(LBL) ";
    otherwise         ot6= " " ;
  end
 opt2  =ot1||ot2||ot3||ot4||ot5||ot6
 FLAG3    = c2d(substr(x.i,55,1))    /* Snap flag three               */
 FLAG4    = c2d(substr(x.i,56,1))    /* Snap flag four                */
 JOBNAME  =     substr(x.i,57,8)     /* Jobname of Snapshot requestor */
 USERID   =     substr(x.i,65,8)     /* User ID of Snapshot requestor */
 DATAMOVR =     substr(x.i,73,8)  /* Name of data mover used, or blank*/
 STORCLAS =     substr(x.i,81,8)     /* Storage class name,or blank   */
 MGMTCLAS =     substr(x.i,89,8)    /* Management class name, or blank*/
 DATACLAS =     substr(x.i,97,8)     /* Data class name, or blank     */
 ESOTERIC =     substr(x.i,1Ø5,8)    /* MVS esoteric name,or blank    */
 VOLCNT   = c2d(substr(x.i,113,4))   /* Volume count                  */
 SEGNUM   = c2d(substr(x.i,217,2)) /* Number of segments of this type */
 SEGLEN   = c2d(substr(x.i,219,2))   /* Length of this type segment   */
 SEGOFFST = c2d(substr(x.i,221,2))   /* Offset to start of segment    */
 com.t = right(date('n',STRTDATE,'j'),11),
         left(STRTIME,11)  right(JOBNAME,8) right(USERID,8),
         right(SNAPTIME,4) right(COMPCODE,4)left(' ',1)
 ti.1 = left(' ',42)||left('Snap',4)
 ti.2 = left('Snap date',12)||left('Snap time',12),
        ||left('Job name',9)||left('User ID',9),
        ||left('time',7)||left('RC',5),
        ||right('Snapshot options',16)
 ti.3 = left('-',9Ø,'-')
if  SEGTYPE = 1  & (SEGOFFST <> Ø) & (SEGLEN <> Ø) Then
  do
     sof=SEGOFFST -3
/*-------------------------------------------------------------------*/
/*    Cluster Definition Segment  (segtype=1)                        */
```

```
/*-------------------------------------------------------------------*/
    "EXECIO * DISKW SVSAM (STEM ti.)"
 SCLSTNAM =     substr(x.i,sof,44)        /*Source cluster name.      */
 SCLSTID  = c2d(substr(x.i,sof+44,2))     /*Source cluster ID number. */
                                        /*Used to relate a cluster name*/
                                          /* to a set of dataset names*/
 TCLSTNAM =     substr(x.i,sof+48,44)     /*Target cluster name.      */
 TCLSTID  = c2d(substr(x.i,sof+92,2))     /*Target cluster ID number. */
                                        /*Used to relate a cluster name*/
                                          /* to a set of dataset names*/
 PATHNAME =     substr(x.i,sof+96,44)     /*Path name (for future use)*/
 CLSTORG  =     substr(x.i,sof+140,8)     /*VSAM Cluster organization */
 clu.1=com.t||option
 clu.2=left(' ',22)
 clu.3=left('Source cluster:',16)||SCLSTNAM
 clu.4=left('Target cluster:',16)||TCLSTNAM
    "EXECIO * DISKW SVSAM (STEM clu.)"
end
if  SEGTYPE = 2  & (SEGOFFST <> 0) & (SEGLEN <> 0) Then
  do
     sof=SEGOFFST -3
/*-------------------------------------------------------------------*/
/* Dataset Names Segment   (segtype=2)                               */
/* The following section is only present                             */
/* if this is a SNAP DATASET command                                 */
/*-------------------------------------------------------------------*/
 SRCDSN   =     substr(x.i,sof,44)      /* Name of source dataset     */
 SRCCLSID = c2d(substr(x.i,sof+44,2))   /* Source cluster ID number   */
                                      /* Used to relate a cluster name */
                                        /*  to a set of dataset names */
 SRCDSNID  = c2d(substr(x.i,sof+46,2))  /* Source dataset ID number   */
                                       /*Used to relate a dataset name */
                                        /*        to a set of extents */
 TRGDSN    =     substr(x.i,sof+48,44)  /* Target dataset name        */
 TRGCLSID  = c2d(substr(x.i,sof+92,2))  /* Target cluster ID number   */
                                       /*Used to relate a cluster name */
                                        /*  to a set of dataset names */
 TRGDSNID  = c2d(substr(x.i,sof+94,2))  /* Target dataset ID number   */
                                      /* Used to relate a dataset name */
                                        /*        to a set of extents */
 DSNTYPE   =     substr(x.i,sof+97,1)   /* Catalog DSNTYPE field      */
if    DSNTYPE  = "D" then do
      clusd.1=left('Source Data   :',16)||SRCDSN
      clusd.2=left('Target Data   :',16)||TRGDSN
    "EXECIO * DISKW SVSAM (STEM clusd.)"
end
if    DSNTYPE  = "I" then do
      clusi.1=left('Source Index  :',16)||SRCDSN
      clusi.2=left('Target Index  :',16)||TRGDSN
    "EXECIO * DISKW SVSAM (STEM clusi.)"
```

```
end
if    DSNTYPE ¬="D" & DSNTYPE ¬="I"  then do
    "EXECIO * DISKW SNVSAM (STEM ti.)"
      dsnn.1 =com.t||option
      dsnn.2 =left(' ',22)
      dsnn.3 =left('Source Dsn:',12)||SRCDSN
      dsnn.4 =left('Target Dsn:',12)||TRGDSN
    "EXECIO * DISKW SNVSAM (STEM dsnn.)"
end
 dsn.1=com.t||option||left(SRCDSN,44)
  "EXECIO * DISKW SSUMM  (STEM dsn.)"
end
if  SEGTYPE = 3  & (SEGOFFST <> Ø) & (SEGLEN <> Ø) Then
 do
   do j = Ø to segnum -1
     inc  = (SEGOFFST + (j*SEGLEN))- 3
/*-----------------------------------------------------------------*/
/*    Snapped Extent List Segment (segtype=3)                      */
/*-----------------------------------------------------------------*/
 EXTnum   = j+1
 EXTFLAG   =     substr(x.i,inc,1)         /*Extent fglag options     */
 IOSTTIME  = smf(c2d(substr(x.i,inc+4,4)))
                                          /*Start time of I/O for extent*/
 IOSTDATE  = substr(c2x(substr(x.i,inc+8,4)),3,5) /*Start date of I/O */
 IOTIME    = c2d(substr(x.i,inc+12,4))  /*I/O time to Snap this extent*/
 SNAPRET   = c2d(substr(x.i,inc+16,2))     /*Snap return code         */
 SNAPRES   = c2d(substr(x.i,inc+18,2))     /*Snap reason code         */
 IOIRET    = c2d(substr(x.i,inc+2Ø,2))    /*I/O interface return code */
 DMOVERET  = c2d(substr(x.i,inc+22,2))     /*Data mover return code   */
 DMOVERES  = c2d(substr(x.i,inc+24,2))     /*Data mover reason code   */
 CNTTOKEN  = c2d(substr(x.i,inc+26,2))     /*Snap token count         */
 TOKEN     = c2d(substr(x.i,inc+28,4))     /*Snap token               */
 SRCFUNC   = c2d(substr(x.i,inc+32,2))  /*Source functional extent num*/
 SRCSUB    =     substr(x.i,inc+34,8)      /*RVA subsystem name that  */
                                         /*owns the source extent, or*/
                                           /*  blank if non-RVA       */
 SRCDEV    = c2d(substr(x.i,inc+42,2))  /*Device address of source vol*/
 SRCVOL    =     substr(x.i,inc+44,6)      /*Source volume id         */
 SRCBOE    = c2d(substr(x.i,inc+5Ø,4))  /*Begin of source extent addr.*/
 SRCEOE    = c2d(substr(x.i,inc+54,4))  /*End of source extent address*/
 TRGFUNC   = c2d(substr(x.i,inc+58,2))  /*Target functional extent num*/
 TRGSUB    =     substr(x.i,inc+6Ø,8)      /*RVA subsystem name that  */
                                         /*  owns the target extent, or*/
                                         /*  blank if non-RVA         */
 TRGDEV    = c2d(substr(x.i,inc+68,2))  /*Device address of target vol*/
 TRGVOL    =     substr(x.i,inc+7Ø,6)   /*Target volume id           */
 TRGBOE    = c2d(substr(x.i,inc+76,4))  /*Begin of target extent addr.*/
 TRGEOE    = c2d(substr(x.i,inc+8Ø,4))  /*End of target extent addr.  */
 SEXTDSID  = c2d(substr(x.i,inc+84,2))  /*Source dataset ID number:   */
                                         /*Used to relate to a given   */
```

```
                                        /*             dataset name   */
 TEXTDSID  = c2d(substr(x.i,inc+86,2))   /*Target dataset ID number:  */
                                        /*Used to relate to a given   */
                                        /*             dataset name   */
 SEXTCLID  = c2d(substr(x.i,inc+88,2))  /*Source cluster ID number:   */
                                        /*Used to relate to a given   */
                                        /*             dataset name   */
 TEXTCLID  = c2d(substr(x.i,inc+9Ø,2))  /*Target cluster ID number:   */
                                        /*Used to relate to a given   */
                                        /*             dataset name   */
  if EXTFLAG = Ø then
    extnote  = 'No options specified';
  else
    do;
      extnote  = "";
 ext= left(' ',1)||left('Ext. Snap:',1Ø)||right(IOTIME,4),
      ||left(' ',1),
      ||left('Source Vol:',12)||SRCVOL,
      ||left(' ',3),
      ||left('Target Vol:',12)||TRGVOL
/*-------------------------------------------------------------------*/
/* Extent flag options byte                                          */
/*-------------------------------------------------------------------*/
 SELECT
   when EXTFLAG = '1ØØØØØØØ'b then  extnote  = 'Snapshot';
   when EXTFLAG = 'Ø1ØØØØØØ'b then  extnote  = 'Data Mover';
   when EXTFLAG = 'ØØØØØØØ1'b then  extnote  = 'Extent not processed';
   otherwise  extnote = 'No options specified';
 END
    select
     when  SEXTDSID = 1 then dsorg= 'Non VSAM'
     when  SEXTDSID = 2 then dsorg= 'VSAM - Data'
     when  SEXTDSID = 3 then dsorg= 'VSAM - Indx'
   end
if SEXTDSID  = 1 then do
  dsne.1=left('Extent #:',1Ø)||right(EXTnum,2)||ext
  dsne.2=left(' ',28)||left('Source dev.:',12)||right(SRCDEV,8),
         ||left(' ',1)||left('Target dev.:',12)||right(TRGDEV,8)
  dsne.3=left(' ',28)||left('Extent beg.:',12)||right(SRCBOE,8),
         ||left(' ',1)||left('Extent beg.:',12)||right(TRGBOE,8)
  dsne.4=left(' ',28)||left('Extent end.:',12)||right(SRCEOE,8),
         ||left(' ',1)||left('Extent end.:',12)||right(TRGEOE,8)
    "EXECIO * DISKW SNVSAM (STEM dsne.)"
end
if SEXTDSID  = 2 then do
  exd.1= left('Extent #:',1Ø)||right(EXTnum,2),
         ||left(' ',1)||left('(Data)',7)||ext
    "EXECIO * DISKW SVSAM (STEM exd.)"
end
if SEXTDSID  = 3 then do
```

```
   exi.1 =left('Extent #:',10)right(EXTnum,2),
        ||left(' ',1)||left('(Index)',7)||ext
    "EXECIO * DISKW SVSAM (STEM exi.)"
end
end
end
end
if  SEGTYPE = 4  & (SEGOFFST <> 0) & (SEGLEN <> 0) Then
 do
   do k = 0 to segnum -1
     incr = (SEGOFFST + (j*SEGLEN))- 3
/*-------------------------------------------------------------------*/
/*    DDSR Extent List Segment (segtype=4)                           */
/*-------------------------------------------------------------------*/
 DDSRTYPE = c2d(substr(x.i,incr,1))       /* Type of DDSR extent seg. */
 DDSRTIME = smf(c2d(substr(x.i,incr+1,4)))  /* Start time of I/O      */
 DDSRDATE = substr(c2x(substr(x.i,inc+5,4)),3,5)  /*Start date of I/O */
 DDSRFUNC = c2d(substr(x.i,incr+11,2))      /*Functional extent number*/
 DDSRSUB  =     substr(x.i,incr+13,8)       /* RVA subsystem name     */
 DDSRDEV  = c2d(substr(x.i,incr+21,2))      /* Device address         */
 DDSRVOL  =     substr(x.i,incr+23,6)       /* Volume identifier      */
 DDSRBOE  = c2d(substr(x.i,incr+29,4))    /* Beginning extent in CCHH.*/
 DDSREOE  = c2d(substr(x.i,incr+33,4))      /* Ending extent in CCHH. */
 TDSRDSID = c2d(substr(x.i,incr+37,2))    /* Target dataset ID number:*/
                                          /* used to relate to a given*/
                                            /*           dataset name */
 TDSRCLID = c2d(substr(x.i,incr+39,2))    /* Target cluster ID number:*/
                                          /* used to relate to a given*/
                                          /*             dataset name */
end
end
  END
  END
/*     Close & free all allocated files                              */
say
say 'Snapshot Record Summary Report. . . :'summ
say 'VSAM file Snapshot Report . . . . . :'vsam
say 'Non VSAM file Snapshot Report . . . :'nvsam
say
  "EXECIO 0 DISKW SVSAM  (FINIS "
  "EXECIO 0 DISKW SNVSAM (FINIS "
  "EXECIO 0 DISKW SSUMM  (FINIS "
  "FREE FILE(SSUMM SVSAM SNVSAM SMF)"
  exit
/*-------------------------------------------------------------------*/
/* Error exit routine                                                */
/*-------------------------------------------------------------------*/
ERROR: say 'The following command produced non-zero RC =' RC
       say SOURCELINE(SIGL)
       exit
```

```
SMF: procedure
/* REXX - convert a SMF time to hh:mm:ss:hd format   */
 arg time
     time1    = time % 100
     hh       = time1 % 3600
     hh       = RIGHT("0"||hh,2)
     mm       = (time1 % 60) - (hh * 60)
     mm       = RIGHT("0"||mm,2)
     ss       = time1 - (hh * 3600) - (mm * 60)
     ss       = RIGHT("0"||ss,2)
     fr       = time //  1000
     fr       = RIGHT("0"||fr,2)
     rtime  = hh||":"||mm||":"||ss||":"||fr
     return rtime
```

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Displaying the virtual storage map from IPCS

Every monitoring package for OS/390 or z/OS provides an option for displaying the virtual storage address range and the range of addresses in use for the different areas of storage (for example PLPA, read/write nucleus, extended CSA, etc). This information can be very useful when diagnosing system problems or determining the real size of certain storage areas.

Although monitoring packages can provide storage map information from your active system, what happens when you need to review a dump dataset for a problem that occurred prior to the last batch of applied system maintenance or when you need to examine a dump dataset that was sent to you from the Atlanta office when you work in Dallas? Presumably, the storage map on those systems differs from that of your current, running system.

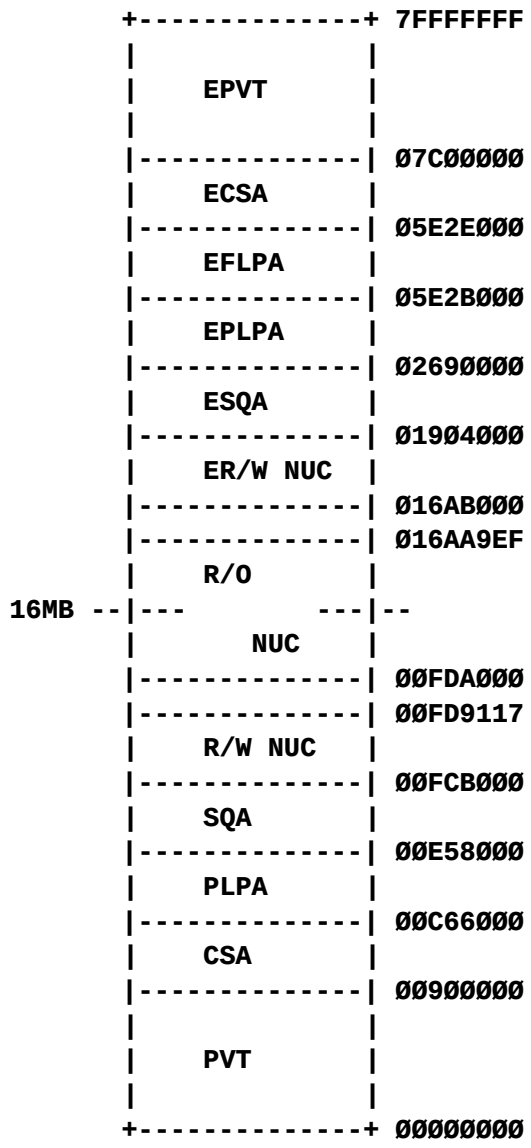
THE STOREMAP IPCS VERBEXIT ROUTINE

The STOREMAP program provided with this article is an IPCS VERBEXIT routine that allows for a virtual storage map display

for the current IPCS default source data. This provides the opportunity to quickly review the storage map from historical dump datasets or from dump datasets that may have been generated at different sites. In its simplest format, from IPCS option 6 you can specify:

```
VERBX STOREMAP
```

This invocation will display the traditional virtual storage map graphic similar to that shown below:



Optional blank-separated keywords can also be supplied to the STOREMAP routine if you are interested in determining the starting and ending addresses of only certain areas of storage.

Valid keywords include PVT, CSA, MLPA, FLPA, PLPA, SQA, RWNUC, RONUC, ERWNUC, ESQA, EPLPA, EFLPA, EMLPA, ECSA, and EPVT. For example:

```
VERBX STOREMAP 'CSA PLPA MLPA RWNUC EMLPA EPVT'
```

would yield output similar to that shown below:

```
   EPVT     start address:  07C00000
              end address:  7FFFFFFF

No storage area available for EMLPA

   R/W NUC  start address:  00FCB000
              end address:  00FD9117

   PLPA     start address:  00C66000
              end address:  00E57FFF

No storage area available for MLPA

   CSA      start address:  00900000
              end address:  00C65FFF
```

ACTIVATING THE STOREMAP VERBEXIT EXIT

In order to make the STOREMAP VERBEXIT routine available to your IPCS session, linkedit STOREMAP into a load library that resides somewhere in the search order for your active session – the linklist or STEPLIB are two options.

To successfully display all the information about the virtual storage map be sure that SQA is included in the dump data.

SUMMARY

Regardless of the source system, STOREMAP can provide an accurate view of the virtual storage map in use at the time the dump data was created. This can be important background information when assessing dump dataset information in any environment and especially as it relates to the current dump data you are reviewing in IPCS.

STOREMAP

```
STOREMAP CSECT
STOREMAP AMODE 31
STOREMAP RMODE ANY
*-------------------------------------------------------------------*
*   STOREMAP is designed to be used as an IPCS VERBX exit routine   *
*   that can be used to display the virtual storage map information *
*   for the current default dump.                                   *
*                                                                   *
*   To be able to display the entire virtual storage map be sure    *
*   the dump data contains SQA.                                     *
*                                                                   *
*   The simplest format for exit invocation is as follows:          *
*                                                                   *
*     VERBX STOREMAP                                                *
*                                                                   *
*   This will list the virtual storage map existing in the current  *
*   default dump.                                                   *
*                                                                   *
*   Specific areas of the virtual storage map can be displayed by   *
*   providing a blank delimited list of keyword parameters          *
*   representing only the areas of storage you are interested in.   *
*   For example:                                                    *
*                                                                   *
*     VERBX STOREMAP 'CSA ESQA EMLPA'                               *
*                                                                   *
*   would display the starting and ending addresses for only CSA,   *
*   extended SQA, and extended MLPA.  Valid keyword parameters       *
*   include:  PVT, CSA, MLPA, FLPA, PLPA, SQA, RWNUC, RONUC, ERWNUC,*
*   ESQA, EPLPA, EFLPA, EMLPA, ECSA, EPVT.                          *
*                                                                   *
*   Regardless of the invocation technique (with or without keyword *
*   parameters), an IPCS symbol will be created representing the    *
*   starting virtual storage address for each area of virtual       *
*   storage requested and detected.  If no keyword parameters are   *
*   specified, a symbol will be created for each area of virtual    *
*   storage defined.  If keywords are specified, a symbol will be   *
*   created for each of the specified areas that are defined in     *
*   the virtual storage map.  The symbol names used for each        *
*   storage area match the keyword parameter names described above. *
*                                                                   *
*   The following IPCS exit services are demonstrated in this       *
*   program:                                                        *
*     Storage Access              (IPCS service code ADPLSACC)      *
*     Expanded Print              (IPCS service code ADPLSPR2)      *
*     Equate Symbol               (IPCS service code ADPLSEQS)      *
*                                                                   *
*   Chapter 1Ø in the OS/39Ø MVS IPCS Customization manual discusses *
*   the various IPCS exit services in detail.  This exit example    *
```

```
*   offers usage demonstration for only a handful of the available    *
*   services.                                                         *
*                                                                     *
*   In order to use the STOREMAP VERBX exit ensure that it is         *
*   linkedited somewhere into the load module search order for your   *
*   active IPCS session.  Linkedit JCL similar to the following can   *
*   be used:                                                          *
*                                                                     *
*      //IEWL     EXEC  PGM=HEWLHØ96,PARM='XREF,LIST,MAP,RENT'       *
*      //SYSPRINT DD    SYSOUT=*                                     *
*      //SYSUT1   DD    UNIT=SYSDA,SPACE=(CYL,(2,1))                 *
*      //OBJECT   DD    DSN=object.code.pds,DISP=SHR                 *
*      //SYSLMOD  DD    DSN=load.library,DISP=SHR                    *
*      //SYSLIN   DD    *                                            *
*         INCLUDE OBJECT(STOREMAP)                                    *
*         ENTRY   STOREMAP                                            *
*         NAME    STOREMAP(R)                                         *
*                                                                     *
*   Register Usage Conventions:                                       *
*                                                                     *
*   RØ        :  work register, but generally available for use by    *
*                calls to system functions                            *
*   R1        :  contains the parameter address on entry; work        *
*                register, but generally available for use by calls   *
*                to system functions                                  *
*   R2 - R7   :  work registers                                       *
*   R8        :  ABDPL base register                                  *
*   R9        :  function specific parameter list address             *
*   R1Ø       :  future base register expansion                       *
*   R11       :  second base register                                 *
*   R12       :  first base register                                  *
*   R13       :  savearea/temporary storage address                   *
*   R14 - R15 :  work registers; return address and return code; but  *
*                generally available for use by calls to system       *
*                functions                                            *
*---------------------------------------------------------------------*
         STM   R14,R12,12(R13)       Save incoming registers
         LR    R12,R15               Copy module address
         LA    R11,4Ø95(,R12)        Set up second ...
         LA    R11,1(,R11)              base register
         USING STOREMAP,R12,R11      Set module addressability
         LR    R2,R1                 Copy parameter address
         LR    R3,R13                Copy savearea address
         STORAGE OBTAIN,LENGTH=WORKLEN,LOC=ANY
         LR    RØ,R1                 Copy working storage address
         LR    R14,R1                Again
         LR    R13,R1                Again
         L     R1,=A(WORKLEN)        Get length
         XR    R15,R15               Set fill byte
         MVCL  RØ,R14                Clear the storage
```

```
         USING WORKAREA,R13          Set addressability
         ST    R3,SAVEAREA+4         Save incoming savearea address
         LA    R9,WORKPACC           Get ADPLPACC address
         USING ADPLPACC,R9           Set addressability
         LR    R8,R2                 Get ABDPL address
         USING ABDPL,R8              Set addressability
         MVC   ASID(2),ADPLASID      Save the ASID
         MVC   CVTADDR(4),ADPLCVT    Save the CVT address
*--------------------------------------------------------------------*
*   The ADPLEXT contains the address of the extension pointer.  If   *
*   you want to process any input parameters passed to the VERBX     *
*   program they can be captured at this point and processed.        *
*                                                                    *
*   +Ø from the ADPLEXT address contains the parameter address.      *
*   +4 from the ADPLEXT address contains the CPPL address.           *
*                                                                    *
*   See comments earlier for the format of valid parameters.         *
*--------------------------------------------------------------------*
         L     R7,ADPLEXT            Get extension address
         LTR   R7,R7                 An extension?
         BZ    NOPARM                No - unusual, but nothing to do
         USING ADPLEXTN,R7           Set addressability
         L     R15,ADPLOPTR          Get parm buffer address
         LTR   R15,R15               A parameter?
         BZ    NOPARM                No - nothing to do
         ST    R15,PARMADDR          Save parm address
         LR    R5,R15                Copy parm buffer address
         S     R15,=F'4'             Point to length
         XR    R14,R14               Clear R14
         ICM   R14,B'ØØ11',Ø(R15)    Save the length
         LR    R6,R14                Copy to R6
         S     R6,=F'4'              Reduce by length word length
PARMLP   DS    ØH
         C     R6,=F'3'              Enough data for a keyword?
         BNL   CHKKYWDS              Yes - go through keyword check
         BCTR  R6,Ø                  Reduce by one for EX
         EX    R6,BLNKCLC            Blanks?
         BNE   BADPARM1              No - that's an error
         B     NOPARM                Done the parm check
CHKKYWDS DS    ØH
         C     R6,=F'6'              Enough for an ERWNUC check?
         BL    KYWDLN5               No - check 5 char keywords
         CLC   Ø(6,R5),=C'ERWNUC'    ERWNUC keyword?
         BNE   KYWD2LN6              No - check next 6 char keyword
         OI    PARMFLG1,PRMERWN      Set the ERWNUC keyword flag
         B     KYWDLN6E              Prepare for next parm
KYWD2LN6 DS    ØH
         B     KYWDLN5               Check 5 char keywords
KYWDLN6E DS    ØH
         LA    R5,6(,R5)             Point past keyword
```

```
         S     R6,=F'6'             Reduce length
         B     NEXTPARM             Prepare for next parm
KYWDLN5  DS    ØH
         C     R6,=F'5'             Enough for 5 char keyword check?
         BL    KYWDLN4              No - check 4 char keywords
         CLC   Ø(5,R5),=C'EMLPA'    EMLPA keyword?
         BNE   KYWD2LN5             No - check next 5 char keyword
         OI    PARMFLG1,PRMEMLPA    Set the EMLPA keyword flag
         B     KYWDLN5E             Prepare for next parm
KYWD2LN5 DS    ØH
         CLC   Ø(5,R5),=C'EFLPA'    EFLPA keyword?
         BNE   KYWD3LN5             No - check next 5 char keyword
         OI    PARMFLG1,PRMEFLPA    Set the EFLPA keyword flag
         B     KYWDLN5E             Prepare for next parm
KYWD3LN5 DS    ØH
         CLC   Ø(5,R5),=C'EPLPA'    EPLPA keyword?
         BNE   KYWD4LN5             No - check next 5 char keyword
         OI    PARMFLG1,PRMEPLPA    Set the EPLPA keyword flag
         B     KYWDLN5E             Prepare for next parm
KYWD4LN5 DS    ØH
         CLC   Ø(5,R5),=C'RONUC'    RONUC keyword?
         BNE   KYWD5LN5             No - check next 5 char keyword
         OI    PARMFLG2,PRMRON      Set the RONUC keyword flag
         B     KYWDLN5E             Prepare for next parm
KYWD5LN5 DS    ØH
         CLC   Ø(5,R5),=C'RWNUC'    RWNUC keyword?
         BNE   KYWD6LN5             No - check next 5 char keyword
         OI    PARMFLG2,PRMRWN      Set the RWNUC keyword flag
         B     KYWDLN5E             Prepare for next parm
KYWD6LN5 DS    ØH
         B     KYWDLN4              Check 4 char keywords
KYWDLN5E DS    ØH
         LA    R5,5(,R5)            Point past keyword
         S     R6,=F'5'             Reduce length
         B     NEXTPARM             Prepare for next parm
KYWDLN4  DS    ØH
         C     R6,=F'4'             Enough for 4 char keyword check?
         BL    KYWDLN3              No - check 3 char keywords
         CLC   Ø(4,R5),=C'EPVT'     EPVT keyword?
         BNE   KYWD2LN4             No - check next 4 char keyword
         OI    PARMFLG1,PRMEPVT     Set the EPVT keyword flag
         B     KYWDLN4E             Prepare for next parm
KYWD2LN4 DS    ØH
         CLC   Ø(4,R5),=C'ECSA'     ECSA keyword?
         BNE   KYWD3LN4             No - check next 4 char keyword
         OI    PARMFLG1,PRMECSA     Set the ECSA keyword flag
         B     KYWDLN4E             Prepare for next parm
KYWD3LN4 DS    ØH
         CLC   Ø(4,R5),=C'ESQA'     ESQA keyword?
         BNE   KYWD4LN4             No - check next 4 char keyword
```

```
         OI    PARMFLG1,PRMESQA      Set the ESQA keyword flag
         B     KYWDLN4E              Prepare for next parm
KYWD4LN4 DS    ØH
         CLC   Ø(4,R5),=C'PLPA'      PLPA keyword?
         BNE   KYWD5LN4              No - check next 4 char keyword
         OI    PARMFLG2,PRMPLPA      Set the PLPA keyword flag
         B     KYWDLN4E              Prepare for next parm
KYWD5LN4 DS    ØH
         CLC   Ø(4,R5),=C'FLPA'      FLPA keyword?
         BNE   KYWD6LN4              No - check next 4 char keyword
         OI    PARMFLG2,PRMFLPA      Set the FLPA keyword flag
         B     KYWDLN4E              Prepare for next parm
KYWD6LN4 DS    ØH
         CLC   Ø(4,R5),=C'MLPA'      MLPA keyword?
         BNE   KYWD7LN4              No - check next 4 char keyword
         OI    PARMFLG2,PRMMLPA      Set the MLPA keyword flag
         B     KYWDLN4E              Prepare for next parm
KYWD7LN4 DS    ØH
         B     KYWDLN3               Check 3 char keywords
KYWDLN4E DS    ØH
         LA    R5,4(,R5)             Point past keyword
         S     R6,=F'4'              Reduce length
         B     NEXTPARM              Prepare for next parm
KYWDLN3  DS    ØH
         CLC   Ø(3,R5),=C'SQA'       SQA keyword?
         BNE   KYWD2LN3              No - check next 3 char keyword
         OI    PARMFLG2,PRMSQA       Set the SQA keyword flag
         B     KYWDLN3E              Prepare for next parm
KYWD2LN3 DS    ØH
         CLC   Ø(3,R5),=C'CSA'       CSA keyword?
         BNE   KYWD3LN3              No - check next 3 char keyword
         OI    PARMFLG2,PRMCSA       Set the CSA keyword flag
         B     KYWDLN3E              Prepare for next parm
KYWD3LN3 DS    ØH
         CLC   Ø(3,R5),=C'PVT'       PVT keyword?
         BNE   KYWD4LN3              No - check next 3 char keyword
         OI    PARMFLG2,PRMPVT       Set the PVT keyword flag
         B     KYWDLN3E              Prepare for next parm
KYWD4LN3 DS    ØH
         B     NEXTPARM              Prepare for next parm
KYWDLN3E DS    ØH
         LA    R5,3(,R5)             Point past keyword
         S     R6,=F'3'              Reduce length
         B     NEXTPARM              Prepare for next parm
NEXTPARM DS    ØH
         LTR   R6,R6                 End of parameter buffer?
         BZ    NOPARM                Yes - that's fine
         CLI   Ø(R5),C' '            A blank?
         BNE   BADPARM1              No - indicate invalid parm
         LA    R5,1(,R5)             Point to next data byte
```

```
         BCTR  R6,Ø                Reduce length by one
         B     PARMLP              Check next keyword
*-------------------------------------------------------------------*
BADPARM1 DS    ØH
         LA    RØ,PRMMSG1L         Get message length
         LA    R1,PARMMSG1         Get message address
         BAL   R14,PRINTLN         Go print the line
         LA    RØ,1                Set message length
         LA    R1,=C' '            Get message address
         BAL   R14,PRINTLN         Go print a blank line
         B     RETURN              Exit when parms are bad
*-------------------------------------------------------------------*
NOPARM   DS    ØH
*-------------------------------------------------------------------*
*   Obtain the CVT.                                                 *
*-------------------------------------------------------------------*
         MVC   ADPLPAAD(4),CVTADDR   Set address to the CVT
         MVC   ADPLDLEN(2),=AL2(CVTOSLVF+1-CVT) Set get length
         OI    ADPLPRDP,ADPLVIRT+ADPLSAMK Indicate virtual 24-bit addr
         L     R15,ADPLSERV          Get service routine address
         CALL  (15),                                              X
               ((R8),                                             X
               CODEACC,                                           X
               (R9)),MF=(E,CALLLST)
         MVC   CBNAME(4),=C'CVT '    Indicate control block acronym
         LTR   R15,R15               Were things ok?
         BNZ   NOSTORE               No - issue storage not found msg
*-------------------------------------------------------------------*
*   Obtain the Storage Map Extension.                               *
*-------------------------------------------------------------------*
         L     R1,ADPLPART           Get buffer location address
         USING CVT,R1
         MVC   CBNAME(4),=C'CVT '    Copy control block name
         MVC   CBADDR(4),ADPLPAAD    Copy control block address
         CLC   CBNAME(3),CVTCVT+1    Correct control block?
         BNE   CBERROR               No - no sense going on
         MVC   GDAADDR(4),CVTGDA     Save GDA address for later use
         MVC   ADPLPAAD(4),CVTSMEXT  Get Storage Map Extension address
         MVC   ADPLDLEN(2),=AL2(CVTEMLPE-CVTVSTGX+4) Set get length
         NI    ADPLPRDP,255-ADPLSAMK Indicate virtual 31-bit addr
         DROP  R1
         L     R15,ADPLSERV          Get service routine address
         CALL  (15),                                              X
               ((R8),                                             X
               CODEACC,                                           X
               (R9)),MF=(E,CALLLST)
         MVC   CBNAME(4),=C'SMEx'    Indicate control block acronym
         LTR   R15,R15               Were things ok?
         BNZ   NOSTORE               No - issue storage not found msg
*-------------------------------------------------------------------*
```

```
*   Extract storage map information                                 *
*-----------------------------------------------------------------*
         L     R1,ADPLPART           Get buffer location address
         USING CVTVSTGX,R1
         MVC   MLPAS(72),CVTMLPAS    Copy the pertinent information
         DROP  R1
*-----------------------------------------------------------------*
*   Obtain the GDA.                                               *
*-----------------------------------------------------------------*
         MVC   ADPLPAAD(4),GDAADDR   Set address to the GDA
         MVC   ADPLDLEN(2),=AL2(GDAEND-GDA) Set get length
         L     R15,ADPLSERV          Get service routine address
         CALL  (15),                                             X
               ((R8),                                            X
               CODEACC,                                          X
               (R9)),MF=(E,CALLLST)
         MVC   CBNAME(4),=C'GDA '    Indicate control block acronym
         LTR   R15,R15               Were things ok?
         BNZ   NOSTORE               No - issue storage not found msg
         USING GDA,R1
         L     R1,ADPLPART           Get buffer location address
         MVC   CBNAME(4),=C'GDA '    Copy control block name
         MVC   CBADDR(4),ADPLPAAD    Copy control block address
         CLC   CBNAME(4),GDAID       Correct control block?
         BNE   CBERROR               No - no sense going on
*-----------------------------------------------------------------*
         MVC   CSA(4),GDACSA         Copy CSA starting address
         MVC   CSASZ(4),GDACSASZ     Copy CSA size
         MVC   ECSA(4),GDAECSA       Copy ECSA starting address
         MVC   ECSAS(4),GDAECSAS     Copy ECSA size
         MVC   SQA(4),GDASQA         Copy SQA starting address
         MVC   SQASZ(4),GDASQASZ     Copy SQA size
         MVC   ESQA(4),GDAESQA       Copy ESQA starting address
         MVC   ESQAS(4),GDAESQAS     Copy ESQA size
         MVC   PVT(4),GDAPVT         Copy Private starting address
         MVC   PVTSZ(4),GDAPVTSZ     Copy Private size
         MVC   EPVT(4),GDAEPVT       Copy EPrivate starting address
         MVC   EPVTS(4),GDAEPVTS     Copy EPrivate size
         DROP  R1
         L     R14,CSA               Get CSA start addr
         L     R15,CSASZ             Get CSA length
         AR    R14,R15               Calculate ...
         BCTR  R14,Ø                    ending addr
         ST    R14,CSAE              Save CSA ending addr
         L     R14,SQA               Get SQA start addr
         L     R15,SQASZ             Get SQA length
         AR    R14,R15               Calculate ...
         BCTR  R14,Ø                    ending addr
         ST    R14,SQAE              Save SQA ending addr
         L     R14,PVT               Get PVT start addr
```

```
         L     R15,PVTSZ             Get PVT length
         AR    R14,R15               Calculate ...
         BCTR  R14,Ø                    ending addr
         ST    R14,PVTE              Save PVT ending addr
         L     R14,ECSA              Get CSA start addr
         L     R15,ECSAS             Get CSA length
         AR    R14,R15               Calculate ...
         BCTR  R14,Ø                    ending addr
         ST    R14,ECSAE             Save CSA ending addr
         L     R14,ESQA              Get SQA start addr
         L     R15,ESQAS             Get SQA length
         AR    R14,R15               Calculate ...
         BCTR  R14,Ø                    ending addr
         ST    R14,ESQAE             Save SQA ending addr
         L     R14,EPVT              Get PVT start addr
         L     R15,EPVTS             Get PVT length
         AR    R14,R15               Calculate ...
         BCTR  R14,Ø                    ending addr
         ST    R14,EPVTE             Save PVT ending addr
*-----------------------------------------------------------------*
         CLC   PARMFLGS(2),=2X'ØØ'   Display by keyword selection?
         BNE   KYWDDSPL              Yes - do keyword display
*-----------------------------------------------------------------*
         LA    RØ,1                  Set message length
         LA    R1,=C' '              Get message address
         BAL   R14,PRINTLN           Go print the line
*-----------------------------------------------------------------*
EPVTCHK  DS    ØH
         MVC   LINEBUF(L'TOPBOTM),TOPBOTM Get line model
         L     R15,EPVTE             Get EPVT ending address
         BAL   R14,HEXCNVT           Make it readable
         MVC   LINEBUF+LNOFFST3(8),DBL1 Copy into output buffer
         LA    RØ,L'TOPBOTM          Set message length
         LA    R1,LINEBUF            Get message address
         BAL   R14,PRINTLN           Go print the line
         LA    RØ,L'FILL             Set message length
         LA    R1,FILL               Get message address
         BAL   R14,PRINTLN           Go print the line
         MVC   LINEBUF(L'FILL),FILL  Get line model
         MVC   LINEBUF+LNOFFST2(4),=C'EPVT' Set area identifier
         LA    RØ,L'FILL             Set message length
         LA    R1,LINEBUF            Get message address
         BAL   R14,PRINTLN           Go print the line
         LA    RØ,L'FILL             Set message length
         LA    R1,FILL               Get message address
         BAL   R14,PRINTLN           Go print the line
         MVC   LINEBUF(L'MIDDLE),MIDDLE Get line model
         L     R15,EPVT              Get EPVT starting address
         BAL   R14,HEXCNVT           Make it readable
         MVC   LINEBUF+LNOFFST3(8),DBL1 Copy into output buffer
```

```
         LA    RØ,L'MIDDLE           Set message length
         LA    R1,LINEBUF            Get message address
         BAL   R14,PRINTLN           Go print the line
         MVC   PREVAREA(4),EPVT      Save EPVT as previous area addr
         MVC   AREASTRT(4),EPVT      Copy start address
         MVC   AREAEND(4),EPVTE      Copy end address
         MVC   AREAID(8),=CL8'EPVT'  Copy identifier
         BAL   R14,SYMDEF            Go define a symbol
*-------------------------------------------------------------------*
ECSACHK  DS    ØH
         CLC   ECSA(4),=F'Ø'         Any data?
         BE    EMLPACHK              No - go check next area
         MVC   AREASTRT(4),ECSA      Copy start address
         MVC   AREAEND(4),ECSAE      Copy end address
         MVC   AREAID(8),=CL8'ECSA'  Copy identifier
         BAL   R14,AREACHK           Go process
*-------------------------------------------------------------------*
EMLPACHK DS    ØH
         CLC   EMLPAS(4),=F'Ø'       Any data?
         BE    EFLPACHK              No - go check next area
         MVC   AREASTRT(4),EMLPAS    Copy start address
         MVC   AREAEND(4),EMLPAE     Copy end address
         MVC   AREAID(8),=CL8'EMLPA' Copy identifier
         BAL   R14,AREACHK           Go process
*-------------------------------------------------------------------*
EFLPACHK DS    ØH
         CLC   EFLPAS(4),=F'Ø'       Any data?
         BE    EPLPACHK              No - go check next area
         MVC   AREASTRT(4),EFLPAS    Copy start address
         MVC   AREAEND(4),EFLPAE     Copy end address
         MVC   AREAID(8),=CL8'EFLPA' Copy identifier
         BAL   R14,AREACHK           Go process
*-------------------------------------------------------------------*
EPLPACHK DS    ØH
         CLC   EPLPAS(4),=F'Ø'       Any data?
         BE    ESQACHK               No - go check next area
         MVC   AREASTRT(4),EPLPAS    Copy start address
         MVC   AREAEND(4),EPLPAE     Copy end address
         MVC   AREAID(8),=CL8'EPLPA' Copy identifier
         BAL   R14,AREACHK           Go process
*-------------------------------------------------------------------*
ESQACHK  DS    ØH
         CLC   ESQA(4),=F'Ø'         Any data?
         BE    ERWNCHK               No - go check next area
         MVC   AREASTRT(4),ESQA      Copy start address
         MVC   AREAEND(4),ESQAE      Copy end address
         MVC   AREAID(8),=CL8'ESQA'  Copy identifier
         BAL   R14,AREACHK           Go process
*-------------------------------------------------------------------*
ERWNCHK  DS    ØH
```

```
         CLC   ERWNS(4),=F'Ø'        Any data?
         BE    ERONCHK               No - go check next area
         MVC   AREASTRT(4),ERWNS     Copy start address
         MVC   AREAEND(4),ERWNE      Copy end address
         MVC   AREAID(8),=CL8'ER/W NUC' Copy identifier
         BAL   R14,AREACHK           Go process
*-------------------------------------------------------------------*
ERONCHK  DS    ØH
         CLC   RONS(4),=F'Ø'         Any data?
         BE    RWNCHK                No - go check next area
         L     R15,PREVAREA          Get start addr of previous area
         BCTR  R15,Ø                 Reduce by one
         C     R15,RONS              End is previous start?
         BE    NORONE                Yes - no extra info required
         MVC   LINEBUF(L'MIDDLE),MIDDLE Get line model
         L     R15,RONE              Get RON ending addr
         BAL   R14,HEXCNVT           Make it readable
         MVC   LINEBUF+LNOFFST3(8),DBL1 Copy into output buffer
         LA    RØ,L'MIDDLE           Set message length
         LA    R1,LINEBUF            Get message address
         BAL   R14,PRINTLN           Go print the line
NORONE   DS    ØH
         MVC   LINEBUF(L'FILL),FILL  Get line model
         MVC   LINEBUF+LNOFFST2(3),=C'R/O' Set area identifier
         LA    RØ,L'FILL             Set message length
         LA    R1,LINEBUF            Get message address
         BAL   R14,PRINTLN           Go print the line
         LA    RØ,L'MB16             Set message length
         LA    R1,MB16               Get message address
         BAL   R14,PRINTLN           Go print the line
         MVC   LINEBUF(L'FILL),FILL  Get line model
         MVC   LINEBUF+LNOFFST2+3(3),=C'NUC' Set area identifier
         LA    RØ,L'FILL             Set message length
         LA    R1,LINEBUF            Get message address
         BAL   R14,PRINTLN           Go print the line
         MVC   LINEBUF(L'MIDDLE),MIDDLE Get line model
         L     R15,RONS              Get RON starting address
         BAL   R14,HEXCNVT           Make it readable
         MVC   LINEBUF+LNOFFST3(8),DBL1 Copy into output buffer
         LA    RØ,L'MIDDLE           Set message length
         LA    R1,LINEBUF            Get message address
         BAL   R14,PRINTLN           Go print the line
         MVC   PREVAREA(4),RONS      Save RON as previous area addr
         MVC   AREASTRT(4),RONS      Copy start address
         MVC   AREAEND(4),RONE       Copy end address
         MVC   AREAID(8),=CL8'R/O NUC ' Copy identifier
         BAL   R14,SYMDEF            Go define a symbol
*-------------------------------------------------------------------*
RWNCHK   DS    ØH
         CLC   RWNS(4),=F'Ø'         Any data?
```

```
         BE    SQACHK               No - go check next area
         MVC   AREASTRT(4),RWNS     Copy start address
         MVC   AREAEND(4),RWNE      Copy end address
         MVC   AREAID(8),=CL8'R/W NUC' Copy identifier
         BAL   R14,AREACHK          Go process
*-------------------------------------------------------------------*
SQACHK   DS    ØH
         CLC   SQA(4),=F'Ø'         Any data?
         BE    PLPACHK              No - go check next area
         MVC   AREASTRT(4),SQA      Copy start address
         MVC   AREAEND(4),SQAE      Copy end address
         MVC   AREAID(8),=CL8'SQA'  Copy identifier
         BAL   R14,AREACHK          Go process
*-------------------------------------------------------------------*
PLPACHK  DS    ØH
         CLC   PLPAS(4),=F'Ø'       Any data?
         BE    FLPACHK              No - go check next area
         MVC   AREASTRT(4),PLPAS    Copy start address
         MVC   AREAEND(4),PLPAE     Copy end address
         MVC   AREAID(8),=CL8'PLPA' Copy identifier
         BAL   R14,AREACHK          Go process
*-------------------------------------------------------------------*
FLPACHK  DS    ØH
         CLC   FLPAS(4),=F'Ø'       Any data?
         BE    MLPACHK              No - go check next area
         MVC   AREASTRT(4),FLPAS    Copy start address
         MVC   AREAEND(4),FLPAE     Copy end address
         MVC   AREAID(8),=CL8'FLPA' Copy identifier
         BAL   R14,AREACHK          Go process
*-------------------------------------------------------------------*
MLPACHK  DS    ØH
         CLC   MLPAS(4),=F'Ø'       Any data?
         BE    CSACHK               No - go check next area
         MVC   AREASTRT(4),MLPAS    Copy start address
         MVC   AREAEND(4),MLPAE     Copy end address
         MVC   AREAID(8),=CL8'MLPA' Copy identifier
         BAL   R14,AREACHK          Go process
*-------------------------------------------------------------------*
CSACHK   DS    ØH
         CLC   CSA(4),=F'Ø'         Any data?
         BE    PVTCHK               No - go check next area
         MVC   AREASTRT(4),CSA      Copy start address
         MVC   AREAEND(4),CSAE      Copy end address
         MVC   AREAID(8),=CL8'CSA'  Copy identifier
         BAL   R14,AREACHK          Go process
*-------------------------------------------------------------------*
PVTCHK   DS    ØH
         L     R15,PREVAREA         Get start addr of previous area
         BCTR  R15,Ø                Reduce by one
         C     R15,PVTE             End is previous start?
```

```
         BE    NOPVTE                Yes - no extra info required
         MVC   LINEBUF(L'MIDDLE),MIDDLE Get line model
         L     R15,PVTE              Get PVT ending addr
         BAL   R14,HEXCNVT           Make it readable
         MVC   LINEBUF+LNOFFST3(8),DBL1 Copy into output buffer
         LA    RØ,L'MIDDLE           Set message length
         LA    R1,LINEBUF            Get message address
         BAL   R14,PRINTLN           Go print the line
NOPVTE   DS    ØH
         LA    RØ,L'FILL             Set message length
         LA    R1,FILL               Get message address
         BAL   R14,PRINTLN           Go print the line
         MVC   LINEBUF(L'FILL),FILL  Get line model
         MVC   LINEBUF+LNOFFST2(3),=C'PVT' Set area identifier
         LA    RØ,L'FILL             Set message length
         LA    R1,LINEBUF            Get message address
         BAL   R14,PRINTLN           Go print the line
         LA    RØ,L'FILL             Set message length
         LA    R1,FILL               Get message address
         BAL   R14,PRINTLN           Go print the line
         MVC   LINEBUF(L'MIDDLE),MIDDLE Get line model
         CLC   PVT(4),=F'Ø'          At the start?
         BNE   NOSTART               No - don't change line format
         MVC   LINEBUF(L'TOPBOTM),TOPBOTM Get line model
NOSTART  DS    ØH
         L     R15,PVT               Get PVT starting address
         BAL   R14,HEXCNVT           Make it readable
         MVC   LINEBUF+LNOFFST3(8),DBL1 Copy into output buffer
         LA    RØ,L'MIDDLE           Set message length
         LA    R1,LINEBUF            Get message address
         BAL   R14,PRINTLN           Go print the line
         MVC   PREVAREA(4),PVT       Save PVT as previous area addr
         MVC   AREASTRT(4),PVT       Copy start address
         MVC   AREAEND(4),PVTE       Copy end address
         MVC   AREAID(8),=CL8'PVT'   Copy identifier
         BAL   R14,SYMDEF            Go define a symbol
*-------------------------------------------------------------------*
DONECHK  DS    ØH
         CLC   PREVAREA(4),=F'Ø'     All done?
         BE    LASTLINE              Yes - pack it in
         MVC   LINEBUF(L'TOPBOTM),TOPBOTM Get line model
         XR    R15,R15               Set to Ø
         BAL   R14,HEXCNVT           Make it readable
         MVC   LINEBUF+LNOFFST3(8),DBL1 Copy into output buffer
         LA    RØ,L'TOPBOTM          Set message length
         LA    R1,LINEBUF            Get message address
         BAL   R14,PRINTLN           Go print the line
*-------------------------------------------------------------------*
LASTLINE DS    ØH
         LA    RØ,1                  Set message length
```

```
         LA    R1,=C' '              Get message address
         BAL   R14,PRINTLN           Go print the line
         B     RETURN                Pack it in for now
*-------------------------------------------------------------------*
KYWDDSPL DS    ØH
         TM    PARMFLG1,PRMEPVT      Display extended private?
         BNO   CHKKYWD2              No - check next keyword
         MVC   AREASTRT(4),EPVT      Copy start address
         MVC   AREAEND(4),EPVTE      Copy end address
         MVC   AREAID(8),=CL8'EPVT'  Copy identifier
         BAL   R14,AREADSPL          Output area information
CHKKYWD2 DS    ØH
         TM    PARMFLG1,PRMECSA      Display extended CSA?
         BNO   CHKKYWD3              No - check next keyword
         MVC   AREASTRT(4),ECSA      Copy start address
         MVC   AREAEND(4),ECSAE      Copy end address
         MVC   AREAID(8),=CL8'ECSA'  Copy identifier
         BAL   R14,AREADSPL          Output area information
CHKKYWD3 DS    ØH
         TM    PARMFLG1,PRMEMLPA     Display extended MLPA?
         BNO   CHKKYWD4              No - check next keyword
         MVC   AREASTRT(4),EMLPAS    Copy start address
         MVC   AREAEND(4),EMLPAE     Copy end address
         MVC   AREAID(8),=CL8'EMLPA' Copy identifier
         BAL   R14,AREADSPL          Output area information
CHKKYWD4 DS    ØH
         TM    PARMFLG1,PRMEFLPA     Display extended FLPA?
         BNO   CHKKYWD5              No - check next keyword
         MVC   AREASTRT(4),EFLPAS    Copy start address
         MVC   AREAEND(4),EFLPAE     Copy end address
         MVC   AREAID(8),=CL8'EFLPA' Copy identifier
         BAL   R14,AREADSPL          Output area information
CHKKYWD5 DS    ØH
         TM    PARMFLG1,PRMEPLPA     Display extended PLPA?
         BNO   CHKKYWD6              No - check next keyword
         MVC   AREASTRT(4),EPLPAS    Copy start address
         MVC   AREAEND(4),EPLPAE     Copy end address
         MVC   AREAID(8),=CL8'EPLPA' Copy identifier
         BAL   R14,AREADSPL          Output area information
CHKKYWD6 DS    ØH
         TM    PARMFLG1,PRMESQA      Display extended SQA?
         BNO   CHKKYWD7              No - check next keyword
         MVC   AREASTRT(4),ESQA      Copy start address
         MVC   AREAEND(4),ESQAE      Copy end address
         MVC   AREAID(8),=CL8'ESQA'  Copy identifier
         BAL   R14,AREADSPL          Output area information
CHKKYWD7 DS    ØH
         TM    PARMFLG1,PRMERWN      Display extended R/W NUC?
         BNO   CHKKYWD8              No - check next keyword
         MVC   AREASTRT(4),ERWNS     Copy start address
```

```
         MVC   AREAEND(4),ERWNE      Copy end address
         MVC   AREAID(8),=CL8'ER/W NUC' Copy identifier
         BAL   R14,AREADSPL          Output area information
CHKKYWD8 DS    ØH
         TM    PARMFLG2,PRMRON       Display R/O NUC?
         BNO   CHKKYWD9              No - check next keyword
         MVC   AREASTRT(4),RONS      Copy start address
         MVC   AREAEND(4),RONE       Copy end address
         MVC   AREAID(8),=CL8'R/O NUC' Copy identifier
         BAL   R14,AREADSPL          Output area information
CHKKYWD9 DS    ØH
         TM    PARMFLG2,PRMRWN       Display R/W NUC?
         BNO   CHKKYWDA              No - check next keyword
         MVC   AREASTRT(4),RWNS      Copy start address
         MVC   AREAEND(4),RWNE       Copy end address
         MVC   AREAID(8),=CL8'R/W NUC' Copy identifier
         BAL   R14,AREADSPL          Output area information
CHKKYWDA DS    ØH
         TM    PARMFLG2,PRMSQA       Display SQA?
         BNO   CHKKYWDB              No - check next keyword
         MVC   AREASTRT(4),SQA       Copy start address
         MVC   AREAEND(4),SQAE       Copy end address
         MVC   AREAID(8),=CL8'SQA'   Copy identifier
         BAL   R14,AREADSPL          Output area information
CHKKYWDB DS    ØH
         TM    PARMFLG2,PRMPLPA      Display PLPA?
         BNO   CHKKYWDC              No - check next keyword
         MVC   AREASTRT(4),PLPAS     Copy start address
         MVC   AREAEND(4),PLPAE      Copy end address
         MVC   AREAID(8),=CL8'PLPA'  Copy identifier
         BAL   R14,AREADSPL          Output area information
CHKKYWDC DS    ØH
         TM    PARMFLG2,PRMFLPA      Display FLPA?
         BNO   CHKKYWDD              No - check next keyword
         MVC   AREASTRT(4),FLPAS     Copy start address
         MVC   AREAEND(4),FLPAE      Copy end address
         MVC   AREAID(8),=CL8'FLPA'  Copy identifier
         BAL   R14,AREADSPL          Output area information
CHKKYWDD DS    ØH
         TM    PARMFLG2,PRMMLPA      Display MLPA?
         BNO   CHKKYWDE              No - check next keyword
         MVC   AREASTRT(4),MLPAS     Copy start address
         MVC   AREAEND(4),MLPAE      Copy end address
         MVC   AREAID(8),=CL8'MLPA'  Copy identifier
         BAL   R14,AREADSPL          Output area information
CHKKYWDE DS    ØH
         TM    PARMFLG2,PRMCSA       Display CSA?
         BNO   CHKKYWDF              No - check next keyword
         MVC   AREASTRT(4),CSA       Copy start address
         MVC   AREAEND(4),CSAE       Copy end address
```

```
         MVC   AREAID(8),=CL8'CSA'   Copy identifier
         BAL   R14,AREADSPL          Output area information
CHKKYWDF DS    ØH
         TM    PARMFLG2,PRMPVT       Display private?
         BNO   CHKKYWDG              No - check next keyword
         MVC   AREASTRT(4),PVT       Copy start address
         MVC   AREAEND(4),PVTE       Copy end address
         MVC   AREAID(8),=CL8'PVT'   Copy identifier
         BAL   R14,AREADSPL          Output area information
CHKKYWDG DS    ØH
*-------------------------------------------------------------------*
RETURN   DS    ØH
         L     R3,SAVEAREA+4         Load incoming savearea address
         LR    R1,R13                Get working storage address
         STORAGE RELEASE,LENGTH=WORKLEN,ADDR=(R1)
         LR    R13,R3                Restore incoming savearea address
         LM    R14,R12,12(R13)       Restore incoming registers
         XR    R15,R15               Set return code
         BR    R14                   Return
*-------------------------------------------------------------------*
*   Termination message routines.                                   *
*-------------------------------------------------------------------*
NOSTORE  DS    ØH
         MVI   LINEBUF,C' '          Set fill byte
         MVC   LINEBUF+1(131),LINEBUF Clear the area
         MVC   LINEBUF(STMSGL),STORMSG Copy the message
         BAL   R14,HEXCNVT           Make the rc readable
         MVC   LINEBUF+51(2),DBL1+6  Copy rc into message
         ICM   R15,B'1111',ADPLPAAD  Get control block address
         BAL   R14,HEXCNVT           Make it readable
         MVC   LINEBUF+37(8),DBL1    Copy c/b address into message
         MVC   LINEBUF+29(4),CBNAME  Copy c/b name into message
         LA    RØ,STMSGL             Get message length
         LA    R1,LINEBUF            Get message address
         BAL   R14,PRINTLN           Go print the line
TERM     DS    ØH
         LA    RØ,1                  Set message length
         LA    R1,=C' '              Get message address
         BAL   R14,PRINTLN           Go print a blank line
         LA    RØ,TRMMSG1L           Get message length
         LA    R1,TERMMSG1           Get message address
         BAL   R14,PRINTLN           Go print the line
         B     RETURN                We're done
*-------------------------------------------------------------------*
CBERROR  DS    ØH
         MVI   LINEBUF,C' '          Set fill byte
         MVC   LINEBUF+1(131),LINEBUF Clear the area
         MVC   LINEBUF(CBEMSG1L),CBEMSG1 Copy the message
         L     R15,CBADDR            Get control block address
         BAL   R14,HEXCNVT           Make the rc readable
```

```
         MVC   LINEBUF+51(8),DBL1    Copy c/b address into message
         MVC   LINEBUF+2Ø(4),CBNAME  Copy c/b name into message
         LA    RØ,CBEMSG1L           Get message length
         LA    R1,LINEBUF            Get message address
         BAL   R14,PRINTLN           Go print the line
         B     TERM                  All done
*--------------------------------------------------------------------*
*   Subroutines                                                      *
*--------------------------------------------------------------------*
PRINTLN  DS    ØH
*--------------------------------------------------------------------*
*   The PRINTLN subroutine generates a line of output using the      *
*   IPCS print service.                                              *
*                                                                    *
*   On entry:  RØ - contains the length of the output line           *
*              R1 - contains the address of the output line          *
*              R8 - contains the address of the ABDPL                *
*                                                                    *
*   On exit:  R15 - contains the return code from the IPCS print     *
*                   service                                          *
*--------------------------------------------------------------------*
         STM   RØ,R15,REGSAVE        Save the registers
         LA    R7,WORKPPR2           Get BLSUPPR2 address
         MVC   Ø(PPR2999-PPR2ØØØ,R7),PPR2 Copy the PPR2 model
         MVC   PPR2BUF-PPR2(4,R7),ADPLBUF Copy print buffer address
         ST    RØ,PPR2BUFL-PPR2(,R7) Save the message length
         L     R3,PPR2BUFL-PPR2(,R7) Copy the message length
         L     R15,ADPLBUF           Get message buffer address
         MVI   Ø(R15),C' '           Set fill byte
         MVC   1(131,R15),Ø(R15)     Clear message buffer area
         L     R15,ADPLBUF           Get message buffer address
         BCTR  R3,Ø                  Reduce length by one for EX
         EX    R3,MSGMVC             Copy the message
         MVI   PPR2PFL1-PPR2(R7),PPR2MSG Indicate buffer contains a msg
         L     R15,ADPLSERV          Get service routine address
         CALL  (15),                                                X
               ((R8),                                               X
               CODEPR2,                                             X
               (R7)),MF=(E,CALLLST)
PRINTLNE DS    ØH
         LM    RØ,R14,REGSAVE        Restore required registers
         BR    R14                   Return
*--------------------------------------------------------------------*
AREACHK  DS    ØH
*--------------------------------------------------------------------*
*   The AREACHK subroutine generates appropriate output lines for    *
*   the identified area of virtual storage.                          *
*                                                                    *
*   On entry:  AREASTRT - contains the starting address of the       *
*                         area being processed                       *
```

```
*              AREAEND  - contains the ending address of the          *
*                         area being processed                        *
*              AREAID   - contains the identifier of the area         *
*                         being processed                             *
*-----------------------------------------------------------------*
         STM   RØ,R15,REGSAVE2       Save registers
         L     R15,PREVAREA          Get start addr of previous area
         BCTR  R15,Ø                 Reduce by one
         C     R15,AREAEND           End is previous start?
         BE    NOAREAE               Yes - no extra info required
         MVC   LINEBUF(L'MIDDLE),MIDDLE Get line model
         L     R15,AREAEND           Get area ending addr
         BAL   R14,HEXCNVT           Make it readable
         MVC   LINEBUF+LNOFFST3(8),DBL1 Copy into output buffer
         LA    RØ,L'MIDDLE           Set message length
         LA    R1,LINEBUF            Get message address
         BAL   R14,PRINTLN           Go print the line
NOAREAE  DS    ØH
         MVC   LINEBUF(L'FILL),FILL  Get line model
         MVC   LINEBUF+LNOFFST2(8),AREAID Set area identifier
         LA    RØ,L'FILL             Set message length
         LA    R1,LINEBUF            Get message address
         BAL   R14,PRINTLN           Go print the line
         MVC   LINEBUF(L'MIDDLE),MIDDLE Get line model
         L     R15,AREASTRT          Get area starting address
         BAL   R14,HEXCNVT           Make it readable
         MVC   LINEBUF+LNOFFST3(8),DBL1 Copy into output buffer
         LA    RØ,L'MIDDLE           Set message length
         LA    R1,LINEBUF            Get message address
         BAL   R14,PRINTLN           Go print the line
         MVC   PREVAREA(4),AREASTRT  Save start as previous area addr
         BAL   R14,SYMDEF            Go define a symbol
         LM    RØ,R15,REGSAVE2       Restore registers
         BR    R14
*-----------------------------------------------------------------*
AREADSPL DS    ØH
*-----------------------------------------------------------------*
*   The AREADSPL subroutine generates appropriate output lines for    *
*   the identified area of virtual storage.                           *
*                                                                     *
*   On entry:  AREASTRT - contains the starting address of the        *
*                         area being processed                        *
*              AREAEND  - contains the ending address of the          *
*                         area being processed                        *
*              AREAID   - contains the identifier of the area         *
*                         being processed                             *
*-----------------------------------------------------------------*
         STM   RØ,R15,REGSAVE2       Save registers
         CLC   AREASTRT(4),=F'Ø'     A starting address?
         BE    AREADS2Ø              No - make one more check
```

```
AREADS1Ø DS    ØH
         MVC   LINEBUF(L'AREAMSG2),AREAMSG2 Get line model
         MVC   LINEBUF+3(8),AREAID   Copy the identifier
         L     R15,AREASTRT          Get area starting address
         BAL   R14,HEXCNVT           Make it readable
         MVC   LINEBUF+L'AREAMSG2(8),DBL1 Copy into output buffer
         LA    RØ,L'AREAMSG2+8       Set message length
         LA    R1,LINEBUF            Get message address
         BAL   R14,PRINTLN           Go print the line
         MVC   LINEBUF(L'AREAMSG3),AREAMSG3 Get line model
         L     R15,AREAEND           Get area starting address
         BAL   R14,HEXCNVT           Make it readable
         MVC   LINEBUF+L'AREAMSG3(8),DBL1 Copy into output buffer
         LA    RØ,L'AREAMSG3+8       Set message length
         LA    R1,LINEBUF            Get message address
         BAL   R14,PRINTLN           Go print the line
         LA    RØ,1                  Set message length
         LA    R1,=C' '              Get message address
         BAL   R14,PRINTLN           Go print a blank line
         BAL   R14,SYMDEF            Go define a symbol
         B     AREADSPE              We 're done
AREADS2Ø DS    ØH
         CLC   AREAID(8),=CL8'PVT'   Area is PVT?
         BE    AREADS1Ø              Yes - start address of Ø is ok
         MVC   LINEBUF(L'AREAMSG1),AREAMSG1 Get line model
         MVC   LINEBUF+L'AREAMSG1(8),AREAID Copy area identifier
         LA    RØ,L'AREAMSG1+8       Set message length
         LA    R1,LINEBUF            Get message address
         BAL   R14,PRINTLN           Go print the line
         LA    RØ,1                  Set message length
         LA    R1,=C' '              Get message address
         BAL   R14,PRINTLN           Go print a blank line
AREADSPE DS    ØH
         LM    RØ,R15,REGSAVE2       Restore registers
         BR    R14
*-------------------------------------------------------------------*
HEXCNVT  DS    ØH
*-------------------------------------------------------------------*
*   The HEXCNVT subroutine converts the hex contents of R15 to      *
*   a human-readable format in variable DBL1.                       *
*-------------------------------------------------------------------*
         ST    R15,DBL2              Save the value
         UNPK  DBL1(9),DBL2(5)       Unpack it
         NC    DBL1(8),=8X'ØF'       Turn off high nibble
         TR    DBL1(8),=C'Ø123456789ABCDEF' Make it readable
         BR    R14                   Return
*-------------------------------------------------------------------*
SYMDEF   DS    ØH
*-------------------------------------------------------------------*
*   Create an IPCS symbol for the specified symbol name.  On entry  *
```

```
*   to this routine:                                                  *
*     AREAID   - contains the name of the symbol to be defined        *
*     AREASTRT - contains the starting address of area for symbol     *
*                definition                                           *
*     AREAEND  - contains the ending address of area for symbol       *
*                definition                                           *
*-------------------------------------------------------------------*
         STM   RØ,R15,REGSAVE3       Save the registers
         NI    FLAG1,255-SYMTRY      Reset the SYMTRY flag
         MVC   SYMNAME(32),=4ØC' '   Clear symbol name area
         MVC   SYMREMRK(4Ø),=4ØC' '  Clear remark area
         MVC   SYMLEN(4),=F'8'       Set default length
         MVC   SYMNAME(8),AREAID     Copy symbol name
         CLC   SYMNAME(8),=C'R/W NUC ' R/W NUC?
         BNE   CHKSYM2               No - check next special case
         MVC   SYMNAME(8),=C'RWNUC   ' Move in altered symbol name
         B     SYMØ                  Go on
CHKSYM2  DS    ØH
         CLC   SYMNAME(8),=C'R/O NUC ' R/O NUC?
         BNE   CHKSYM3               No - check next special case
         MVC   SYMNAME(8),=C'RONUC   ' Move in altered symbol name
         B     SYMØ                  Go on
CHKSYM3  DS    ØH
         CLC   SYMNAME(8),=C'ER/W NUC' Extended R/W NUC?
         BNE   CHKSYM4               No - check next special case
         MVC   SYMNAME(8),=C'ERWNUC  ' Move in altered symbol name
         B     SYMØ                  Go on
CHKSYM4  DS    ØH
         B     SYMØ                  Go on
SYMØ     DS    ØH
         MVC   SYMREMRK(21),=C'Starting address for ' Remark prefix
         MVC   SYMREMRK+21(8),AREAID Remark suffix
SYM1     DS    ØH
         LA    R7,WORKESSY           Get ESSY area address
         MVC   Ø(ESSYLRL,R7),ESSY    Initialize the area
         MVC   ESSYSYM-ESSY(32,R7),SYMNAME Copy symbol name
         MVC   ESSYAST-ESSY(2,R7),=C'CV' Move in address space type
         MVC   ESSYLAD-ESSY(4,R7),AREASTRT Move in start address
         L     R1,AREASTRT           Copy starting address
         L     R15,AREAEND           Copy ending address
         SR    R15,R1                Calculate length
         LA    R15,1(,R15)           Add one
         STCM  R15,B'1111',ESSYDLE-ESSY(R7) Save area length
         MVC   ESSYDTY-ESSY(1,R7),=C'U' Indicate type as AREA
         MVC   ESSYDTD-ESSY(32,R7),ESSYSYM-ESSY(R7) Move in data name
         MVC   ESSYRL-ESSY(2,R7),=AL2(4Ø) Move in remark length
         MVC   ESSYRT-ESSY(4Ø,R7),SYMREMRK Copy symbol remark
*-------------------------------------------------------------------*
*   Determine proper ASID                                           *
*-------------------------------------------------------------------*
```

```
         MVC   ESSYAS2-ESSY+2(2,R7),ASID Move in default ASID
         CLC   SYMNAME(3),=C'PVT'    Private?
         BE    SYSSYM                Yes - default ASID is good
         CLC   SYMNAME(4),=C'EPVT'   Extended Private?
         BE    SYSSYM                Yes - default ASID is good
         MVC   ESSYAS2-ESSY+2(2,R7),=AL2(1) Set ASID to 1
SYSSYM   DS    ØH
         OI    ESSYFC-ESSY(R7),ESSYFCD Set NODROP attribute on symbol
         L     R15,ADPLSERV          Load addr of exit services router
         CALL  (15),                                                  X
               ((R8),                                                 X
               CODEEQS,                                               X
               (R7)),MF=(E,CALLLST)
         C     R15,=F'12'            Symbol equate ok?
         BL    SYM1E                 Yes - go on
         TM    FLAG1,SYMTRY          Is this the second try?
         BO    NOSYM1                Yes - issue message
         OI    FLAG1,SYMTRY          Set flag
         B     SYM1                  Try a second time
SYM1E    DS    ØH
         LM    RØ,R14,REGSAVE3       Restore the registers
         BR    R14                   Return
NOSYM1   DS    ØH
         MVI   LINEBUF,C' '          Set fill byte
         MVC   LINEBUF+1(131),LINEBUF Clear the area
         MVC   LINEBUF(L'SYMDMSG1),SYMDMSG1 Copy the message
         LA    R1,LINEBUF+L'SYMDMSG1 Point to target area
         L     R14,SYMLEN            Get symbol length
         MVC   Ø(32,R1),SYMNAME      Copy symbol name
         LA    R1,Ø(R14,R1)          Point to target area
         MVC   Ø(9,R1),=C' - RC(  )' Move in remainder of message
         BAL   R14,HEXCNVT           Make the rc readable
         MVC   6(2,R1),DBL1+6        Copy rc into message
         L     R14,SYMLEN            Get symbol length
         LA    RØ,L'SYMDMSG1+9(,R14) Get message length
         LA    R1,LINEBUF            Get message address
         BAL   R14,PRINTLN           Go print the line
         LA    RØ,1                  Set message length
         LA    R1,=C' '              Get message address
         BAL   R14,PRINTLN           Go print a blank line
         B     SYM1E                 Go back for more
*-------------------------------------------------------------------*
*   Executed instructions                                           *
*-------------------------------------------------------------------*
BLNKCLC  CLC   Ø(*-*,R5),=3C' '      Remaining parm data blanks?
MSGMVC   MVC   Ø(*-*,R15),Ø(R1)      Copy the message
*-------------------------------------------------------------------*
*   Constants                                                       *
*-------------------------------------------------------------------*
CODEACC  DC    A(ADPLSACC)           Storage access service code
```

```
CODEPR2  DC    A(ADPLSPR2)           Expanded print service code
CODEEQS  DC    A(ADPLSEQS)           Equate symbol service code
*-------------------------------------------------------------------*
PPR2     BLSUPPR2 DSECT=NO           IPCS expanded print parm list
*-------------------------------------------------------------------*
ESSY     BLSRESSY DSECT=NO           IPCS equate symbol parm list
*-------------------------------------------------------------------*
PARMMSG1 DC    C'STRMP110I - Invalid parm detected.  Valid parms are: '
         DC    C' EPVT ECSA EMLPA EFLPA EPLPA ESQA ERWNUC RONUC RWNUC '
         DC    C'SQA PLPA FLPA MLPA CSA PVT'
PRMMSG1L EQU   *-PARMMSG1
*-------------------------------------------------------------------*
STORMSG  DC    C'STRMP112I - Unable to locate xxxx at xxxxxxxx - '
         DC    C'RC(xx)'
STMSGL   EQU   *-STORMSG
*-------------------------------------------------------------------*
CBEMSG1  DC    C'STRMP132I - Invalid xxxx control block detected at '
         DC    C'xxxxxxxx'
CBEMSG1L EQU   *-CBEMSG1
*-------------------------------------------------------------------*
TERMMSG1 DC    C'STRMP189I - Storage map display terminated.'
TRMMSG1L EQU   *-TERMMSG1
*-------------------------------------------------------------------*
SYMDMSG1 DC    C'STRMP131I - Error detected defining symbol '
         DC    C'- RC(xx)'
SYDMSG1L EQU   *-SYMDMSG1
*-------------------------------------------------------------------*
TOPBOTM  DC    CL50'            +--------------+           '
FILL     DC    CL50'            ]              ]           '
MIDDLE   DC    CL50'            ]--------------]           '
MB16     DC    CL50'     16MB --]---        ---]--         '
LNOFFST1 EQU   3
LNOFFST2 EQU   17
LNOFFST3 EQU   29
*-------------------------------------------------------------------*
AREAMSG1 DC    C'No storage area available for '
AREAMSG2 DC    C'   xxxxxxxx start address:  '
AREAMSG3 DC    C'              end address:  '
*-------------------------------------------------------------------*
         LTORG ,
*-------------------------------------------------------------------*
WORKAREA DSECT
SAVEAREA DS    18F
CALLLST  CALL  ,(,,,,,,),MF=L
REGSAVE  DS    16F                   Subroutine register save area
REGSAVE2 DS    16F                   Subroutine register save area
REGSAVE3 DS    16F                   Subroutine register save area
ASID     DS    XL2
*-------------------------------------------------------------------*
AREASTRT DS    F                     Area starting address
```

```
AREAEND  DS    F                     Area ending address
AREAID   DS    CL8                   Area identifier
*-------------------------------------------------------------------*
PARMADDR DS    F                     Incoming parameter address
GDAADDR  DS    F                     Address of the GDA from the CVT
MLPAS    DS    F  ]Keep contiguous]  Starting virtual addr of MLPA
MLPAE    DS    F  ]                ]  Ending virtual addr of MLPA
FLPAS    DS    F  ]                ]  Starting virtual addr of FLPA
FLPAE    DS    F  ]                ]  Ending virtual addr of FLPA
PLPAS    DS    F  ]                ]  Starting virtual addr of PLPA
PLPAE    DS    F  ]                ]  Ending virtual addr of PLPA
RWNS     DS    F  ]                ]  Starting virtual addr of R/W Nuc
RWNE     DS    F  ]                ]  Ending virtual addr of R/W Nuc
RONS     DS    F  ]                ]  Starting virtual addr of R/O Nuc
RONE     DS    F  ]                ]  Ending virtual addr of R/O Nuc
ERWNS    DS    F  ]                ]  Starting virtual addr of ER/W Nuc
ERWNE    DS    F  ]                ]  Ending virtual addr of ER/W Nuc
EPLPAS   DS    F  ]                ]  Starting virtual addr of EPLPA
EPLPAE   DS    F  ]                ]  Ending virtual addr of EPLPA
EFLPAS   DS    F  ]                ]  Starting virtual addr of EFLPA
EFLPAE   DS    F  ]                ]  Ending virtual addr of EPLPA
EMLPAS   DS    F  ]                ]  Starting virtual addr of EMLPA
EMLPAE   DS    F  ]                ]  Ending virtual addr of EMLPA
*-------------------------------------------------------------------*
CSA      DS    F                     Starting virtual addr of CSA
CSASZ    DS    F                     Size of CSA
CSAE     DS    F                     Ending virtual addr of CSA
SQA      DS    F                     Starting virtual addr of SQA
SQASZ    DS    F                     Size of SQA
SQAE     DS    F                     Ending virtual addr of SQA
ECSA     DS    F                     Starting virtual addr of ECSA
ECSAS    DS    F                     Size of ECSA
ECSAE    DS    F                     Ending virtual addr of ECSA
ESQA     DS    F                     Starting virtual addr of ESQA
ESQAS    DS    F                     Size of ESQA
ESQAE    DS    F                     Ending virtual addr of ESQA
PVT      DS    F                     Starting virtual addr of Private
PVTSZ    DS    F                     Size of Private
PVTE     DS    F                     Ending virtual addr of PVT
EPVT     DS    F                     Starting virtual addr of EPrivate
EPVTS    DS    F                     Size of EPrivate
EPVTE    DS    F                     Ending virtual addr of PVTE
*-------------------------------------------------------------------*
PREVAREA DS    F                     Previous mapped area's start addr
*-------------------------------------------------------------------*
CVTADDR  DS    F
PARMFLGS DS    ØXL2
PARMFLG1 DS    X                     Parm flag 1
PRMEPVT  EQU   X'8Ø'                 EPVT parm specified
PRMECSA  EQU   X'4Ø'                 ECSA parm specified
```

```
PRMEMLPA EQU   X'2Ø'                EMLPA parm specified
PRMEFLPA EQU   X'1Ø'                EFLPA parm specified
PRMEPLPA EQU   X'Ø8'                EPLPA parm specified
PRMESQA  EQU   X'Ø4'                ESQA parm specified
PRMERWN  EQU   X'Ø2'                ERWNUC parm specified
PARMFLG2 DS    X                    Parm flag 2
PRMRON   EQU   X'8Ø'                RONUC parm specified
PRMRWN   EQU   X'4Ø'                RWNUC parm specified
PRMSQA   EQU   X'2Ø'                SQA parm specified
PRMPLPA  EQU   X'1Ø'                PLPA parm specified
PRMFLPA  EQU   X'Ø8'                FLPA parm specified
PRMMLPA  EQU   X'Ø4'                MLPA parm specified
PRMCSA   EQU   X'Ø2'                CSA parm specified
PRMPVT   EQU   X'Ø1'                PVT parm specified
CBNAME   DS    CL8                  Control block name save area
CBADDR   DS    ØD,CL(8)             Control block address save area
WORKPACC DS    ØD,CL(ADPLLACC)
WORKPPR2 DS    ØD,CL(PPR2999-PPR2ØØØ)
WORKESSY DS    ØD,CL(ESSYHRL)
LINELEN  DS    F
LINEBUF  DS    CL(132)
DBL1     DS    2D
DBL2     DS    2D
SYMNAME  DS    CL(32)               Symbol name
SYMREMRK DS    CL(4Ø)               Symbol remark
SYMLEN   DS    F                    Symbol length
FLAG1    DS    XL1
SYMTRY   EQU   X'8Ø'
WORKLEN  EQU   *-WORKAREA
*--------------------------------------------------------------------*
RØ       EQU   Ø
R1       EQU   1
R2       EQU   2
R3       EQU   3
R4       EQU   4
R5       EQU   5
R6       EQU   6
R7       EQU   7
R8       EQU   8
R9       EQU   9
R1Ø      EQU   1Ø
R11      EQU   11
R12      EQU   12
R13      EQU   13
R14      EQU   14
R15      EQU   15
*--------------------------------------------------------------------*
         BLSABDPL DSECT=YES,                                        X
               AMDEXIT=YES,                                         X
```

```
         AMDOSEL=NO,                                          X
         AMDPACC=YES,                                         X
         AMDPFMT=YES,                                         X
         AMDPECT=NO,                                          X
         AMDPSEL=NO
PRINT    NOGEN
CVT      DSECT=YES
IHAGDA   ,
         END
```

Compute (Bridgend) has announced Release 2.10 of CBLVCAT for Mainframe, its VSAM file tuning, VSAM catalog display, and VTOC display and modification software.

CBLVCAT has been updated to support 31-bit addressing and is now linked as AMODE=31 on all platforms. This overcomes previous storage restrictions, allowing CBLVCAT to utilize buffers in storage above the 16MB line.

Also new is the CBLVCAT Interactive (VCI) Environment, which is a component of the new CBL Interactive (CBLi) Interface that provides all authorized users with an interactive environment for executing CBLVCAT and SELCOPY.

The VCI component of CBLi allows interactive execution of CBLVCAT control statements sourced from a data set or via a command line. The generated report is stored in internal buffers and presented to the user in a window area with coloured highlighting. The report may be edited and optionally saved to a data set.

Where LISTVCAT option DEFINE is specified, an edit window is automatically opened for the CBLVCAT generated IDCAMS DEFINE job, thus allowing alteration by the user before submission.

For further information contact:
Compute (Bridgend) Ltd, 8 Merthyr Mawr Road, Bridgend, Wales CF31 3NH, UK.
Tel: (01656) 652222.
URL: http://www.cbl.com.

* * *

Axios has announced Version 4.1.0 of SmartAnalyzer, its back-up reliability analysis software. The new version provides users with more details regarding the reliability of their onsite application data back-ups and migrations.

SmartAnalyzer identifies problems and inefficiencies in the way data is managed by either the HSM or DMS disk management systems. It identifies missing and unusable back-ups, unnecessary back-ups, back-ups taken by non-standard tools, and more. It provides comprehensive auditing capabilities for maintenance of data availability and recoverability.

For further information contact:
Axios, 1373-10 Veterans Highway, Hauppauge, NY 11788, USA.
Tel: (631) 979 0100.
URL: http://www.axios.com/whatprod.html.

* * *

Open Software Technologies has announced Version 6.1 of REXXTOOLS/MVS. The product adds access method interfaces, plus many REXX language extensions that increase the functionality of the REXX language.

REXXTOOLS/MVS contains three components, which are Basic Services, and Dynamic SQL Services, and Static SQL Services.

6.1 has a new CICS external interface, an external writer facility, extended addressing or VSAM and the QSAM interface now supports data sets with spanned records..

For further information contact:
Open Software Technologies, PO Box 162652, Altamonte Springs, FL 32716-2652, USA.
Tel: (407) 788 7173.
URL: http://www.open-softech.com/mvs2.htm#newbasic.