OUT OF SPACE RECOVERY WHITE PAPER FROM DTS SOFTWARE

Overview

In recent releases of OS/390 and z/OS, IBM has introduced additional attributes into the data class and storage group SMS constructs in an attempt to provide some of the out-of-space error prevention capabilities DTS Software's SRS and similar products have provided for many years. While the 'space error constraint relief' function does provide some benefit, the recovery facilities provided are of limited scope and utility when compared to the mature functionality, robustness, and ease-of-use of vendor products. This paper will discuss the techniques used by DFSMS and Space Recovery System and the advantages of the latter.

How Space Error Constraint Relief Works

Space error prevention in DFSMS is provided (for SMS managed datasets only) through the use of attributes in the Data Class and Storage Group constructs assigned to a dataset. (Datasets which are not SMS managed or which are not assigned a data class are not eligible for DFSMS space error prevention). The following is a short discussion of how DFSMS space error prevention works.

Data Class Requirements

Two data class attributes (SPACE CONSTRAINT RELIEF and REDUCE SPACE UP TO) are used if insufficient space is available to meet a request for primary space. If allowed, DFSMS will spread the primary space amount across multiple volumes, but only if the dataset is initially allocated as multivolume, i.e., a volume count was specified in the JCL or data class. DFSMS can reduce the size of the space request by a single percentage like 50%. DFSMS has eliminated the old restriction of a maximum of 5 extents to satisfy a space request. There is no increase in the total number extents so the primary allocation could use up all 16 extents of a non-EF data set. If space is still insufficient, the allocation fails. The same process may also be attempted when a secondary extent is required, but only if the secondary extent is to be obtained on a new volume. Space reduction is not performed if secondary cannot be obtained on

Advantages of SRS over DFSMS

Data Set Types
- DFSMS basically help SMS managed EF dataset with the proper data class and storage group definitions
- SRS handles all types of data sets based on installation defined rules completely separate from SMS ACS Classes
- Rules can examine over 300 different variables, not just the 20 or so passed to ACS routines
- SRS handles SMS and non-SMS, EF and non-EF, VSAM and non-VSAM, EXCP and PDS data sets, even tape data sets.

Multiple Recovery Attempts
- DFSMS will make one attempt to reduce the primary space and has no secondary space recovery. All other recovery attempts are to add additional volumes
- SRS will reduce the primary space by a percentage until it reaches a installation define minimum
- SRS will reduce the amount of secondary space to the largest extent on the volume trying to use any available space
- SRS can increase the secondary space to conserve extents for data sets with very small secondary amounts
- The last thing SRS will do is make the data set multivolume.
- For critical jobs, SRS can prompt the operator

Rule Tracing
- DFSMS has no trace facility for ACS routines. If you need assistance from IBM, a system dump is required
- SRS has extensive rule tracing. The simple addition of a //ACCTRACE DD card will generate a trace showing the complete selection logic
- SRS has module tracing to assist in resolving problems with SRS logic flow

Integrity Checking
- DFSMS has no integrity checking. If the data class sets allows DFSMS to make the data set multi-volume, there is no runtime checking to ensure the program/data set is capable of handling a multi-volume data set.
- SRS has multiple checks to ensure the program, the access method and use by other jobs does not expose the installation to data lost or turn a B37 into a 0C4.

Reporting
- DFSMS has no facility to report on the successful out of space recoveries. No SMF records are generated so the installation can not take corrective action to prevent the out of space condition in the future.
- SRS can generate log records, SMF records and even send email on all successful and unsuccessful recovery attempts.
- SRS can automatically submit a job to copy data sets that SRS made multi-volume back to a single volume.

SRS

the current volume. Additional volumes may only be obtained dynamically if the DYNAMIC VOLUME COUNT attribute is also specified in the data class.

Storage Group Requirements

At allocation time, DFSMS attempts to place the new dataset on the most appropriate volume in the storage group assigned by the ACS routines. If all of the desirable volumes are filled to a level higher than the storage group occupancy threshold, then DFSMS will attempt to place the dataset on a volume in 'quiesced' status, or, beginning with z/OS version 1.3, on a volume in a storage group designated as an 'overflow' storage group. This is not really an error-prevention technique, but rather a volume-selection algorithm used to insure that data is distributed evenly over the volumes. It applies to all datasets. The use of 'quiesced' volumes or overflow storage groups can prevent the primary storage groups from becoming overused, but at the expense of having datasets wind up on other, less desirable volumes in a manner that cannot be predicted in advance.

z/OS version 1.4 introduced 'extend' storage groups, which allow datasets to extend to additional volumes (again, only if the additional volumes are present in the JCL or if DYNAMIC VOLUME COUNT was specified in the data class). A dataset may be extended to a new volume in the extend storage group even if there is still some space in the original storage group, since the use of extend storage groups is preferred over the use of secondary space reduction on new volumes.

ACS Routine Requirements

In order to implement space error constraint relief under DFSMS, the Automatic Class Selection routines must be updated to assign the necessary data classes and storage groups. For datasets that are already assigned to data classes, the data classes must be updated to include the space error recovery attributes. If some types of datasets are not subject to space error prevention or if different space reduction percentages are to be used for different datasets, additional data classes must be created. If overflow storage groups are to be used, the storage group definitions must be updated, and the ACS routines must be changed to assign these storage groups in addition to those currently being assigned. If extend storage groups are to be used, they must be defined and 'linked' to the original storage groups (each storage group can link to only one 'extend' storage group).

Reporting

DFSMS has no reporting facility to show which jobs required space recovery. No SMF records are created when a data set is "saved". There are no log messages to the SYSLOG or the user. This makes it difficult to change the root cause of the problem.

> "I don't just want to save jobs. I want to know which jobs were saved and fix the JCL so they don't need to be saved over and over."

The Space Recovery System Solution

The developers at DTS Software pioneered the concepts of DASD space error prevention in the early 1980s. Since that time, the technologies and strategies used for error prevention have been refined and extended to the point where even the largest installations that use DTS Software's Space Recovery System experience virtually no unwanted out-of-space errors. SRS is a mature product that provides much more complete prevention of errors along with a simple rules-based control language and interface that makes it easy to implement, and equally important, easy to understand. SRS provides error prevention for all types of datasets, SMS and non-SMS, DB2, VSAM and non-VSAM, sequential, partitioned, and all others. Dataset and job-level granularity allows customization of SRS processing at a level of detail, which cannot be attained with DFSMS. SRS integrity checking prevents error recovery in situations where it might not be appropriate; such as applications which use 'home-grown' access methods or NOTE/POINT processing.

While SRS is compatible with the use of DFSMS space error constraint relief processing, with SRS in place the additional complexity of more data classes and more storage groups, with varying attributes, and changes to the ACS routines, is unnecessary. SRS can provide complete, centralized, easily understandable error prevention as well as additional features like the ability to alter the secondary space request based on current dataset size or number of extents, without the need to alter the SMS configuration in any way.

SRS

Handles all types of data.

SRS can prevent out-of-space errors and perform other processing on all types of datasets. DFSMS processing is limited to SMS-managed datasets, which are assigned a data class with the proper attributes and where the storage group definitions are appropriate.

Multiple Reduction Attempts.

If insufficient space is available to meet the request for primary or secondary space, SRS will make multiple attempts to get the space, reducing the size of the request each time until the request is satisfied or until a designated 'floor' value is reached. This techniques makes it much more likely that the request for space will succeed, and also allows the space to be decremented in small amounts, allowing the obtained space to be closer to the requested amount. DFSMS processing makes a single attempt to reduce space and fails the allocation if the reduced amount cannot be obtained.

Secondary Space Reduction.

If sufficient space cannot be obtained on the current volume, SRS will reduce the size of the secondary amount to that of the largest contiguous extent on the volume. This is probably the most common type of space error prevention performed, and may occur several times as the amount of available space on a volume fluctuates while a dataset is extended. It is not performed at all by DFSMS. If secondary space cannot be obtained, DFSMS will attempt to make the data set multi-volume. Making a data set multi-volume is the last thing SRS will do, not the first.

Provide Secondary Space.

If no secondary space amount is specified, SRS can provide a value for secondary space, based on the primary space allocation or other factors, allowing the job to continue. DFSMS cannot provide secondary space if none is specified in the JCL or Data Class.

Modify Secondary Space Amount.

SRS can dynamically modify the amount of secondary space requested while the job is running. This feature can be used to allow the job to increase the size of secondary space requests as the number of extents increases, allowing the dataset to use fewer extents, decreasing the chance for error and reducing the necessity to make the data set multi-volume. The size of the secondary space request can also be changed in other ways based on job or dataset name, type of job (production or test, batch or TSO, etc.), time of day, or other factors. This 'flexible secondary' extension feature allows SRS to match secondary space requests to installation requirements, decreasing the overall space usage. DFSMS only assigns data classes and storage groups and does not provide such a feature.

'Last-Resort' Recovery.

Sometimes, despite use of primary and secondary space reduction and dynamic volume addition, it is not possible to prevent an out-of-space condition from occurring. This might happen if, for example, a dataset has extended to all of the available volumes in the storage group, or if one volume on which a sequentially striped dataset must extend is full. In these cases, SRS can dynamically interrupt the job and notify the operator that a failure is imminent. The operator can then take appropriate action, such as adding new volumes to the storage group or migrating unused data, to allow the job to complete successfully. This feature is unique to SRS. Obviously, this would only be used for mission critical applications where an out of space failure could be disastrous.

> The bottom line is, without SRS, I still get Space Abends. There are just too many situations where DFSMS doesn't recover the job.

Logic Tracing.

SRS provides a logic tracing facility that allows the storage administrator to see which SRS recovery rules were executed and why space error prevention was or was not provided. This sort of trace is invaluable in debugging and 'what if' analysis. DFSMS space error constraint relief is embodied only in the data class and storage group attributes and the ACS routines, which do not provide any logic trace. (However, the SRS companion products Allocation Control Center and SMS/Debug do provide a logic trace for the DFSMS ACS routines).

Automatic Rebuild.

When a job, which required SRS to make multi-volume, completes, SRS can automatically submit a job that invokes the system data mover to copy the dataset back to single-volume status.

SRS
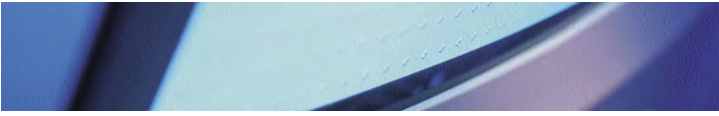
SMF Reporting.

SRS can write SMF records for each out-of-space error recovery attempt, whether successful or unsuccessful. An SMF reporting program is provided which summarizes these records and displays the results in terms of job and dataset names and type of recovery (primary or secondary space reduction, add-volume, etc.). These reports are useful in determining the cause of any out-of-space failures that do occur, and in finding jobs that are repeatedly 'saved' and thus may require tuning. There is no such facility in DFSMS.

Integrity Checking.

By default, SRS performs multiple integrity checks before dynamically adding volumes to a dataset in order to insure that the added volume can be successfully used. For example, SRS checks to see whether the dataset being extended is in use by more than one job, whether it is catalogued, and whether it is using an access method such as EXCP or NOTE/POINT processing which might not support multivolume access. The SRS rules can be used to override these checks for datasets known to support multivolume data. What good it is if a B37 is turned into an 0C4 because DFSMS made a SORTWKnn data set multi-volume. No such integrity checks are made when DFSMS space error constraint is used alone.

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Centralized Error Recovery Rules.

Like all of the DTS Software products, SRS uses a set of simple IF/THEN/ELSE rules to provide out-of-space error recovery for all types of data. Unlike the DFSMS ACS routines, which run only when a dataset is created in order to assign SMS constructs, the SRS rules are executed at the time that space error recovery processing is required. This allows much more detailed control over recovery, including dataset and job-level granularity. Space error recovery processing can be based on the type of space request (primary, secondary, or new volume), the dataset or job name, time of day, volume serial number, and any of hundreds of other criteria. With SRS, the creation of additional data classes and storage groups just to prevent X37 abends is unnecessary. The ACS routines and SMS constructs can remain undisturbed while SRS provides insurance that jobs will not fail due to DASD space errors.

Other Features.

SRS provides more than just prevention of space errors for DASD datasets. With SRS, installations have detailed control over the creation of duplicate-named datasets (the NOT CATL-GD 2 issue), as well as the prevention of S837 abends on tape datasets that exceed the JCL volume count. SRS can be used to limit the size of datasets by failing extend requests when a specified limit is reached.

Space Recovery System - The End of Out-of-Space Errors

With SRS in place, out-of-space errors are not merely reduced, they are effectively eliminated. For further information, contact your DTS Software representative at 770-922-2444, or visit us on the web at www.dtssoftware.com.

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