Can CIM help resolve your Space Problems?

This White Paper sets out the key principles for the identification and solution of online system availability failures due to space problems. CIM provides information and practical support to enable storage professionals to improve batch performance and re-locate catalogs without having to make the data unavailable for a significant period.

The Symptoms

The organisation is failing to get online systems available to deadline because the batch workload is over running, and jobs are failing due to space allocation problems on disk volumes.

The Operations Analysts are being paid overtime because they are called in overnight to manually resolve the space problems on critical path jobs.

The Storage Team are assuring management that enough disk space is available, but that not all of it is currently useable.

The organisation is paying for the missed SLA's, but the problem is not being resolved!

The Cause

The organisation has dataset allocations that are failing because there is insufficient space in the VTOC of a volume to allow any additional DSCB's to be allocated. The volume holds many small datasets, but still has a significant amount of space available which is currently unusable.

The Storage Team will have identified the problem, but the resolution requires the applications to be unavailable while all the data is moved, before the disks can be reformatted.

The only time when having an application unavailable is acceptable is during non-working hours or a pre-arranged maintenance window. Generally, pre-arranged maintenance windows are reserved for major projects, such as system upgrades, which would incur penalties if they are delayed. The only time any work can be done involves paying overtime for employees to work outside their normal working hours.

The Cure

Using Catalog Information Management (CIM) it may be possible to solve problems without the need to have the applications down while you reorganise your storage.

CIM provides an insight into the logical disk space usage that is required and judges if the problem can be solved using tools which can be used during the online day, rather than tools which can only safely be used during quiet hours or maintenance windows.

The Treatment

As the disk in question holds several thousand heavily used small datasets clearing all the data from the volume and reformatting is not an option.

Most sites use IBM's ICKDSF product for preparing disks for use by z/OS systems, including allocating the VTOC. Referring to the IBM "Device Support Facilities: User's Guide and Reference" (Document number: GC35-0033-28 or Book Name: ICK4020B) shows that the ICKDSF product can also be used for maintaining volumes once they are in use.

Indeed the REFORMAT option of ICKDSF provides several parameters for working with the VTOC of an existing DASD volume:

- **NEWVTOC:** This option allows the VTOC to be rebuilt in a new location on the disk volume. The sizing of the VTOC can also be changed as it is rebuilt
- **EXTVTOC:** This option allows the existing VTOC to be extended from the current location
- **REFVTOC:** This option allows the VTOC to be rebuilt in its existing location with out being resized

Therefore it appears that the problem can be resolved by using either the NEWVTOC or EXTVTOC parameters of the ICKDSF REFORMAT Option. Choosing which of these options to use depends on a number of factors:

- **NEWVTOC:**
  - The volume must be offline to all systems when the ICKDSF job is running
  - A large enough single contiguous extent must be available on the disk to hold the new VTOC
- **EXTVTOC:**
  - The space contiguous to the existing VTOC must be available for the VTOC to expand into
  - If there is not enough contiguous free space after the VTOC to allow for the planned expansion, we need to consider what data needs to be moved to allow the VTOC to expand

So while the expansion of the VTOC is achieved using ICKDSF, CIM ensures a large enough free extent is available for the new VTOC to be allocated, or to confirm that sufficient contiguous space is available for the planned expansion after the existing VTOC.

Using the NEWVTOC Option

The NEWVTOC Parameter of the ICKDSF REFORMAT utility allows the VTOC to be relocated to a different position on the volume.

Consideration 1:

For improved performance the Catalogue Address Space (CAS) on each z/OS image retains a pointer to the start of the VTOC on all volumes when they first accessed from that system. Moving a VTOC while a disk is online to a system could result in inconsistent access to data and possibly corruption of the data on the disk.

Therefore, the major consideration when evaluating if the NEWVTOC parameter can be used is that the disk volume must be taken of line to all systems before the ICKDSF job can be run.

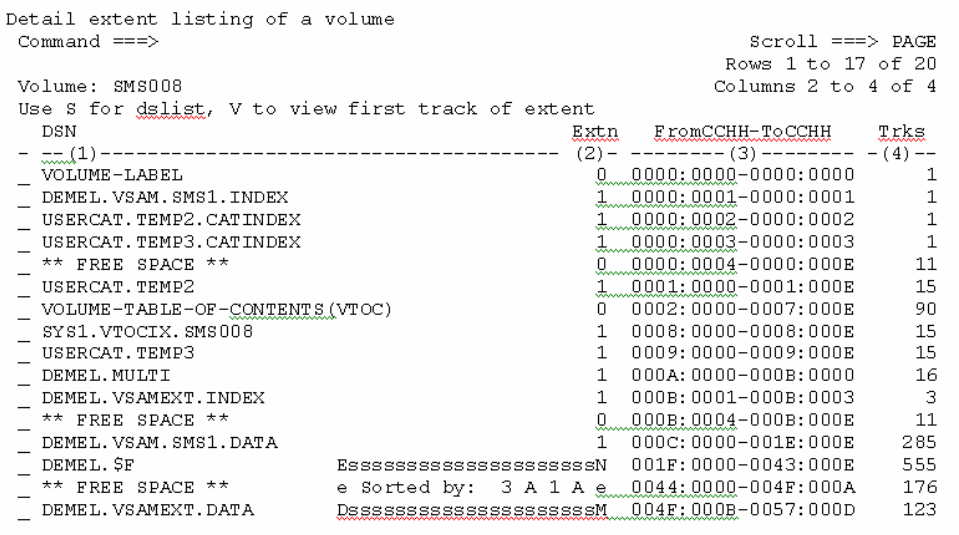
If the volume can not be taken offline to all systems for the period when the ICKDSF job is running, the NEWVTOC parameter can not be used. This decision must be made with local knowledge and consideration for the impact on all systems.

Consideration 2:

In order for the ICKDSF job to allocate a new VTOC on the disk a single extent of free space large enough to hold the new VTOC must be available on the disk. As most sites no longer use physical 3390's, the positioning of the VTOC on a disk is no longer a performance consideration.

Establishing if a single extent of free space is available on the disk volume can be done easily using CIM. From the CIM Primary Option Panel, selecting 21.16, it is possible to display the extents allocated on a disk. Sorting this display by the "FromCCHH-ToCCHH" column allows you to view the extents in physical order. You can then see the size of the existing VTOC, and establish if a single extent exists which is larger enough to take the new VTOC.

The screenshot below shows an example of the detail extent listing of a volume sorted by the "FromCCHH-ToCCHH" column. On this volume the VTOC can be seen to occupy 90 tracks, and we can also see that a free space extent of 176 tracks exists.



```
Detail extent listing of a volume
 Command ===>                                                Scroll ===> PAGE
                                                           Rows 1 to 17 of 20
 Volume: SMS008                                           Columns 2 to 4 of 4
 Use S for dslist, V to view first track of extent
   DSN                                        Extn   FromCCHH-ToCCHH     Trks
 - --(1)------------------------------------ (2)- --------(3)-------- -(4)--
 _ VOLUME-LABEL                               0   0000:0000-0000:0000       1
 _ DEMEL.VSAM.SMS1.INDEX                      1   0000:0001-0000:0001       1
 _ USERCAT.TEMP2.CATINDEX                     1   0000:0002-0000:0002       1
 _ USERCAT.TEMP3.CATINDEX                     1   0000:0003-0000:0003       1
 _ ** FREE SPACE **                           0   0000:0004-0000:000E      11
 _ USERCAT.TEMP2                              1   0001:0000-0001:000E      15
 _ VOLUME-TABLE-OF-CONTENTS(VTOC)             0   0002:0000-0007:000E      90
 _ SYS1.VTOCIX.SMS008                         1   0008:0000-0008:000E      15
 _ USERCAT.TEMP3                              1   0009:0000-0009:000E      15
 _ DEMEL.MULTI                                1   000A:0000-000B:0000      16
 _ DEMEL.VSAMEXT.INDEX                        1   000B:0001-000B:0003       3
 _ ** FREE SPACE **                           0   000B:0004-000B:000E      11
 _ DEMEL.VSAM.SMS1.DATA                       1   000C:0000-001E:000E     285
 _ DEMEL.$F                 EssssssssssssssssssssN   001F:0000-0043:000E     555
 _ ** FREE SPACE **         e Sorted by:  3 A 1 A e   0044:0000-004F:000A     176
 _ DEMEL.VSAMEXT.DATA       DsssssssssssssssssssssM   004F:000B-0057:000D     123
```

Creating the new VTOC.

Once you have established that you are able to take the volume offline to all systems and that a single extent exists on the volume large enough to allocate the size of VTOC you intend to create, you can proceed.

As placement of the VTOC is no longer a performance consideration, it is possible to use the ANY sub-parameter to allow ICKDSF to place the VTOC in the first available extent that is large enough to hold the new VTOC. The Sample JCL below would create a new VTOC of 10 Tracks in the first free extent of 10 tracks or more:

```
//EXAMPLE  JOB
//NEWVTOC  EXEC PGM=ICKDSF
//VOLDD    DD   DISP=SHR,UNIT=3390,VOL=SER=TMP121
//SYSPRINT DD   SYSOUT=A
//SYSIN    DD   *
 REFORMAT DDNAME(VOLDD) VERIFY(TMP121) NEWVTOC(ANY,10)
/*
```

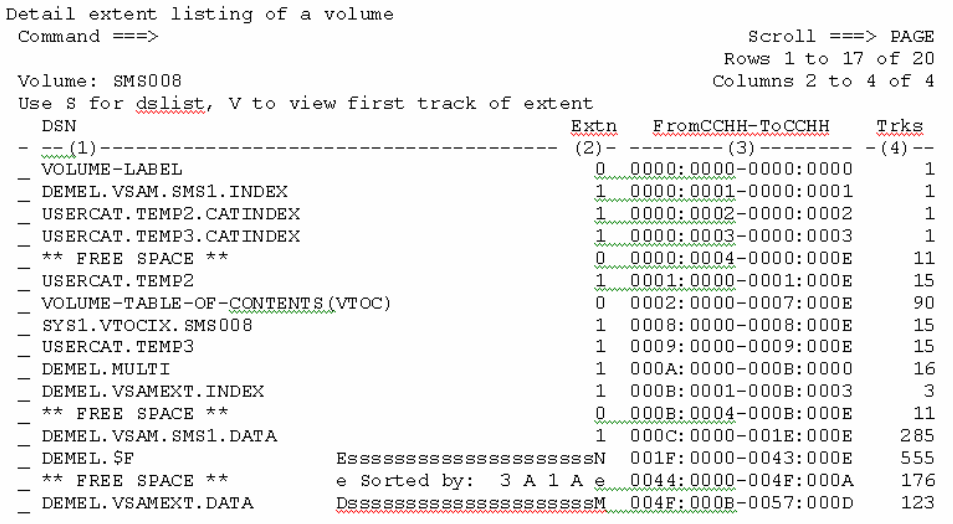
Once the job has completed successfully the volume can be brought online to all systems.

Extending the VTOC

The EXTVTOC Parameter of the ICKDSF REFORMAT utility allows the VTOC to be enlarged from its current location on the volume.

It is only possible to extend the VTOC in its current location if the space immediately contiguous to the VTOC is available when the ICKDSF REFORMAT is run. Establishing if the required space is available can be done easily using CIM. From the CIM Primary Option Panel, selecting 21.16, it is possible to display the extents allocated on a disk. Sorting this display by the "FromCCHH-ToCCHH" column allows you to view the extents in physical order.

The screenshot below shows an example of the detail extent listing of a volume sorted by the "FromCCHH-ToCCHH" column. On this volume the VTOC can be seen to occupy 90 tracks, and we can also see that the contiguous space is occupied by the VTOC Index, a User Catalog and some local datasets:



Having located the VTOC on the listing of your volume, you will then be able to see if the contiguous space is available, or what data needs to be moved to free the space.

If the volume is a system volume, the systems programmers will need to be involved in deciding if and when data can be moved. Special consideration must be given to moving datasets such as Page Datasets, JES Spool or Checkpoint Datasets, and Coupling facility datasets.

Assuming that the volume involved is not a “System” volume, it is reasonable to expect that every piece of data that requires moving should fall in to one of the following categories:

- Local Data – Any locally created user, batch or online datasets
- Catalog – Data or Index portion of a Catalog.
- VTOC Index – SYS1.VTOCIX.volser
- VVDS – SYS1.VVDS.volser

Moving each of these data types requires consideration as detailed below, but in the example shown in the screen shot above it may be necessary to move 3 different types of data. Moving a mixture of data types will need consideration to be given to the order in which the data is moved.

Moving Local Data

If the data that requires moving is local data you will need to consider what the data is and therefore if or when it can be moved and what tools are available to move it. One of the simplest methods of moving the data is to use HSM to migrate it from the disk to ML1 or ML2 during a period when it is not being used.

Moving a Catalog

While in general moving a catalog is not a task to be under taken without serious consideration and considerable disruption to the system, CIM provides the Re-org While Open function which can limit the disruption to your systems, and will re-locate the catalog elsewhere on the same volume.

The CIM Re-org While Open allows a catalog to be re-organised while in use. The only limitation is that the catalog must remain on the same volume; therefore enough space must be available on the existing volume for the catalog to be re-allocated.

During the process of reorganising the catalog, CIM will place a shared enqueue on the catalog, which means that all read requests to the catalog can be serviced. A request to create, delete or alter a catalog entry will result in all subsequent requests being queued until after the re-organisation has completed. It is therefore important that you consider the workload of the catalog when deciding on the timing of any reorganisation.

The CIM Re-org While Open is available by selecting 1.31 from the CIM primary option panel. The panels will then guide you through the 3 step process of:

1. Allocating a temporary dataset
2. Re-organising the catalog
3. Deleting the temporary dataset

Moving the VTOC Index

It is advisable to only attempt to re-locate the VTOC Index during a planned systems maintenance interval, as it is necessary to delete and re-allocate the VTOC Index. Any access attempts during the period between deletion and rebuilding of the VTOC Index may cause jobs to fail or possibly data corruption.

The following procedure explains the steps involved in re-locating the VTOC Index:

1. Convert the disk from IXVTOC format to OSVTOC format using ICKDSF
2. Delete the VTOC Index
3. Extend the VTOC: Using ICKDSF
4. Allocate the VTOC index and convert the disk from OSVTOC to IXVTOC format using ICKDSF

Details for Steps 1 and 4 are available from Chapter 12 of IBM's "Device Support Facilities: User's Guide and Reference".

Moving the VVDS

It is also advisable to only attempt to re-locate the VVDS during a planned systems maintenance interval, as it is necessary to delete and re-allocate the VVDS. Any access attempts during the period between deletion and rebuilding of the VTOC Index will result in errors.

The following process can be used to relocate the VVDS dataset:

1. Back-up the VVDS: use CIM option 11 to create the JCL required
2. Delete the VVDS: using CIM option 15
3. Extend the VTOC: using ICKDSF as described below
4. Recover the VVDS: use CIM Option 15 to recover the VVDS from the Back-up taken in step 1

Extending the VTOC

Once you have the contiguous space available to permit the VTOC to extend, the following ICKDSF job should be used:

```
//EXAMPLE  JOB
//NEWVTOC  EXEC PGM=ICKDSF
//VOLDD    DD   DISP=SHR,UNIT=3390,VOL=SER=TMP121
//SYSPRINT DD   SYSOUT=A
//SYSIN    DD   *
 REFORMAT DDNAME(VOLDD) VERIFY(TMP121) EXTVTOC(100)
/*
```

The value used in the EXVTOC parameter is the total number of tracks, in hexi-decimal, that the VTOC will occupy after it has been extended.

The Verdict

The actual resolution of the problem lies within the IBM ICKDSF utility, but usage of ICKDSF generally requires the Disk to be made unavailable to all systems.

Without CIM, using ICKDSF while the volume is online would be a very risky proposition which could result in:

- Data Corruption
- Application Failures
- System Outages

CIM provides the insight into the location of data on the disk, from which you can evaluate what data needs moving. If the data that requires moving includes a catalog, then CIM provides the option available for re-locating the catalog, without having to make the data referenced through that catalog unavailable for a significant period.

CIM makes it possible to resolve the problem with out losing valuable online system availability.