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DFSMShsm Fast Replication Technical Guide

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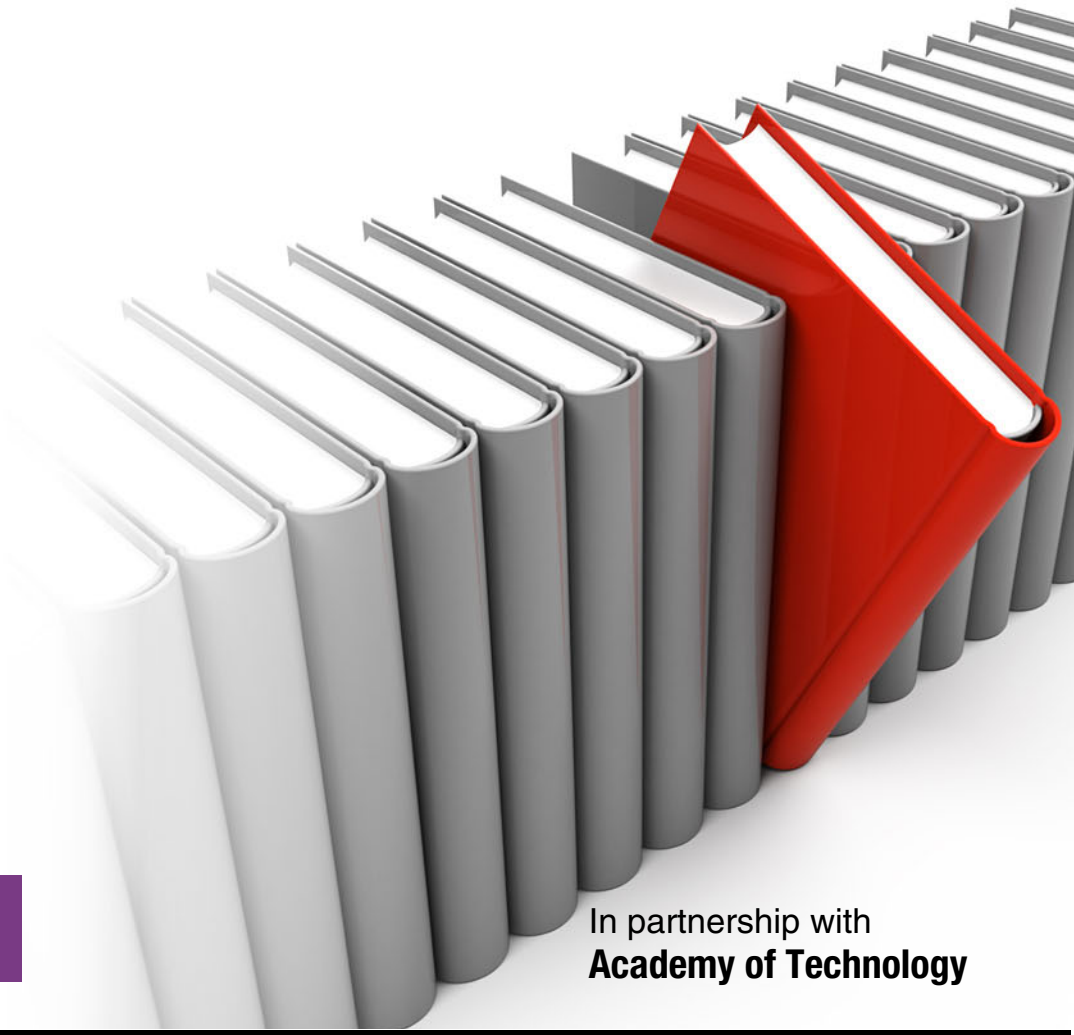
Jeanne Vangsness



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DFSMShsm Fast Replication Technical Guide

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Note: Before using this information and the product it supports, read the information in “Notices” on page ix.

Second Edition (April 2015)

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Contents

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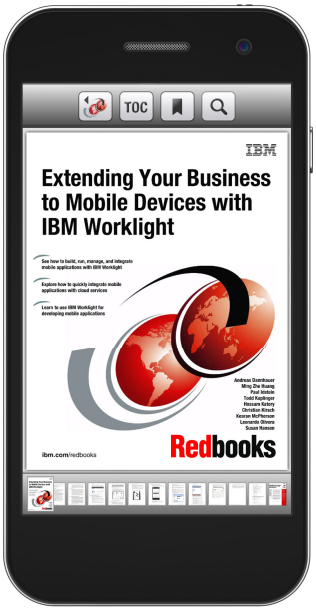

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Preface

DFSMShsm fast replication provides DFSMShsm management for the use of volume-level fast replication. Fast replication is made possible by using the FlashCopy® capability of storage servers. With this capability, a set of storage groups can be defined as a copy pool. The volumes in this pool are processed collectively creating, by fast replication, backup versions that are managed by DFSMShsm.

Recovery can be performed at the volume or copy pool level. This capability is designed to work specifically with DB2® Version 8 or later. With DFSMShsm fast replication, the backup and recovery of DB2 copy pools can be managed by DFSMShsm. DFSMShsm fast replication provides a quick, easy-to-use backup and recovery solution.

This IBM® Redbooks® publication consists of a technical overview of the DFSMShsm fast replication function in z/OS® V1R12 Data Facility Storage Management Subsystem (DFSMS). It provides you with the information that you need to understand and evaluate the function, with practical implementation hints and tips.

This book is written for storage professionals, database administrators, and system programmers who have experience with the components of DFSMS. It provides sufficient information for you to implement the DFSMShsm fast replication function in your storage environment.

Authors

This book was produced by a pair of specialists from around the world working at the International Technical Support Organization, Poughkeepsie Center.

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Editions: The current edition (2015) has minor updates from the prior edition (2011) and does not include a “Changes” page.

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1

DFSMShsm fast replication overview

This chapter provides an overview of the additional features in the DFSMShsm fast replication function since Phase 1 in z/OS V1.5 DFSMShsm. These enhancements allow DFSMShsm to fully use the latest FlashCopy features of the IBM System Storage® DS8000® and complete the Phase 2 implementation. In this chapter, we review the concept of fast replication, FlashCopy, and the enhancements as of z/OS V1.12 DFSMShsm.

1.1 DFSMShsm fast replication sample configuration

We start with a sample fast replication configuration to provide a quick overview of DFSMShsm fast replication and insight into the contents of this book.

1.1.1 Fast replication diagram

Figure 1-1 shows a sample FRBACKUP-based target configuration, just to provide a first look at what this book is all about. You will understand this figure and the detail behind it after you read through this Redbooks publication and are ready to create a similar configuration.

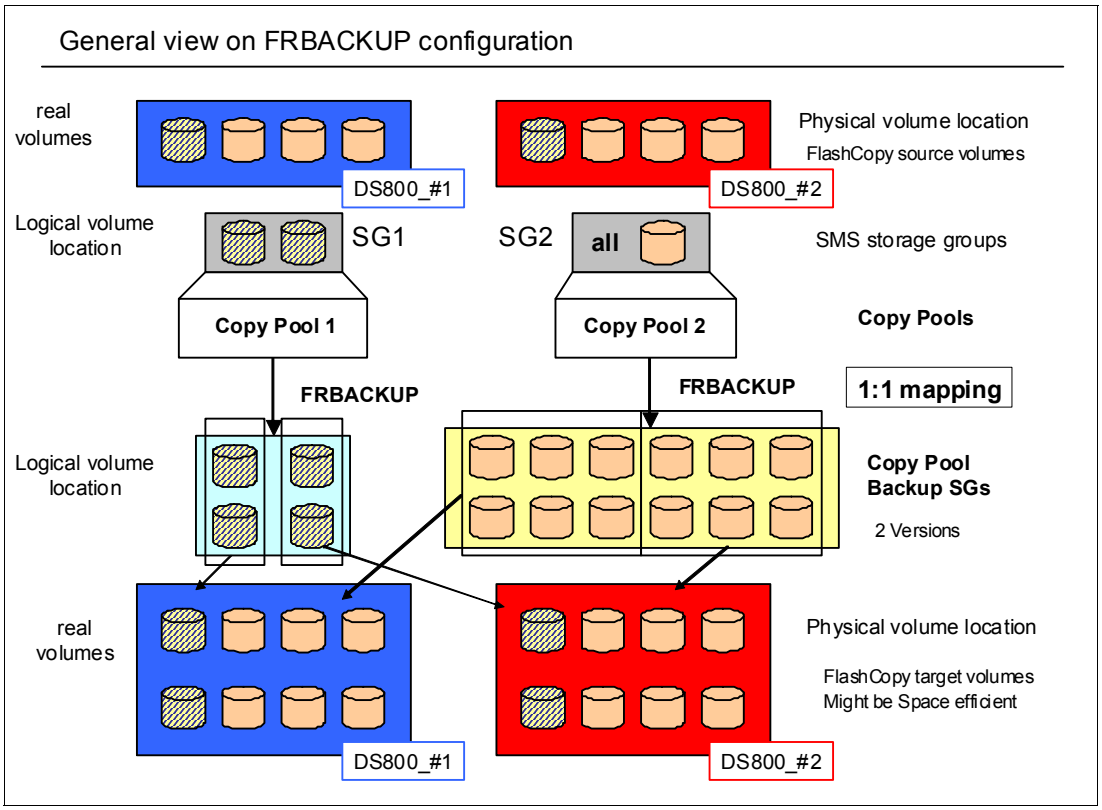

Figure 1-1 Potential fast replication target configuration

The remainder of this chapter provides information about what FRBACKUP is all about and why IBM is providing this solution. DFSMShsm fast replication builds exclusively on the FlashCopy functionality in the DS8000 and any vendor disk that supports these interfaces.

1.1.2 FlashCopy function overview

In a z/OS and storage-management subsystem (SMS) environment, physical full volume copies are generally not useful. FlashCopy, as the DS800 implements the function, provides physical copies from a source volume to a target volume within the same DS8000 only. With DFSMShsm fast replication management, this method changed. DFSMShsm manages your configuration through enhanced SMS constructs. Figure 1-1 shows a sample fast replication configuration. It provides an overview of a FRBACKUP configuration and points out where the real physical volumes reside. It also shows the logical constructs that are wrapped around the physical volumes and storage subsystems. In this book, we focus on the DS8000 FlashCopy function. It applies in a still more restricted fashion to the ESS 800.

SMS already has the logical concept of storage groups to logically group volumes. Another tier of logical grouping is copy pools, which map to SMS storage groups and can have up to 256 SMS storage groups that are mapped to a copy pool. This copy pool is the source site of a fast replication configuration. The target or backup location has another SMS construct, which is a copy pool backup storage group (CPBSG). A CPBSG has all the potential FlashCopy target volumes and contains only FlashCopy target volumes.

Figure 1-1 on page 2 shows a fast replication configuration as a general-purpose fast backup and fast recovery solution. DFSMShsm fast replication is geared toward DB2 but can also be used for other means when an instant backup copy of any number of application volumes through FlashCopy is required.

However, Figure 1-1 on page 2 does not show the possible automatic dumps to tape from the CPBSG volumes.

1.2 Fast replication review

Fast replication uses FlashCopy, which is a point-in-time copy of a volume. A point-in-time copy gives the appearance of an almost instantaneous volume copy.

The process of fast data replication occurs so quickly because it builds a map, with pointers, to the source volume tracks or extents. Applications no longer a need to wait for the physical copy to complete before they can resume the access to the data. Both the source data and target data are available for read/write access almost immediately, while the copy process continues in the background. This process guarantees that the contents of the target volume are an exact duplicate of the source volume at that point in time. You can back up, recover to, and resume processing from that point in time.

Most 24x7 database operations require a mirror solution that has no or little impact on application performance, and provides immediate access to a copy of the mirrored data. This access to a copy of mirrored data, which can be obtained by various techniques with a minimal impact on mirroring, is one of the main returns on investment (ROI) that many companies practice.

In the past, volume-level point-in-time copies were used almost exclusively as disaster recovery backups. With new software services that are available, these copies, clones, or mirrors can be used for job restart, data mining, and application testing.

1.2.1 Point-in-time hardware support

The DFSMShsm fast replication line item supports the volume-level FlashCopy function of the IBM DS8000 disk storage subsystem and any other disk storage subsystem that supports FlashCopy application programming interfaces (APIs).

Tip: Appropriate microcode levels might be required to activate these features on the storage device.

The process of creating a point-in-time copy has two phases. The first phase completes in a few milliseconds by constructing a map to describe the source volume.

At the completion of this first phase, the data is cloned and both the source and target volumes are available for read and write access. From the user's perspective, the source and target volumes' contents are an exact duplicate at this point in time, even though actual copying of data was not initiated.

The second phase consists of copying the physical source volume data to the target volume. The point-in-time copy is maintained and preserved by an on-demand copy of the data to the target volume. When an update request is issued for either a source or target volume data set that is not yet copied to the target volume, the write is done directly to the target and the bitmap is updated to ensure that the track from the source volume is not copied over later. The following situations are possible:

- Read request to the source volume

  The data is read from the source volume.

- Read request to the target volume:

  If the data was already copied from the source volume to the target volume, the data is read from the target volume. If the data was not yet copied to the target volume, the data is read from the source volume.

- Write request to the source volume

  If the data was already copied from the source volume to the target volume, this task results in a normal write to the source volume. However, if the data was not yet copied from the source volume to the target volume, the data is copied from the source volume to the target volume before the source volume update occurs.

- Write request to the target volume

  If the data was already copied from the source volume to the target volume, the write request results in a normal write to the target volume. However, if the data was not yet copied from the source volume, the write is done directly to the target volume and the bitmap is updated to ensure that the track from the source volume is not copied over later.

1.2.2 FlashCopy: Background copy

By default, FlashCopy performs a background copy. The background copy task makes a physical copy of all tracks from the source volume to the target volume. Destaging algorithms are used to efficiently manage the background DS8000 copy process. The background copy task runs at a lower priority than normal I/O on the DS8000 in order to not affect the normal application I/O processing.

The DS8000, by using the metadata structure that was created during the FlashCopy establish command, tracks which data was copied from the source to the target and manages the integrity of both copies. If an application wants to read data from the target that was not yet copied, the data is read from the source; otherwise, the read can be satisfied from the target volume.

Before the DS8000 updates a not-yet-copied track on the source volume, the DS8000 performs an on-demand copy of the track to the target volume by a function that is called "*copy-on-write*". Subsequent reads to this track on the target volume are satisfied from the target volume.

After all tracks are copied to the target volume, the FlashCopy relationship automatically ends unless the persistent FlashCopy option was specified.

As Figure 1-2 on page 5 illustrates, a FlashCopy relationship goes through three stages:

- Establishing the relationship
- Copying the data
- Terminating the relationship

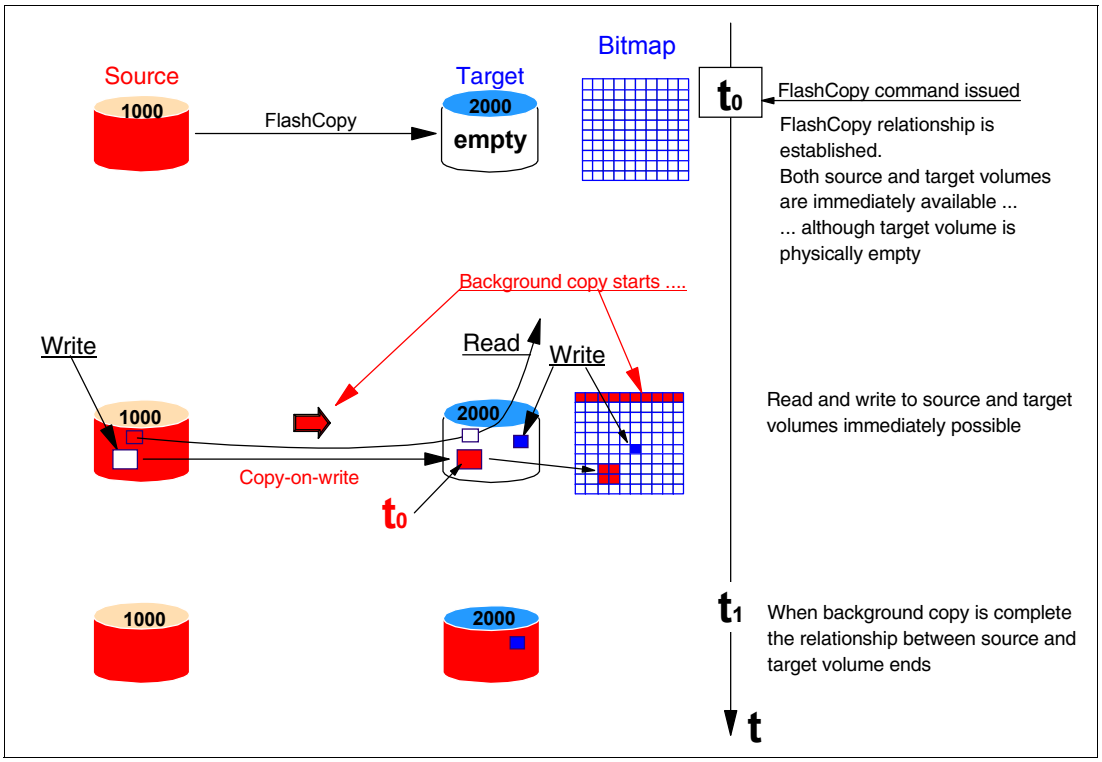

Figure 1-2 FlashCopy with background copy

Volume FlashCopy is a physical copy from the very first track to the very last track, independently of the data that is on these tracks.

1.2.3 FlashCopy: No background copy

When you select *not* to perform the background copy, the relationship is established but the background copy task of all source volume tracks is *not* initiated. Only the source tracks that receive application updates are copied to the target. Before the DS8000 updates a track on the source volume, the DS8000 performs an on-demand copy or “copy-on-write” of the track to the target volume, therefore preserving the T_0 copy.

A FlashCopy relationship that was established when you selected no-background copy remains active until one of the following events occurs:

- An explicit FlashCopy withdraw is done to terminate the relationship.

  When a FlashCopy withdraw is used to terminate a no-background copy FlashCopy relationship, the target volume is left in an indeterminate state. Part of the tracks on the volume might contain data from the source volume, although other tracks might contain residual data that was on the target volume before the copy. Do not use the volume in these conditions unless it is reformatted or used for another copy operation.

- All source device tracks were copied on the target device because they were all updated.

  The FlashCopy relationship is automatically terminated, but the volume is valid.

- All target device tracks were updated by user applications.

  The FlashCopy relationship is automatically terminated, but the volume is valid.

When a no-background copy FlashCopy relationship is terminated, the target volume is left in an indeterminate state. Part of the tracks on the volume might contain data from the source volume, although other tracks might contain residual data that was on the target volume before the copy. Do not use the volume in these conditions unless it is reformatted or used for another copy operation.

1.2.4 FlashCopy Version 1

FlashCopy Version 1 is no longer commonly used and applies only to the ESS disk storage subsystem. The new standard for FlashCopy is V2, which is available on the DS8000.

FlashCopy V1 is invoked at the volume level. The following considerations apply:

- The source and target volumes must have the same track format, which is also true for Version 2.
- The target volume must be as large as the source volume, which is also a condition for Version 2.
- The source and target volumes must be within the same ESS logical subsystem (LSS). This rule is not applicable any more for DS8000.
- A source and a target volume can be involved in one FlashCopy relationship at a time only. A DS8000 can have up to 12 target volumes that are based on a source volume.

A FlashCopy establish command is issued either when invoked by a TSO command, the DFSMSdss utility, the ANTRQST macro, or by using the ESS or DS8000 Copy Services web GUI or the ESS, or when the DS8000 establishes a FlashCopy relationship between the source volume and the target volume.

Restriction: When you use FlashCopy Version 1, any subsequent FRBACKUP COPYPOOL command that is issued against the same copy pool, or against another copy pool with a common storage group before all of the background copies are complete, causes the command to fail. This restriction does not exist for FlashCopy Version 2 because a source volume can be in multiple concurrent relationships.

1.2.5 FlashCopy Version 2

FlashCopy Version 2 is the standard for DS8000.

FlashCopy Version 2 supports all of the FlashCopy V1 functions, plus these enhancements:

- FlashCopy V2 can be used for data set copies and volume copies.
- The source and target of a FlashCopy can be on different LSSs even within an ESS storage subsystem.
- Up to 12 FlashCopy relationships are allowed.
- Incremental copies are possible.
- In-band FlashCopy commands can be sent over Peer-to-Peer Remote Copy (PPRC) links to a remote site.
- FlashCopy consistency groups can be created.

In addition, the FlashCopy establish times were reduced. Figure 1-3 compares the features of FlashCopy Version 1 and FlashCopy Version 2.

	FlashCopy V1 Original	FlashCopy V1 Updated	FlashCopy V2 Lic 2.2.0
Background Copy Mode	COPY or NOCOPY	COPY, NOCOPY NOCOPY->COPY	COPY, NOCOPY NOCOPY->COPY
Disposition	Ended	Ended / Persistent	Ended / Persistent
Data Movement	Full	Full	Full or Incremental
Relationship(s)	Single	Single	Multiple
Granularity	Volumes, Tracks	Volumes, Tracks	Volumes, Tracks, Data Set
Data Set	Single	Single	Multiple
Source/Target Boundaries	Same LSS	Same LSS	Cross LSS Cross Cluster

Applies to ESS models F10, F20, and 800

Figure 1-3 FlashCopy V1 and FlashCopy V2 comparison for ESS

Figure 1-3 is only relevant for the ESS disk storage subsystem. Everything that is under the FlashCopy V2 column applies to the DS8000 FlashCopy functions. Also, the capability exists to have a Metro Mirror primary volume as a FlashCopy target volume for full copy and for data set-level FlashCopy. This capability is called Remote Pair FlashCopy or Preserve Mirror (PMR) and is only available in DS8000. For more information, see Chapter 2, “Planning for FRBACKUP” on page 9.

1.3 DFSMShsm FRBACKUP new features

There are many ways to execute FRBACKUP. Each method differs depending on your installation requirements. The new additional features that are added to DFSMShsm help increase the various ways that you can back up your data.

Since z/OS Data Facility Storage Management Subsystem (DFSMS) 1.5, the following FRBACKUP function was added:

- Use of INCREMENTAL on copy pools is provided by z/OS DFSMS 1.8.0 PTF UA28767.
- Allowing use of an alternate CPBSG is provided by z/OS DFSMS 1.9.0 PTF UA36434.
- Allowing PPRC primary volumes to be selected as target volumes for FRBACKUP and FRRECOV function with new keywords that are provided in PTFs:
  - z/OS DFSMS 1.8.0 UA42371
  - z/OS DFSMS 1.9.0 UA42372
- Fast replication tape support is provided in base z/OS DFSMS V1.8.0.

- The following function was added in base z/OS DFSMS 1.11:
  - Capture catalog information allows for recovery of deleted data sets that are provided in base z/OS DFSMS V1.11.
  - If an error occurs during FRBACKUP, ARC1803I lists the DFDSS failing message and VOLSER in the backup activity log to help diagnose errors.
  - In a NOCOPY scenario, if an error occurs, a withdraw is done; now the target volume will be reinitialized after withdraw.
- Copy pool recovery from dump tape is provided in base z/OS DFSMS 1.12.0.
- Fast reverse restore is provided in base z/OS DFSMS 1.12.0.
- FlashCopy to space efficient volumes is provided in base z/OS DFSMS 1.12.0.
- Additional items were added in z/OS DFSMS 1.12.0:
  - Up to 64 volume recovery tasks
  - Up to 64 data set recovery tasks
  - Up to 254 volume pairs to be backed up at one time

These features are available through new parameters in the FRBACKUP and FRRECOV commands. They are described in more detail in Chapter 5, “DFSMShsm fast replication commands” on page 65.

The remainder of this book describes the steps that are required to update your environment to implement DFSMShsm fast replication.

2

Planning for FRBACKUP

This chapter provides planning information to look into and understand before you implement FRBACKUP. It is important to understand the main intention of FRBACKUP, which we describe first and then we offer general comments about the solution.

Because FRBACKUP is based on the DS8000 FlashCopy function and its variation, we categorize the different FRBACKUP configurations according to the underlying FlashCopy functions. This part includes several FlashCopy paragraphs that you can skip if you are familiar with the DS8000 FlashCopy function.

This chapter includes these FlashCopy functions:

- Incremental FlashCopy
- FlashCopy with background copy
- FlashCopy without background copy:
  - When the target volume is fully provisioned
  - When the target volume is Space Efficient (SE)
- Remote Pair FlashCopy or Preserve Mirror (PMR)
- FlashCopy consistency group

Various planning aspects for recovery follow at the end of this chapter.

We also describe the DS8000 firmware requirements for different DS8000 models.

2.1 General FRBACKUP usage and planning considerations

In z/OS with system-managed I/O configurations, the full volume FlashCopy functions that are provided by the DS8000 are limited on overall usability because the DS8000 FlashCopy function is basically a full volume physical copy from a source to a target volume. FlashCopy does not distinguish among a volume label, VTOC index, or SYS1.VVDS, which is important for each volume to locate the data sets on the volume. FlashCopy physically copies a complete source volume from the very first track to the very last track to a target volume and overrides everything on the target volume.

With DFSMShsm's FRBACKUP solution, this approach changed. With DFSMShsm through DFSMSdss, with system-managed storage, you can use the Copy Services functions of the DS8000, such as FlashCopy, in a productive way, which is demonstrated in the following paragraphs.

Another reason to move from conventional I/O through Fibre Channel connection (FICON®) channels and through a z/OS host to FlashCopy based I/O is to remove this I/O overhead from z/OS and move it to the DS8000 storage subsystem. FRBACKUP uses FlashCopy and does not impose any data copy I/O overhead on the z/OS host. This method includes FRRECOV, which also uses FlashCopy, and an entire pool recovery, volume-level recovery, or data set recovery does not go through FICON channels but stays within the DS8000.

2.1.1 DFSMShsm FRBACKUP system overview

The FRBACKUP solution is based on the FlashCopy function of the DS8000. The software management framework is provided through DFSMShsm and DFSMShsm interfaces with the user. DFSMShsm uses DFSMSdss as an interface to the FlashCopy functions in the DS8000. DFSMShsm uses, for its DFSMSdss interface, cross-memory services to a newly created DFSMSdss address space for FRBACKUP, which is DSSFRB01, as shown in Figure 2-1 on page 11.

DFSMShsm also interfaces with other system services, such as storage management subsystem (SMS) to retrieve SMS constructs and storage group volumes. DFSMShsm interfaces with the catalogs to organize and manage the FRBACKUP configuration. In particular, the Catalog Search Interface (CSI) is crucial to create a backup version successfully.

Figure 2-1 shows the major components that work with DFSMShsm to create a complete backup copy of an entire DB2 subsystem and all the related volumes quickly by using FlashCopy.

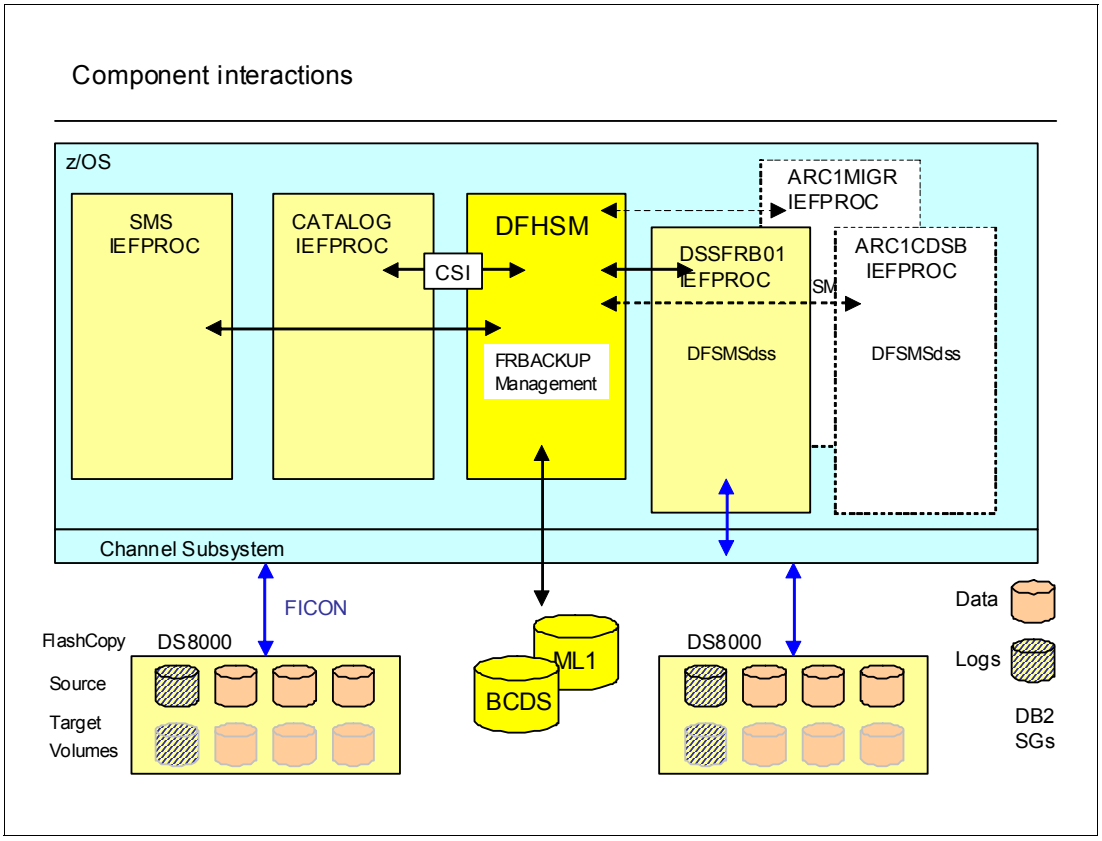

Figure 2-1 DFHSM FRBACKUP z/OS component interaction

2.1.2 FRBACKUP intended use

The FRBACKUP solution is geared toward DB2 installations to use FlashCopy to create complete backup versions of an entire DB2 configuration. This approach does not limit the FRBACKUP solution to DB2 only, but extra care is required when you consider FRBACKUP as a general-purpose backup solution.

Figure 2-1 provides a high-level system view. It highlights a crucial interface, which is the catalog search interface (CSI) that DFSMShsm uses to retrieve the entire content of the user catalogs. The user catalog can be an Integrated Catalog Facility (ICF) user catalog or Basic Catalog Structure (BCS). DFSMShsm expects a clean user catalog, which contains only data set entries that point to data sets that reside on volumes either within the managed copy pool or outside the copy pool.

CSI does not return a zero return code when the catalog in question contains orphan entries. A nonzero CSI return code prevents data set-level recovery if the data set moved or was deleted at the time of the recovery. The condition of a *clean* catalog is strict but necessary to create volume copies of the managed copy pool volumes successfully, which allows a successful recovery to be performed.

2.2 FlashCopy considerations that relate to FRBACKUP

There are two FlashCopy types in a z/OS environment:

- Volume-level FlashCopy
- Data set-level FlashCopy

2.2.1 FlashCopy target volume types

With volume-level FlashCopy, we further distinguish the FlashCopy target volume type, which can be either of the following possibilities:

- A fully provisioned target volume that requires the same amount of disk storage space as the corresponding FlashCopy source volume.
- An SE volume that resides in a DS8000 extent pool-based repository where only changed data of SE target volumes is stored. FlashCopy to an SE target volume must be explicitly permitted when FlashCopy is triggered through interfaces, such as DFSMSdss. SE FlashCopy is only available for volume-level FlashCopy with no background copy (NOCOPY). It is not supported for data set-level FlashCopy. So, it is not possible to perform a data set-level FlashCopy to an SE target volume.

FlashCopy source and target volumes, or data sets, are in a relationship. This relationship ends automatically when the background copy completes. In the case of NOCOPY, the relationship stays until it is explicitly withdrawn.

2.2.2 FlashCopy stages

FlashCopy is performed in two stages:

1. FlashCopy logical copy completes in a few milliseconds and creates merely a bitmap structure. After the local copy competes, the target volume or data set is immediately available for reads and writes.
2. In the case of a background copy, the physical copy process copies data in tracks from the source volume to the target volume.

2.3 FlashCopy options

When a FlashCopy relationship is established, you can specify how FlashCopy is to copy data from the source to the target volume:

- Full copy background copy

  After the FlashCopy logically completes, a background copy process starts and copies all data from the source volume to the target volume. If an update to a source volume track is not yet copied, this track is immediately copied “copy-on-write” before the update takes place on the source volume. The sequential background copy continues until all data is copied from the source to the target volume. When all data is copied, the relationship between source and target volume is terminated. To track the tracks that were already copied, the DS8000 storage subsystem maintains a bitmap for each track of the target volume.

- Full copy NOCOPY

  FlashCopy with NOCOPY indicates no background copy task. If an update occurs on the source volume, the track that is going to be changed is first copied to the target volume “copy-on-write” before the update happens on the source volume. This process happens only for the very first update. Subsequent updates of the same data on the source volume are not copied. The relationship between source and target volume does not end until all data is modified (meaning copied) on the source volume, or if the relationship is explicitly withdrawn through a command.

- Incremental background copy

  When incremental FlashCopy is requested for the first time, a full volume background copy is performed. Subsequent incremental FlashCopies background-copy the data that changed since the previous FlashCopy request. The DS8000 storage subsystem tracks changed tracks by maintaining bitmaps for the source and the target FlashCopy volumes. If data changed on a track, a bit was set that indicated that this track needed to be copied when a new incremental FlashCopy is requested.

2.3.1 Full volume FlashCopy

Full volume FlashCopy is another volume-level relationship between a source volume and a target volume within the *same* DS8000. Usually, the volume capacity is equal for both volumes.

We distinguish this full volume FlashCopy relationship whether background copy or no background copy (NOCOPY) is used. Figure 2-2 provides an overview of full volume FlashCopy.

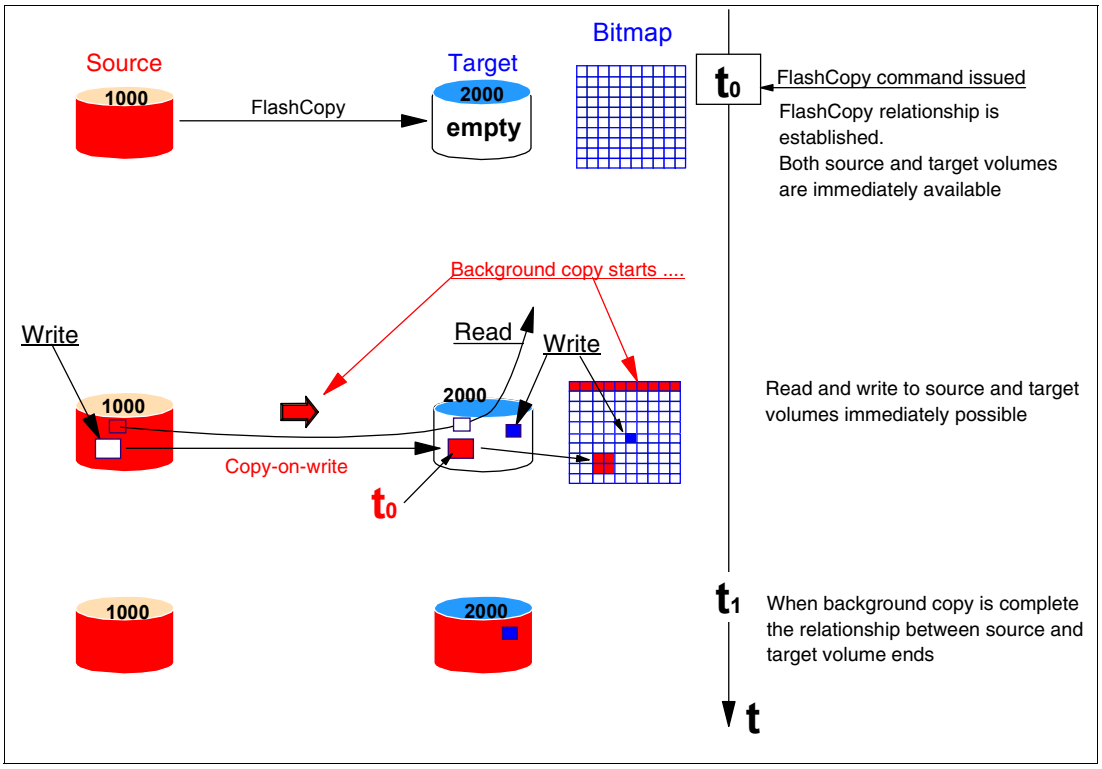

Figure 2-2 Full volume FlashCopy overview

At t0 when the FlashCopy command is issued and logically completes in a few milliseconds, both volumes, source and target volume, are immediately available for application I/Os.

2.3.2 FlashCopy with no background copy (NOCOPY)

The middle part in Figure 2-2 on page 13 covers both approaches: background copy or NOCOPY. In the case of NOCOPY, background copy will not start and the target volume has no valid data. A read to the target volume will be resolved from the source volume as indicated in this diagram. A write to the source volume will impose a copy-on-write and copies the data from t0 first to the target volume before the actual update on the source takes place.

A corresponding entry in the bitmap reflects the new volume when reading this data from the target volume. This copy-on-write occurs only one time at the first time that t0 data is changed on the source volume. Subsequent updates to the same t0 data on the source volume do not impose another copy-on-write because the t0 data is already secured on the target volume. For NOCOPY, this process happens for each update to different t0 data on the source volume. The FlashCopy relationship remains until the last t0 data is changed on the source volume. After the entire source volume changes, you get all t0 data copied-on-write to the target and the FlashCopy relationship then ends.

2.3.3 FlashCopy with background copy

With background copy, FlashCopy starts to copy all source data to the target volume and indicates its copy progress in the FlashCopy target volume bitmap to direct potential reads of t0 data from the target volume to the correct volume. After all data is background-copied from the source volume to the target volume, the FlashCopy relationship between both volumes ends, as shown in the lower part of Figure 2-2 on page 13.

Both FlashCopy variations need a fully provisioned FlashCopy target volume, which means that the FlashCopy target volume requires the same size and space as the FlashCopy source volume. In case of NOCOPY, this requirement can be considered as a waste of disk space. In this case, the FlashCopy target volume can be an SE FlashCopy target volume.

2.3.4 FlashCopy NOCOPY to Space Efficient target volume

We describe how SE FlashCopy works. The DS8000 has a particular volume type, which is a track Space Efficient (TSE) volume that is only available to be used as a FlashCopy target volume. A count key data (CKD) volume that is defined as SE does not take any real space in a DS8000. An SE volume has only a virtual capacity and it is mapped into a repository. The repository is a pre-allocated storage area in a DS8000 extent pool. The repository stands for a virtually sized pseudo extent pool within the real extent pool and maps itself to real disk storage space as depicted in Figure 2-3 on page 15.

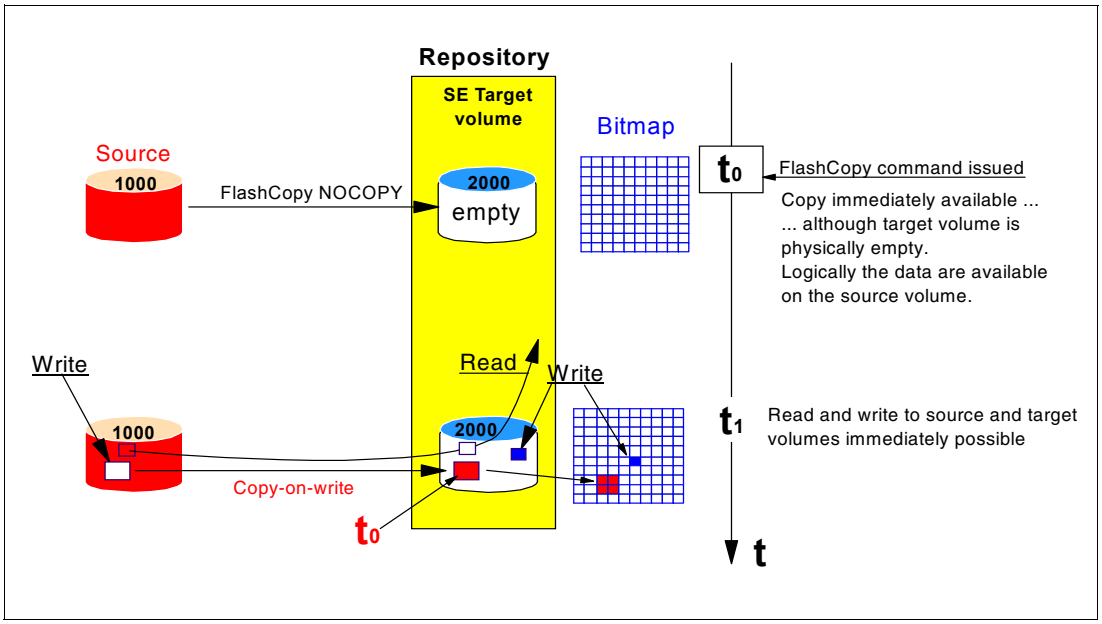

Figure 2-3 FlashCopy NOCOPY with SE target volume

Figure 2-3 shows an overview of a full volume FlashCopy, which is always a NOCOPY relationship when it maps to an SE target FlashCopy volume. All the rules apply as outlined in 2.3.2, “FlashCopy with no background copy (NOCOPY)” on page 14 about FlashCopy NOCOPY.

This repository typically has only a fraction of the virtual capacity that is backed up to real disk storage. For example, the virtual capacity of this repository is defined to virtually hold 200 x 3390-27, which is approximately 5 TB. Assume that about 10% of that capacity changes between each FlashCopy operation, which imposes the copy-on-write I/O operation between source and target FlashCopy volumes. The real size of this repository is then sufficient with 0.5 TB or 500 GB of real disk storage space for the repository.

You might want to verify the SE configuration within the DS8000 first and determine whether a repository is defined. If any repositories are defined in the DS8000, list and verify the volumes that are defined and the virtual size of the TSE volumes.

Example 2-1 shows how to determine whether SE repositories are in a DS8000 by using the DS command-line interface (CLI).

Example 2-1 Query the DS8000 for SE repositories

```
dscli>
dscli> lssestg  -l
Date/Time: 28. Oktober 2010 18:47:05 CEST IBM DSCLI Version: 6.5.1.193 DS: IBM.2107-754ACME
extpool stgtype configstate repcapstatus repcap(GiB/Mod1) vircap repcapalloc vircapalloc
==========================================================================================
P0      fb      Normal      below                  16.0   32.0          -        10.0
P14     ckd     Normal      below                  76.0  108.0        0.0        18.0
dscli>
```

Example 2-1 on page 15 shows two repositories in the DS8000. In extent pool P0, a repository exists for fixed block (FB) SE volumes. Extent pool P14 has CKD volumes and also a repository for FlashCopy target SE volumes.

Using the **mkckdvol** command, you can create CKD volumes. The **mkckdvol** command also specifies whether the volume is a standard fully provisioned volume or an SE volume. SE volumes are created by using the **tse** parameter to specify **tse** as a value to the storage allocation method (SAM).

Example 2-2 shows how to list all defined TSE volumes in extent pool P14.

Example 2-2 List only SE volumes in a specify extent pool (output is edited)

```
dscli>
dscli> lsckdvol  -l  -extpool p14  -sam tse
Date/Time: 28. Oktober 2010 18:28:40 CEST IBM DSCLI Version: 6.5.1.193 DS: IBM.2107-754ACME
Name    ID   accstate device volser voltype  extpool sam cap (cyl) cap (10^9B) cap (2^30B)
==========================================================================================
SE_0E21 0E21 Online   3390-9 YYDE21 CKD Base P14     TSE     10017         8.5         7.9
SE_0E5F 0E5F Online   3390-9 YYDE5F CKD Base P14     TSE     10017         8.5         7.9
dscli>
```

The list output in Example 2-2 is slightly edited to format well for this example. Example 2-2 shows two defined TSE volumes. It also shows the current volume labels or VOLSERs. These volumes are virtual models 3390-9 with 10017 cylinder capacity.

When you plan to use SE FlashCopy target volumes within a FRBACKUP configuration, you need at least the same number of TSE FlashCopy target volumes as the number of volumes within the copy pool. This rule applies for a copy pool backup storage group (CPBSG) to be used with FlashCopy no background copy. You cannot use TSE FlashCopy target volumes when you plan for more than a backup version in a CPBSG (Versions > 1). You also cannot use TSE FlashCopy target volumes within a CPBSG when you plan to use incremental FlashCopy for your FRBACKUP command.

2.3.5 Incremental FlashCopy

When incremental FlashCopy is used for the first time, a full volume FlashCopy with background copy is performed. Because this FlashCopy relationship is incremental, the relationship is kept even after the full background copy is complete.

Subsequent incremental FlashCopies copy only the data that changed since the last FlashCopy. Figure 2-4 shows an overview of how the DS8000 tracks changed CKD tracks by maintaining bitmaps for the source FlashCopy volume and its corresponding target FlashCopy volume.

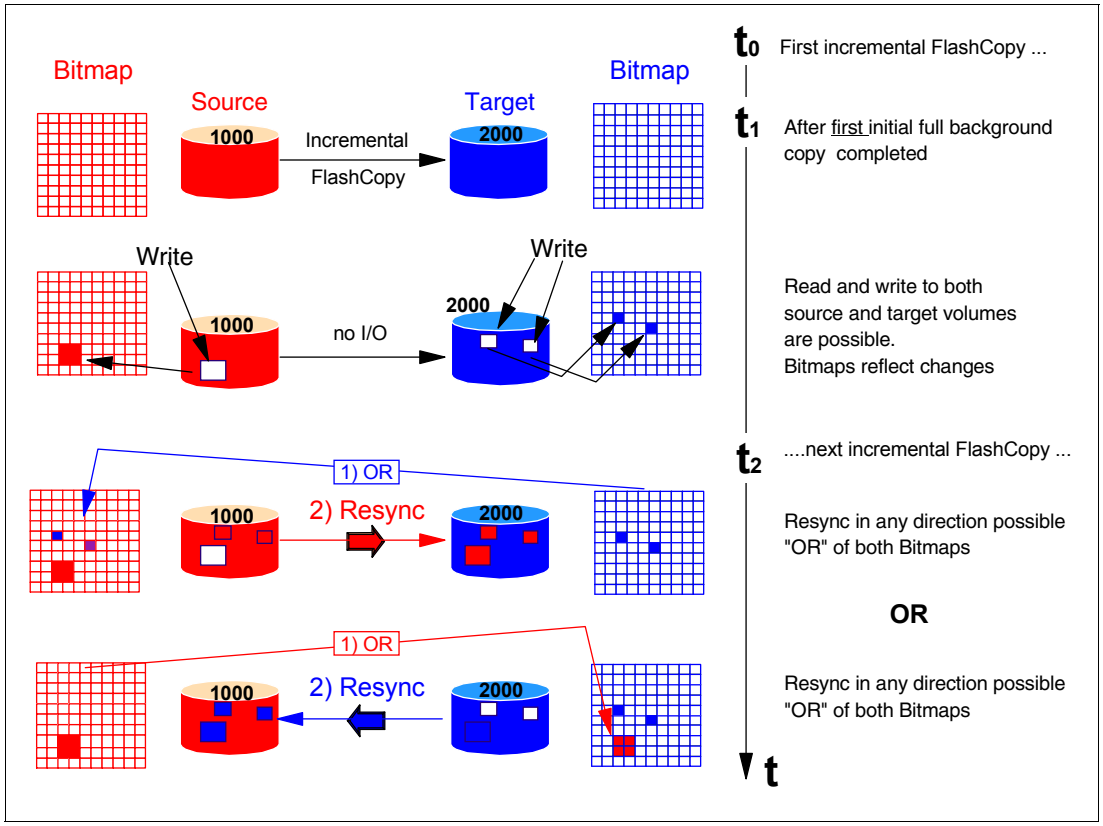

Figure 2-4 Incremental FlashCopy overview

As depicted in Figure 2-4, a bit is set in the related bitmap when a track is changed. Also, the bit applies to the source volume and the target volume. Therefore, at the next incremental FlashCopy, the entire track is copied when it is flagged in the bitmap.

With incremental FlashCopy, a flash back is possible at any time and in either direction as indicated in the diagram. When the next incremental FlashCopy is performed, both bitmaps are OR'ed and all tracks that are flagged in the combined bitmap will be copied from the new source volume to the new target volume.

A limitation today is that a FlashCopy source volume can be in only one incremental relationship. If you need additional copies of the source volume when an incremental FlashCopy relationship still exists, the other relationship has to be a full volume relationship, which can be a relationship with either NOCOPY or background copy. Currently, the DS8000 firmware supports up to 12 full volume FlashCopy relationships from the same source volume.

2.3.6 FlashCopy consistency groups

FlashCopy consistency groups are used to create consistent copies of logically related data that spans multiple volumes. The process freezes the source volumes so that any further writes are held. After the copy completes, the volumes are then “thawed” and I/O resumes normally. Because this process must complete within 2 minutes, this process is best used on smaller DB2 log files. Users then have a consistent set of non-fuzzy backups of the logs and bootstrap data sets (BSDS).

2.4 Remote Pair FlashCopy

Remote Pair FlashCopy or Preserve Mirror (PMR) is a new development that allows a FlashCopy target volume to be a Metro Mirror primary volume at the same time. Before PMR, it was already possible to map a FlashCopy target volume to a Metro Mirror primary volume (Figure 2-5). But a FlashCopy operation changed the FULL DUPLEX status of the Metro Mirror volume pair to DUPLEX PENDING during the period when FlashCopy copied all the data from the FlashCopy source to the FlashCopy target. From the FlashCopy target, which is the Metro Mirror primary volume, the data is asynchronously replicated from this Metro Mirror primary to its corresponding Metro Mirror secondary volume.

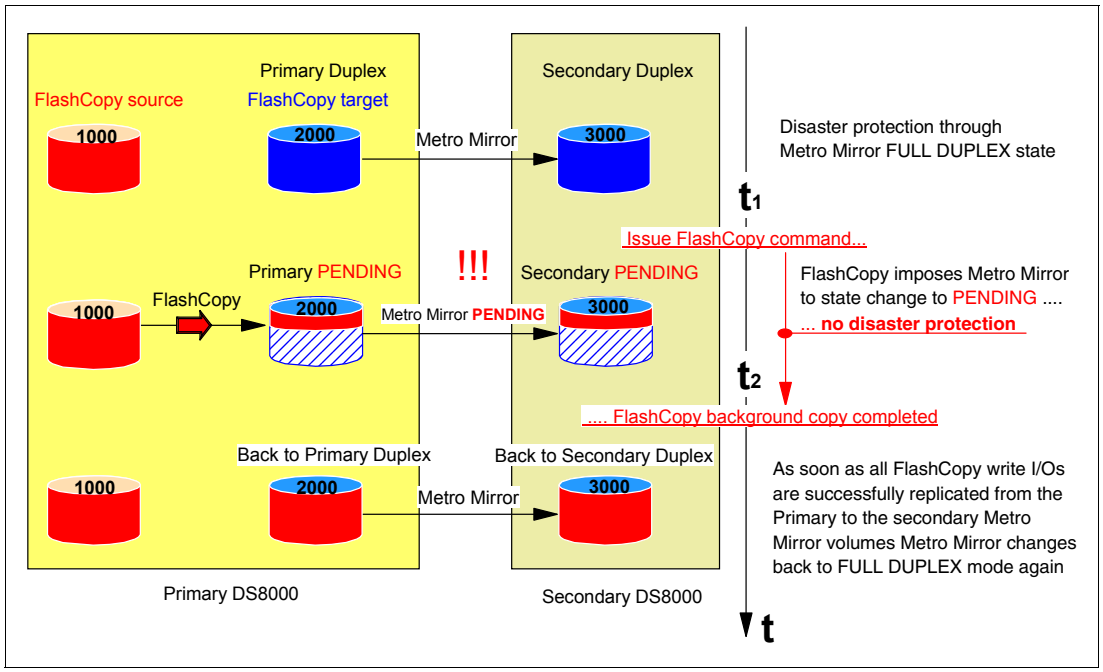

Figure 2-5 FlashCopy target volume is also Metro Mirror primary volume - previous implementation

As Figure 2-5 shows, the disaster recovery protection is exposed between t_1 and t_2. Other negative impacts of this Metro Mirror volume state change cause problems in a Geographically Dispersed Parallel Sysplex GDPS® HyperSwap® configuration. GDPS will HyperSwap from the primary site to the secondary site when a primary PENDING condition is detected, which leads to a bad configuration because the secondary volume is not in a FULL DUPLEX state either. So, this approach is not an option for any disaster recovery configurations that are based on Metro Mirror. In this context, a Global Copy primary volume cannot be a FlashCopy target volume at the same time.

Figure 2-5 on page 18 shows the FlashCopy source volume as a non-mirrored volume, and only the FlashCopy target volume is a Metro Mirrored primary volume, which does not matter when the FlashCopy source volume is also at the same time a Metro Mirror primary volume.

Figure 2-6 shows the enhanced version of FlashCopy in a Metro Mirror environment. In contrast to the situation in Figure 2-5 on page 18, the FlashCopy source volume and the FlashCopy target volume are required to be in a Metro Mirror relationship. When a FlashCopy command with PMR is issued to a mirrored FlashCopy target volume, this FlashCopy command is propagated through the DS8000 firmware over the Peer-to-Peer Remote Copy (PPRC) link to the corresponding secondary volume.

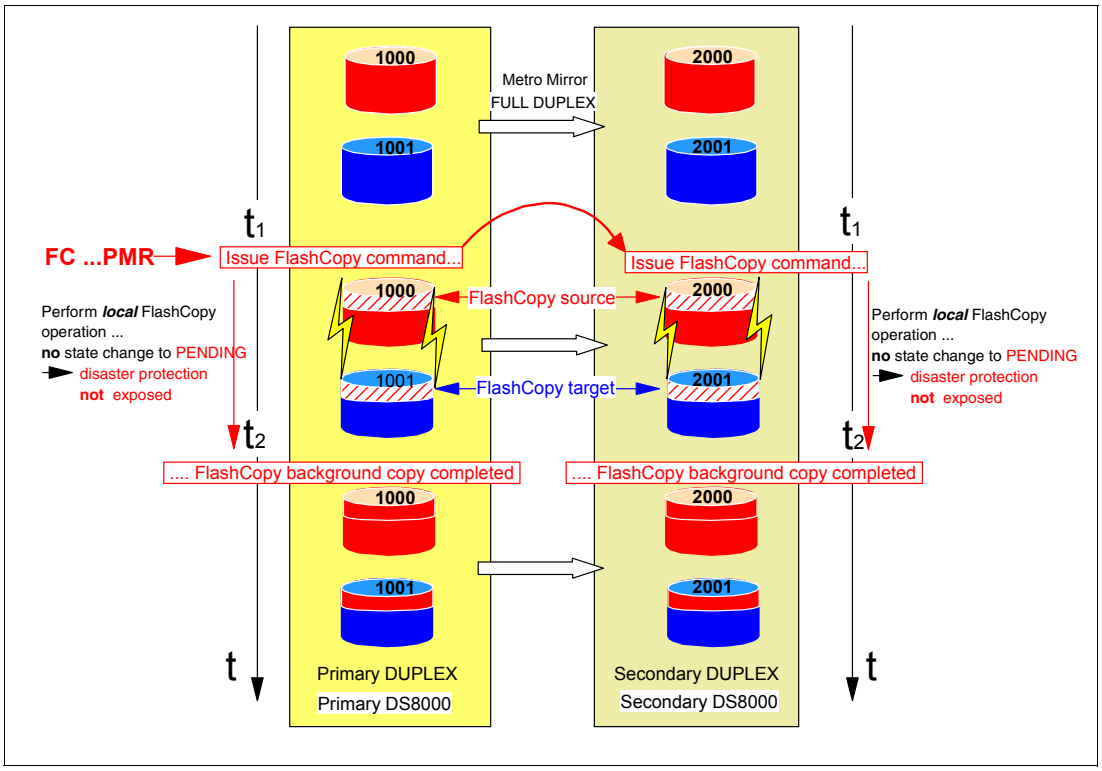

Figure 2-6 FlashCopy Preserve Mirror without exposing FULL DUPLEX state

Each DS8000 locally executes the FlashCopy command independently from the other site. Coordinating the actual FlashCopy operation is not necessary except to guarantee that both FlashCopy operations are successful. If one of the two sites fails its FlashCopy operation, the other FlashCopy relationship is removed, as well.

The usual FlashCopy rules apply. You can use the FlashCopy source and targets immediately after the FlashCopy command is issued.

From a usage point of view, full volume FlashCopies, including PMR, are an exception in z/OS environments. One such exception is FRBACKUP, which supports FlashCopy with PMR.

2.5 FRBACKUP planning considerations for DB2

DB2 Version 8 introduced two new utilities that use DFSMShsm fast replication services:

- BACKUP SYSTEM
- RESTORE SYSTEM

The goal of these new utilities is to achieve high availability with fast and non-intrusive backup and fast recovery to minimize service interruption.

The appeal of an approach for using DS8000 FlashCopy through DFSMShsm and DFSMSdss is the speed to create an instantaneous copy of all related DASD volumes at a certain point in time. These backups on FlashCopy target volumes are always on DASD. This method allows for a fast recovery from these FlashCopy target volumes.

Next, we describe the FlashCopy versions to use and the planning considerations that apply to the DASD configuration before you use the DB2 BACKUP SYSTEM and RESTORE SYSTEM utilities.

DB2 always asks for separate copy pools for data, such as table spaces and indexes, and for its logging volumes. DB2 needs a certain naming scheme for the involved copy pool names, which must follow this format:

DSN$*location-name*$*cp-type*

The various parts of the name are defined:

DSN	A unique DB2 product identifier (a constant).
$	A fixed character delimiter.
location-name	The DB2 location name (a variable).
$	Another fixed character delimiter.
cp-type	The copy pool type is either DB for the data copy pool or LG for the log volumes' copy pool.

The following information and figures are provided as examples of a configuration to create two backup versions for all corresponding DB2 volumes that belong to the same DB2 subsystem.

2.5.1 Planning for the DB2 application data pool

In Figure 2-7 on page 21, the DB2 application copy pool has the name DSN$dbxa$DB.

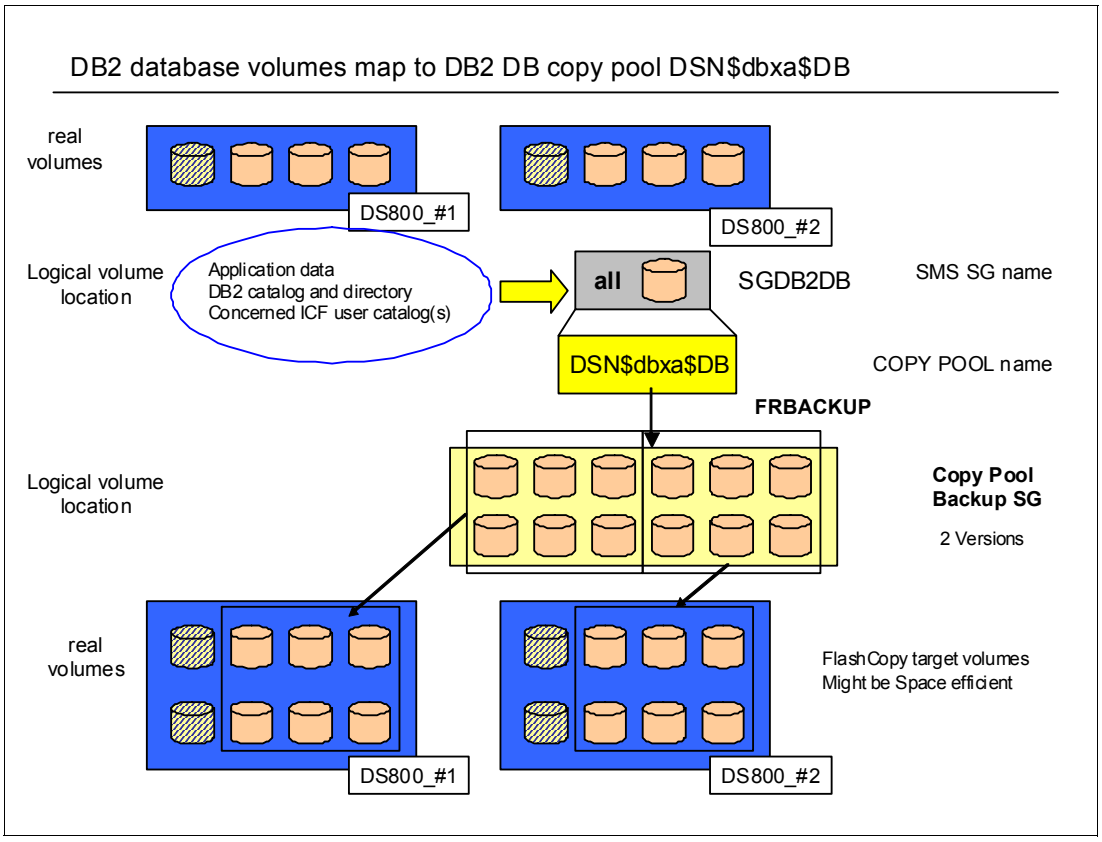

Figure 2-7 Map DB2 storage group to FRBACKUP copy pool and CPBSG

Figure 2-7 shows a configuration with two DS8000 storage subsystems and the relationship that exists within each DS8000. This figure also illustrates the logical relationships that play a role within a FRBACKUP configuration structure and do not rely on a DS8000 subsystem scope. The application volumes are shown in beige. The DB2 logging volumes are striped.

The upper part of this figure shows the application volumes within the two DS8000 subsystems: DS8000_#1 and DS8000_#2. Both subsystems are equal in their size and structure, which is implied by the four volume icons per DS8000. This structure is not mandatory, but it is the preferred practice. Each subsystem contains the same number of DB2 data volumes and also the same number of DB2 logging volumes.

Logically, these volumes are pooled within an SMS storage group. In the example, SMS storage group SGDB2DB contains all DB2 database volumes for a total of six volumes.

For FRBACKUP, we need the SMS extension to the storage group constructs, which are copy pools (CPs) and CPBSGs. In the Interactive Storage Management Facility (ISMF) copy pool application, you define the SMS storage groups that must be logically grouped together. In our example, copy pool DSN$dbxa$DB has one defined SMS storage group, SGDB2DB. Up to 256 distinct SMS storage groups can be defined to a copy pool, including the site of the actual application volumes. We also need the backup site that is logically grouped within a CPBSG. This other SMS storage group is exclusively used by the DFSMShsm fast replication function.

You define a set of volumes to this CPBSG that exclusively function as FlashCopy target volumes. Because FlashCopy is possible within the same DS8000 only, you must define the correct number of volumes in each DS8000 in the corresponding CPBSG. In our example, each DS8000 has three DB2 data volumes. Because we defined two backup versions, we need at least six FlashCopy target volumes within each DS8000 for a total of 12 FlashCopy target volumes that are logically grouped together in a CPBSG construct. The name of a CPBSG follows the same rules as for other SMS storage groups. The volume size of the source and target volume must be equal to allow for FRBACKUP for DB2 BACKUP SYSTEM and FRRECOV for DB2 RESTORE SYSTEM.

DFSMShsm supports up to 85 backup versions. These versions can reside not only on FlashCopy target volumes but also on tape volumes. Most of your backup versions can be on tape and you can keep only the most recent backup versions on FlashCopy target volumes.

2.5.2 Planning for the DB2 log volumes data pool

Similar considerations apply as in 2.5.1, “Planning for the DB2 application data pool” on page 20. In Figure 2-8 on page 23, we show the DB2 copy pool DSN$dbxa$LG. This copy pool contains all related SMS storage groups that contain DB2 logging volumes, backup control data sets (BCDS), and the related integrated catalog facility (ICF) user catalogs.

ICF user catalog considerations

The ICF user catalogs must reside on a volume within the copy pool and contain only catalog entries that belong to data sets that reside on volumes within the copy pool. The user catalog has to be clean. The catalog must not contain orphan entries or entries for data sets that reside on volumes outside of the copy pool. These rules are strict. Using data sets outside of the copy pool does not prevent you from recovering all of the data within the copy pool. Orphan entries in the catalog can prevent FRBACKUP from creating a backup copy that will recover all of the data within the copy pool successfully.

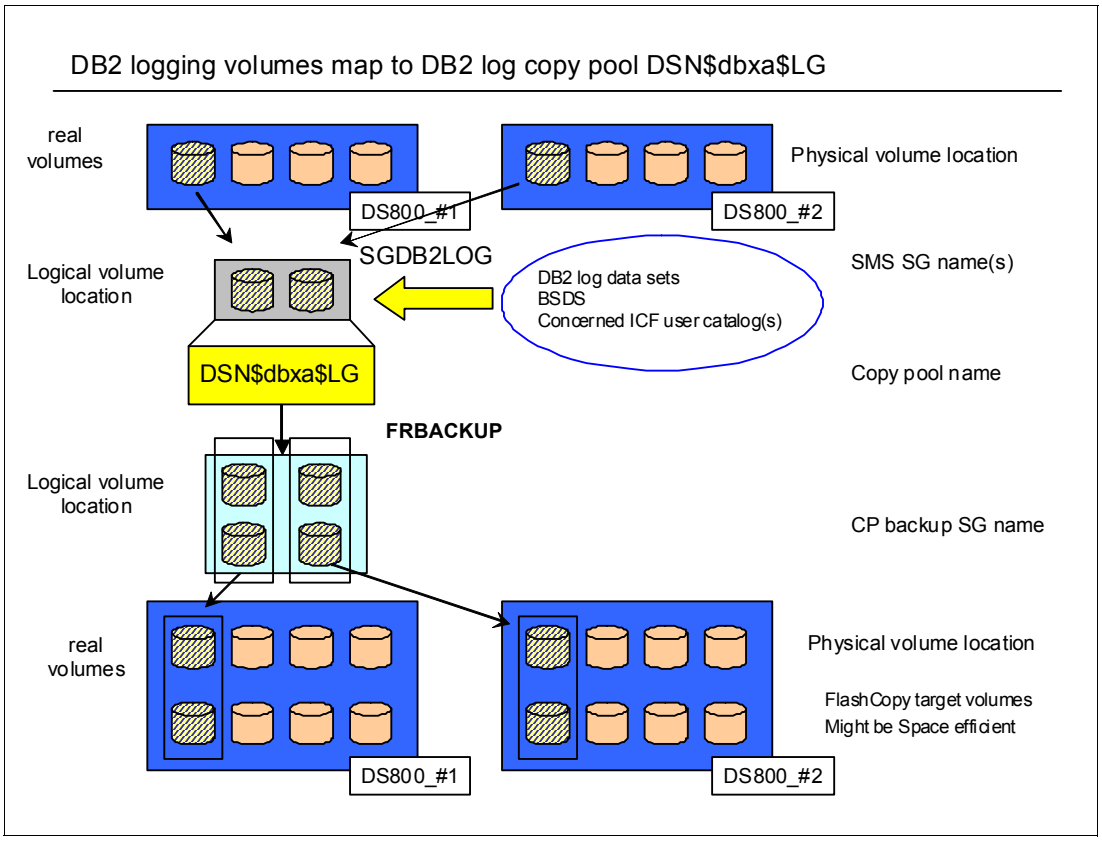

Figure 2-8 Map DB2 logging storage group to FRBACKUP copy pool and CPBSG

Figure 2-8 uses the copy pool DSN$dbxa$LG to combine all DB2 storage groups that contain DB2 logging volumes. For performance and scaling, the volumes of the SMS storage group SGDB2LOG are also physically spread across both DS8000 subsystems and logically combined through DGDB2LOG.

Because we want two backup versions for the logging volumes also, we provide the correct number of FlashCopy target volumes in each DS8000. In Figure 2-8, two FlashCopy target volumes are within DS8000_#1 and another two FlashCopy target volumes are within DS8000_#2.

SMS storage groups for the DB2 subsystem

You can have two SMS storage groups for the DB2 subsystem. Due to a dual logging approach, it might be suitable to subdivide the dual logging volumes into separate SMS storage groups, such as SGDB2LG1 and SGDB2LG2. Then, combine both SMS storage groups into the common copy pool DSN$dbxa$LG.

The same conditions apply as described in 2.5.1, “Planning for the DB2 application data pool” on page 20 for the ICF user catalogs and the content within these catalogs.

The actual FlashCopy mapping from the volumes out of the copy pool to the FlashCopy target volumes in the CPBSG is performed by DFSMShsm during the PREPARE phase of FRBACKUP or during the actual execution of FRBACKUP.

2.5.3 FRBACKUP target configuration for a DB2 subsystem

Figure 2-9 shows the entire FRBACKUP configuration for a DB2 subsystem. FRBACKUP is performed on a copy pool level; therefore, FRBACKUP is required to be issued twice to create an instantaneous backup of the entire DB2 subsystem data.

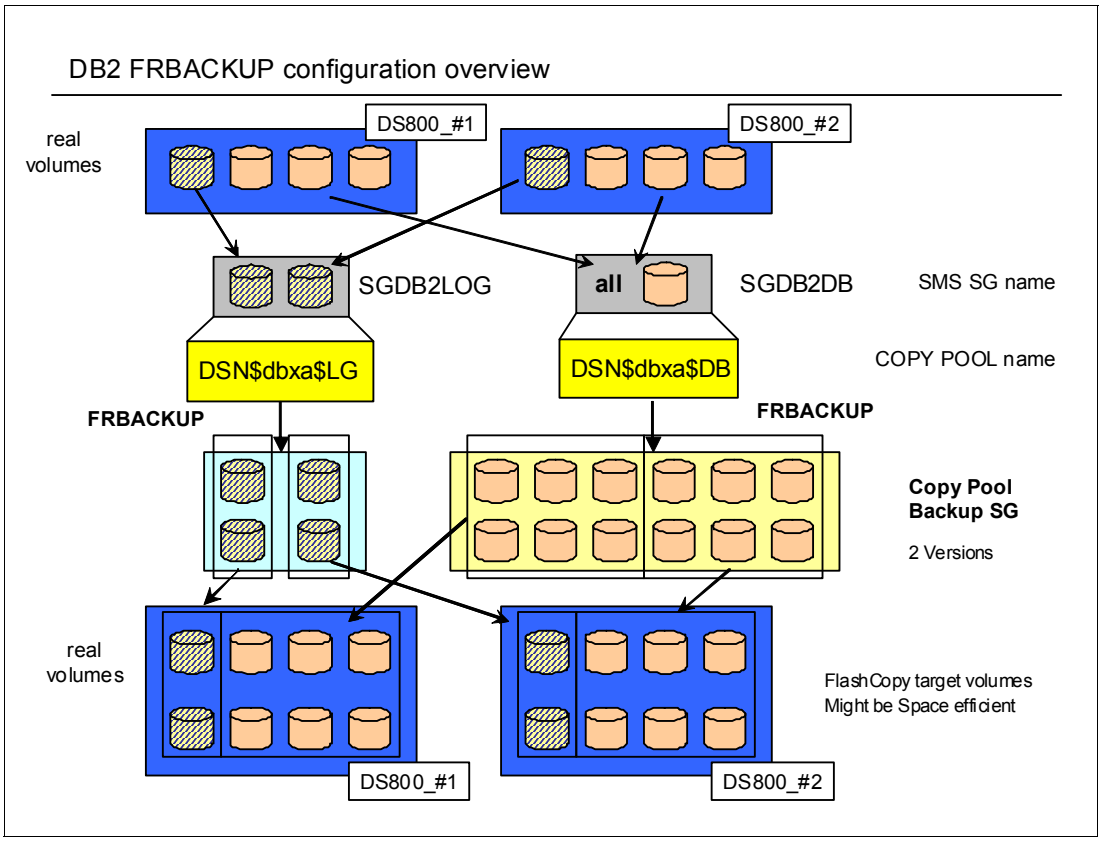

Figure 2-9 Overall DB2 storage groups mapped to FRBACKUP configuration

The FRBACKUP commands are actually issued through the DB2 utility function DB2 BACKUP SYSTEM.

2.5.4 System overview of FRRECOV from DB2 data CPBSG

Figure 2-10 shows the point-in-time (PiT) recovery of an entire DB2 database copy pool by using the FRRECOV command.

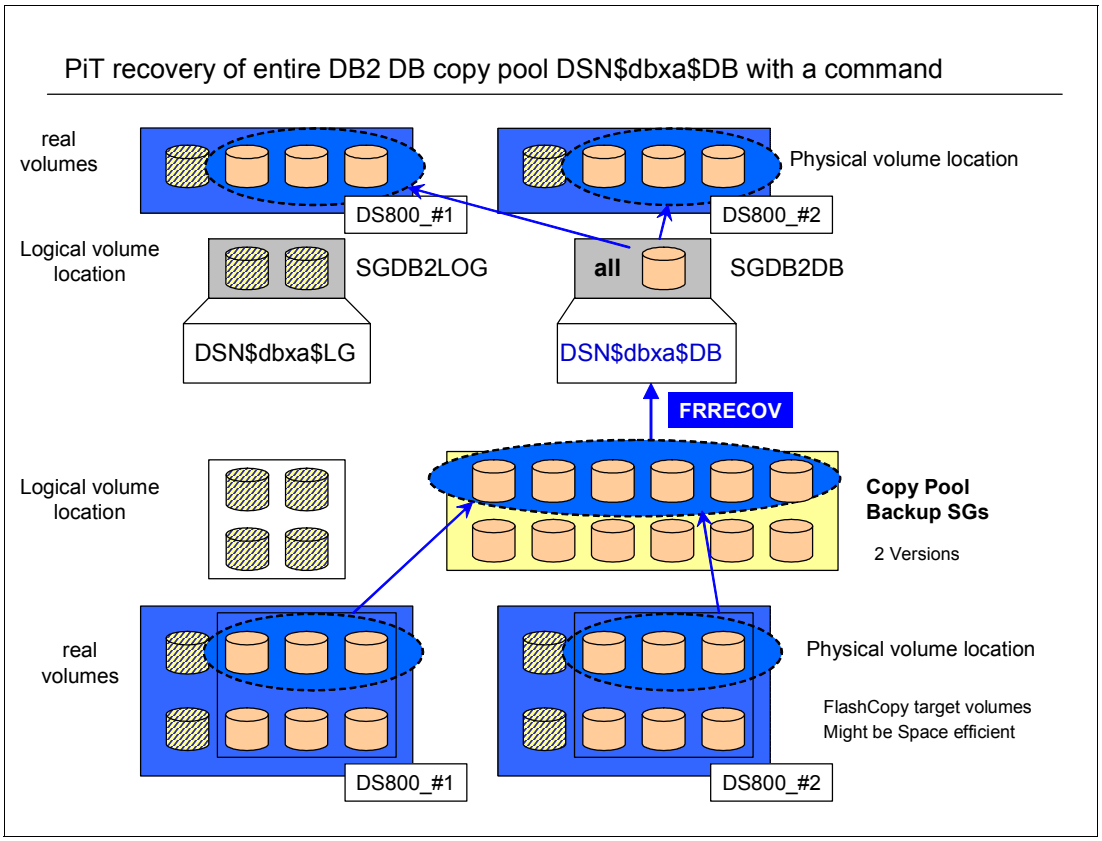

Figure 2-10 Recover PiT copy of entire DB2 data storage group with a single command

3

Storage management subsystem environment

This chapter provides the necessary information to implement the storage management subsystem (SMS) environment for the DFSMShsm fast replication function.

SMS provides two types of constructs to define the topology of volumes that must be used by DFSMShsm fast replication:

- Copy pool
- Storage group of type copy pool backup

These definitions enable DFSMShsm to know the volumes, target and source that must be processed for the fast replication functions and how to manage them.

3.1 SMS constructs

DFSMS is a component of DFSMSdfp. Your storage administrator uses Data Facility Storage Management Subsystem (DFSMS) to assign various attributes to your data sets and objects so that the system can automatically assume storage management tasks that were previously performed manually. DFSMS helps your storage administrator simplify storage management and use system space and resources more efficiently.

To use DFSMS, your storage administrator designs a configuration that contains sets of attributes, which are called *constructs*, of the various class and group applications. The storage administrator uses SMS classes and groups to define the goals and requirements that the system must meet for a data set or volume. The storage administrator can create any number of constructs, giving each construct a unique name. For example, the storage administrator can define a storage class for data sets or objects that require high performance and another storage class for standard performance. The storage administrator can add, delete, copy, and alter classes as needs change.

After the storage administrator defines the necessary constructs, the storage administrator writes automatic class selection (ACS) routines to assign constructs to data sets and to manage data sets.

The storage administrator uses the Interactive Storage Management Facility (ISMF) to create the correct classes and groups, and ACS routines to assign them to data according to your installation's policies.

When a new data set is allocated or an object is to be written, DFSMS invokes ACS routines to assign a configuration of DFSMS classes to the data set or object. The attributes from the DFSMS classes then govern the space management, performance, and availability of the data set or object from its creation to its deletion.

Figure 3-1 shows the relationship of the classes and groups to your goals and requirements.

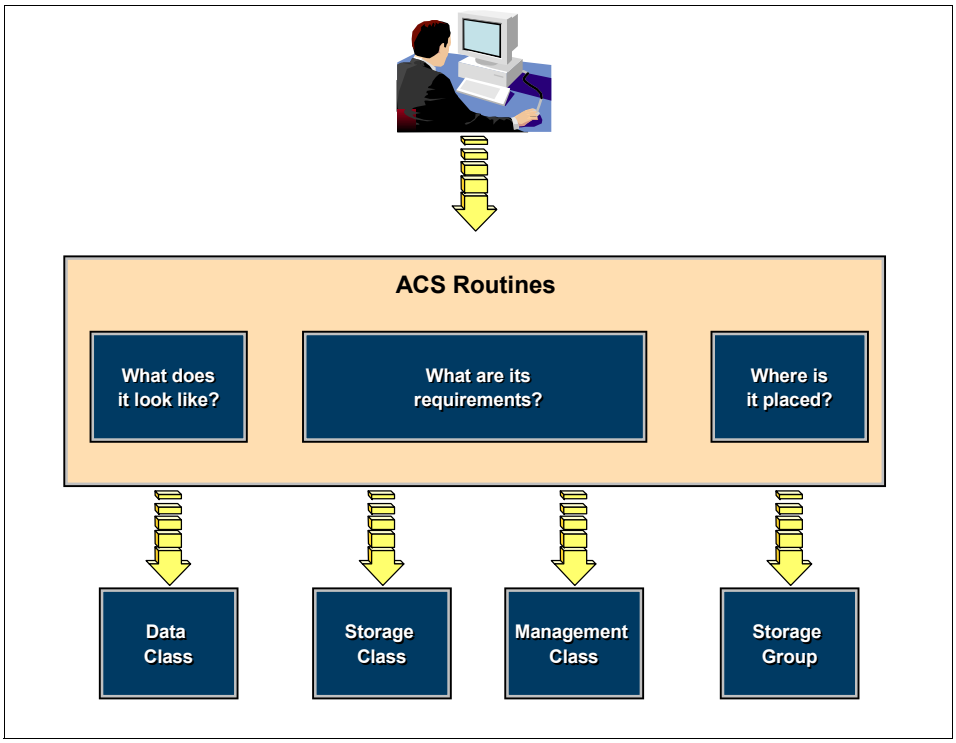

Figure 3-1 ACS routines allocating data sets

You can display a list of the available data classes, storage classes, management classes, and storage groups. You can look at the attributes that are associated with any specific class, but you cannot change any of the attributes. If you have authorization, you can change the name of a storage class and the name of a management class that are associated with any of your data sets that are managed by DFSMS. If you need to make any other changes, you must ask your storage administrator to make them for you.

3.2 SMS constructs for fast replication

DFSMShsm manages the fast replication backups, and recovery can be performed at the copy pool level, the volume level, and at the data set level.

In this section, we describe the DFSMS constructs that are used to manage DFSMShsm fast replication.

3.2.1 Copy pool

A *copy pool* is the SMS construct that defines the storage groups that must be processed collectively by the DFSMShsm function. A copy pool can contain the names of up to 256 storage groups that must be processed collectively for DFSMShsm fast replication.

Naming conventions

The name of this type of construct can be up to 23 characters. The first character of the name can be an uppercase alphabetic or national character. Any of the remaining characters can be an uppercase alphabetic character, national character, or a number.

Defining a copy pool

When you define a copy pool, the individual source pool storage group names are entered. The actual volumes that are associated with each storage group are retrieved during subsequent processing. The volumes that are processed during a function, such as fast replication backup, might not be the same volumes that are associated with the storage group at the time that the copy pool was established. For example, if volumes are added to a storage group within a copy pool, those volumes will be processed as part of the next fast replication backup automatically. The copy pool definition does not need to be updated unless storage groups are added or removed from the pool.

An individual storage group can be associated with up to 50 different copy pools.

Backup versions

As many as 85 backup versions can be maintained for each copy pool. Each version that is maintained requires a unique target volume for each source volume. If you are specifying five backup versions, five target volumes must be available for each source volume that is associated with the copy pool. All target volumes must be available when the FRBACKUP command is issued for execution.

Dump copy

You can request for a dump copy to tape for each volume that is backed up during the FRBACKUP of a copy pool by automatic dump processing of DFSMShsm.

Recovery processing

DFSMShsm can record catalog information of all data sets that are being allocated on the volumes of the copy pool. This record is a prerequisite for the support of moved or deleted data sets when you request to restore individual data sets during FRRECOV processing.

If you want to use a fast replication backup for recovering the entire copy pool, even before the background copy completes (the Fast Reverse Restore function), special processing is necessary during FRBACKUP. You must plan to use Fast Reverse Restore and specify it during the copy pool definition in the ISMF Copy Pool Define panel (Figure 3-5 on page 35).

To preserve the full duplex status of a Metro Mirror volume pair when the target volume in a FlashCopy relationship is at the same time a primary volume of a Metro Mirror volume pair, you can request to preserve the full duplex status as part of the copy group definition (Figure 3-4 on page 34).

3.2.2 Copy pool backup storage group

The special storage group type of copy pool backup was introduced when DFSMShsm fast replication was first introduced with z/OS DFSMS V1.5. It is intended to contain only the candidate target volumes for a certain copy pool storage group.

Volumes in a copy pool backup storage group

Volumes that are associated with a CPBSG are reserved for DFSMShsm use. SMS Source Control Data Set (SCDS) validation will fail if a CPBSG is assigned for allocation by the SMS ACS storage group selection routines. When you try to delete or open a data set on one of these volumes without using DFSMShsm fast replication (for example, by using ISPF DSLIST services), an error will occur. The error message says that the data set is not cataloged. Therefore, you cannot change the contents of a copy pool backup volume outside of the control of DFSMShsm.

Storage group status

The SMS status of storage group and volume is used during data set allocation and end-of-volume extend. The SMS status of a CPBSG and volume is not used by DFSMShsm during a fast replication request. (For example, a status of DISABLE NEW or DISABLE ALL does not prevent DFSMShsm from processing the volume.) You can restrict DFSMShsm access to a volume in a CPBSG by varying the volume offline to z/OS.

Every pool type storage group that is part of a copy pool must be associated with a CPBSG. Usually, this association is established by populating the associated field in the pool storage group definition that refers to a particular CPBSG. Only pool storage groups can define associated CPBSGs. A pool storage group can specify its own CPBSG or specify a CPBSG that is shared by multiple pool storage groups.

Source and target volumes

For each source volume in a storage group to be copied, enough eligible target volumes in the CPBSG must exist to satisfy the needs of the number of specified backup versions. Otherwise, FRBACKUP processing will fail.

An eligible target volume must conform to the following requirements:

- Have the same track format as the source volume.
- Be the exact size of the source volume.

3.3 ISMF panels

The Interactive Storage Management Facility (ISMF) provides a series of applications for storage administrators to define and manage the SMS configuration. Figure 3-2 shows the ISMF Primary Option Menu for storage administrators.

```
                ISMF PRIMARY OPTION MENU - z/OS DFSMS V1 R12
Selection or Command ===>

0  ISMF Profile              - Specify ISMF User Profile
1  Data Set                  - Perform Functions Against Data Sets
2  Volume                    - Perform Functions Against Volumes
3  Management Class          - Specify Data Set Backup and Migration Criteria
4  Data Class                - Specify Data Set Allocation Parameters
5  Storage Class             - Specify Data Set Performance and Availability
6  Storage Group             - Specify Volume Names and Free Space Thresholds
7  Automatic Class Selection - Specify ACS Routines and Test Criteria
8  Control Data Set          - Specify System Names and Default Criteria
9  Aggregate Group           - Specify Data Set Recovery Parameters
10 Library Management        - Specify Library and Drive Configurations
11 Enhanced ACS Management   - Perform Enhanced Test/Configuration Management
C  Data Collection           - Process Data Collection Function
G  Report Generation         - Create Storage Management Reports
L  List                      - Perform Functions Against Saved ISMF Lists
P  Copy Pool                 - Specify Pool Storage Groups for Copies
R  Removable Media Manager   - Perform Functions Against Removable Media
X  Exit                      - Terminate ISMF
Use HELP Command for Help; Use END Command or X to Exit.
```

Figure 3-2 ISMF Primary Option Menu

This primary option menu differs from the menu that users see. In addition to the options on the ISMF Primary Option Menu for End Users, the primary option menu for storage administrators includes the following choices:

- Storage Group
- Automatic Class Selection
- Control Data Set
- Aggregate Group
- Library Management
- Enhanced ACS Management
- Data Collection
- Report Generation
- List
- Copy Pool
- Removable Media Manager

3.4 Preparing for DFSMShsm fast replication

Your storage administrator must define copy pools and associated source and backup storage groups to use the DFSMShsm fast replication function.

Use the following procedures to define the necessary copy pool constructs and CPBSGs and to associate existing pool storage groups with CPBSGs for DFSMShsm fast replication support.

3.4.1 Defining copy pools

You can define and maintain your copy pool definitions by selecting option **P Copy Pool - Specify Pool Storage Groups for Copies** (enter `P` at the prompt) from the ISMF Primary Option Menu as shown in Figure 3-2 on page 31.

Copy pool applications

The Copy Pool Application Selection panel displays as shown in Figure 3-3. We choose option **3 Define - Define a Copy Pool**.

```
                        COPY POOL APPLICATION SELECTION
Command ===>

To perform Copy Pool Operations, Specify:
  CDS Name . . . . 'SYS1.SMS.SCDS'
                               (1 to 44 character data set name or 'Active' )
  Copy Pool Name   CP1                              (For Copy Pool List, fully
                                              or partially specified or * for all)

Select one of the following options  :
  3  1. List    - Generate a list of Copy Pools
     2. Display - Display a Copy Pool
     3. Define  - Define a Copy Pool
     4. Alter   - Alter a Copy Pool

If List Option is chosen,
   Enter "/" to select option      Respecify View Criteria
                                   Respecify Sort Criteria


Use ENTER to Perform Selection;
Use HELP Command for Help; Use END Command to Exit.
```

Figure 3-3 Copy Pool Application Selection panel

The Copy Pool Define panel displays, as shown in Figure 3-4 on page 34. You can request additional copies on tape that will be created during the automatic dump of DFSMShsm by specifying **Y** in the Auto Dump field. You are required to populate at least one of the Dump Class fields in this case. If you do not want processing of the copy pool backups during the automatic dump, specification of dump classes is optional.

A good idea is to specify one or more dump classes in the copy pool definition because you can request additional copies on tape by using the FRBACKUP command at any time. The backup version must exist. If you do not define a dump class here, you must specify the dump class on the FRBACKUP command.

```
                              COPY POOL DEFINE                 Page 1 of 5
Command ===>

SCDS Name  . . : SYS1.SMS.SCDS
Copy Pool Name : CP1

To DEFINE Copy Pool, Specify:
  Description ==> COPY POOL 1
              ==>
  Auto Dump . . . N   (Y or N)        Dump Sys/Sys Group Name . . .
  Dump Class  . .                     Dump Class  . .
  Dump Class  . .                     Dump Class  . .
  Dump Class  . .

  Number of DASD Fast Replication Backup
   Versions with Background Copy . . . . . 2       (0 to 85 or blank)
  FRBACKUP to PPRC Primary Volumes allowed . . .     (NO, PN, PP, PR or blank)
  FRRECOV to PPRC Primary Volumes allowed  . . .     (NO, PN, PP, PR or blank)

Use ENTER to Perform Verification; Use DOWN Command to View next Panel;
Use HELP Command for Help; Use END Command to Save and Exit; CANCEL to Exit.
```

Figure 3-4 Copy Pool Define panel (page 1 of 5)

You can specify the number of DASD fast replication backup versions with background copy that you want to keep of this copy pool. The default is two copies.

The number that you specify controls the maximum number of backup versions with background copy. If the requested number of backup versions already exists as a new FRBACKUP command occurs, the oldest backup version is rolled off.

If you use Metro Mirror for all volumes, you can request Preserve Mirror during fast replication backup and recovery. The resulting process is called a *remote pair FlashCopy.*

The field FRBACKUP to PPRC Primary Volumes allowed can be used to request remote pair FlashCopy during FRBACKUP. You can specify the following values:

NO PPRC primary volumes cannot be targets.

PN Metro Mirror primary volumes can be used as FlashCopy targets. Configuration requirements for Preserve Mirror are not considered.

PP Metro Mirror primary volumes can be FlashCopy target volumes. If the target volume is a Metro Mirror primary device, a Preserve Mirror operation is preferred.

PR If the FlashCopy target volume is a PPRC primary volume, the Preserve Mirror operation is required.

blank None specified. Blank is the default.

The field FRRECOV to PPRC Primary Volumes allowed can be used to request remote pair FlashCopy during FRRECOV. The values that you can specify are the same as with field FRBACKUP to PPRC Primary Volumes allowed.

Catalog capture information

On the next panel of Copy Pool Define, as shown in Figure 3-5, you can request to capture the catalog information during the FRBACKUP of all data sets that are contained in the copy pool. During fast replication recovery processing, the saved catalog information will be used to recatalog data sets that were either deleted or moved. You must specify the names of all catalogs (up to ten) that contain entries for data sets on the copy pool volumes in field Catalog Name.

You can choose `R` (required), `P` (preferred), or `N` (none) in the field Capture catalog information for Data Set Recovery. The default is `N`, which disables capture catalog information during FRBACKUP. A setting of `P` (preferred) is best. Otherwise (if you request `R`), DFSMShsm does not tolerate any unresolved catalog information and fails the FRBACKUP processing when the catalog search interface returns an error. Heavily used catalogs often contain logical errors. Therefore, if you specify `R`, you might end up in a failing FRBACKUP processing even if only one catalog entry cannot be resolved.

Important: Ensure that the catalogs are in the same pools as the data sets that are described by the catalogs to support consistent catalog contents when a point-in-time recovery of a pool occurs.

For DFSMShsm fast replication recovery processing to recover a deleted or moved data set, user catalogs must exist on volumes that are defined in storage groups that are defined in the copy pool definition.

```
                              COPY POOL DEFINE                 Page 2 of 5
Command ===>

SCDS Name  . . : SYS1.SMS.SCDS
Copy Pool Name : CP1

To DEFINE Copy Pool, Specify:
  Catalog Name ==> UCAT.TESTFR
               ==>
               ==>
               ==>
               ==>
               ==>
               ==>
               ==>
               ==>
               ==>
  Capture Catalog Information for Data Set Recovery . . . P   (R, P or N)
  Allow Fast Reverse Restore  . . . . . . . . . . . . . . Y   (Y or N)

Use ENTER to Perform Verification; Use UP/DOWN Command to View previous Panel;
Use HELP Command for Help; Use END Command to Save and Exit; CANCEL to Exit.
```

Figure 3-5 Copy Pool Define panel (page 2 of 5)

You can request fast reverse restore during FRRECOV processing for later use by specifying `Y` in the Allow Fast Reverse Restore field.

With fast reverse restore, you can reverse the direction of an existing FlashCopy relationship and restore the source volume to the point-in-time state when it was last flashed to the target without waiting for the background copy to complete. Entering `N` disables fast reverse restore and requires you to wait for the original FlashCopy operation to complete before the recovery starts; this option is the default.

Tip: The copy pool fast reverse restore setting is saved at the time of the fast replication backup. Therefore, when you change the copy pool setting at any time, the new setting will be used only for new fast replication backups. Settings for existing fast replication backups remain unchanged.

On the remaining panels of Copy Pool Define, you can specify the storage groups to include in the copy pool. Page 3 of 5 is shown in Figure 3-6.

You can specify up to 256 storage groups in a copy pool.

Tip: You can specify storage groups that are not yet defined in the Source Control Data Set (SCDS), but this action makes the SCDS invalid for activation. The storage groups that are specified must be defined in the SCDS before you activate the configuration.

```
                              COPY POOL DEFINE                 Page 3 of 5
Command ===>

SCDS Name  . . : SYS1.SMS.SCDS
Copy Pool Name : CP1

To DEFINE Copy Pool, Specify:
  Storage Group Names:  (specify 1 to 256 names)
   ==> SG1
   ==>
   ==>
   ==>
   ==>
   ==>
   ==>
   ==>
   ==>
   ==>

Use ENTER to Perform Verification; Use UP/DOWN Command to View other Panels;
Use HELP Command for Help; Use END Command to Save and Exit; CANCEL to Exit.
```

Figure 3-6 Copy Pool Define panel (page 3 of 5)

3.4.2 Defining copy pool backup storage groups

Each pool storage group to be included in a copy pool must be associated with a CPBSG. The *copy pool backup storage group* (CPBSG) is designated as the target where the copies of the pool storage group will be kept. Usually, each storage group is associated with its own CPBSG.

Define your copy pool backup definitions by selecting option **6 Storage Group - Specify Volume Names and Free Space Thresholds** from the ISMF Primary Option Menu as shown in Figure 3-2 on page 31.

Figure 3-7 shows the Storage Group Application Selection panel.

```
                    STORAGE GROUP APPLICATION SELECTION
Command ===>

To perform Storage Group Operations, Specify:
  CDS Name  . . . . . 'SYS1.SMS.SCDS'
                            (1 to 44 character data set name or 'Active' )
  Storage Group Name    cpbsg1            (For Storage Group List, fully or
                                          partially specified or * for all)
  Storage Group Type    copy pool backup  (VIO, POOL, DUMMY, COPY POOL BACKUP,
                                          OBJECT, OBJECT BACKUP, or TAPE)

Select one of the following options  :
  2  1. List    - Generate a list of Storage Groups
     2. Define  - Define a Storage Group
     3. Alter   - Alter a Storage Group
     4. Volume  - Display, Define, Alter or Delete Volume Information

If List Option is chosen,
   Enter "/" to select option      Respecify View Criteria
                                   Respecify Sort Criteria
Use ENTER to Perform Selection;
Use HELP Command for Help; Use END Command to Exit.
```

Figure 3-7 Storage Group Application Selection panel

With the Storage Group Application Selection panel, you can perform the following tasks:

- Specify the name for the CPBSG.
- Specify the storage group type of `copy pool backup`.
- Associate your existing source pool storage groups with the CPBSG where you want to keep your copies.

After you enter the chosen Storage Group Name and Storage Group Type of `copy pool backup`, select option **2 Define - Define a Storage Group**.

When the CPBSG is defined, you also need to define volumes in it. You need to know which pool storage group must be associated with this CPBSG and the number of versions to keep for the pool storage group. The number of versions is defined in the related copy pool definition. For example, if your pool storage group contains 10 volumes and you want to keep two backup versions, the CPBSG must contain 20 target volumes.

If the pool storage group uses extended or overflow storage groups that are defined, you must also define target volumes for those storage groups. For example, if the pool storage group with 10 volumes has an overflow storage group with five volumes, you must define 30 target volumes in the CPBSG for two backup versions.

Tip: The physical volume status of all volumes in a CPBSG must be `CONVERTED`. (The volume is fully converted to SMS.) Otherwise, the volumes will not be selected as target volumes during FRBACKUP processing.

After you define the CPBSG, you must alter your existing pool storage groups to associate the CPBSGs where you want to keep their copies.

Start by selecting option **6 Storage Group - Specify Volume Names and Free Space Thresholds** from the ISMF Primary Option Menu as shown in Figure 3-2 on page 31. The Storage Group Application Selection panel displays. Specify the Storage Group name that you want and the Storage Group Type of POOL. Then, select option **3 Alter - Alter a Storage Group** (Figure 3-8).

```
                    STORAGE GROUP APPLICATION SELECTION
Command ===>

To perform Storage Group Operations, Specify:
  CDS Name  . . . . . . 'SYS1.SMS.SCDS'
                              (1 to 44 character data set name or 'Active' )
  Storage Group Name    SG1               (For Storage Group List, fully or
                                          partially specified or * for all)
  Storage Group Type                      (VIO, POOL, DUMMY, COPY POOL BACKUP,
                                          OBJECT, OBJECT BACKUP, or TAPE)

Select one of the following options  :
  3  1. List    - Generate a list of Storage Groups
     2. Define  - Define a Storage Group
     3. Alter   - Alter a Storage Group
     4. Volume  - Display, Define, Alter or Delete Volume Information

If List Option is chosen,
   Enter "/" to select option      Respecify View Criteria
                                   Respecify Sort Criteria
Use ENTER to Perform Selection;
Use HELP Command for Help; Use END Command to Exit.
```

Figure 3-8 Storage Group Application Selection panel: Alter a Storage Group

The Pool Storage Group Alter panel displays. Specify the name of the CPBSG that you want in the Copy Pool Backup SG Name field (Figure 3-9 on page 39).

```
                        POOL STORAGE GROUP ALTER         Page 1 of 2
Command ===>

SCDS Name . . . . . : SYS1.SMS.SCDS
Storage Group Name  : SG1
To ALTER Storage Group, Specify:
 Description ==>
             ==>
 Auto Migrate . . N  (Y, N, I or P)   Migrate Sys/Sys Group Name . .
 Auto Backup  . . N  (Y or N)         Backup Sys/Sys Group Name  . .
 Auto Dump  . . . N  (Y or N)         Dump Sys/Sys Group Name  . . .
 Overflow . . . . N  (Y or N)         Extend SG Name . . . . . .
                                     Copy Pool Backup SG Name . . . CPBSG1

 Dump Class . . .                    (1 to 8 characters)
 Dump Class . . .                    Dump Class . . .
 Dump Class . . .                    Dump Class . . .

 ALTER     SMS Storage Group Status . . . N   (Y or N)

Use ENTER to Perform Selection; Use DOWN Command to View next Page;
Use HELP Command for Help; Use END Command to Save and Exit; CANCEL to Exit.
```

Figure 3-9 Pool Storage Group Alter panel

A pool storage group can have only one CPBSG that is associated with it. Many pool storage groups can be associated with the same CPBSG. So, we can have different versions of different pool storage groups in a CPBSG. DFSMShsm keeps control of the copies that you have.

From the Pool Storage Group Alter panel, you can also alter the SMS storage group status by typing `Y` in the ALTER SMS Storage Group Status field. Compared with pool type storage groups, the SMS status of CPBSGs is different: SMS status can be only `ENABLE` or `NOTCON`.

3.5 Considerations

This section covers considerations that relate to DFSMShsm fast replication setup and administration.

3.5.1 DB2

If you want to set up a DFSMShsm fast replication environment for DB2, and you plan to take full system backups, a copy pool that consists of the active logs and bootstrap data sets (BSDS) is required.

The copy pool naming convention for DB2 is `DSN$`*`locn-name`*`$`*`cp-type`*:

- `DSN` is the unique DB2 product identifier.
- $ is a required delimiter.
- *`locn-name`* is the DB2 location name.
- *`cp-type`* is the copy pool type; use `DB` for database or `LG` for logs.

For example, DB2 DB1P has copy pools that are named DSN$DB1P$DB and DSN$DB1P$LG.

For more information, see Chapter 8, “Using DFSMShsm fast replication” on page 165, which is about using DFSMShsm fast replication in a DB2 environment, or *DB2 UDB for z/OS V8: Through the Looking Glass and What SAP Found There*, SG24-7088.

3.5.2 SMS constructs that span storage controllers

Volumes of the following constructs can span volume controllers (Figure 3-10 on page 41):

- Copy pools
- Storage groups
- CPBSGs

Especially if a storage group spans volume controllers, the associated CPBSG must span storage controllers, as well. FlashCopy targets must always be in the same storage controller as their source volumes. Therefore, you need to ensure that the one associated CPBSG contains enough volumes from all storage controllers according to copy pool settings and the number of source volumes in each storage controller.

Example 3-1 describes the constructs CP01, SG3, and CPBSG3 that are used in Figure 3-10 on page 41.

Example 3-1 SMS construct descriptions

```
Copy pool CP01:      4 backup versions with background copies of SG3
SG3:                 3 volumes in the first storage controller, 2 volumes in the other one
CPBSG3:     3*4=12 volumes in the first storage controller, 2*4=8 volumes in the other one
```

If occasionally volumes of another storage controller will be added to SG1, the new scenario looks similar to what we see with CP01. For the correct execution of FRBACKUP CP(CP3) ..., another set of volumes in the new storage controller must be added to CPBSG1.

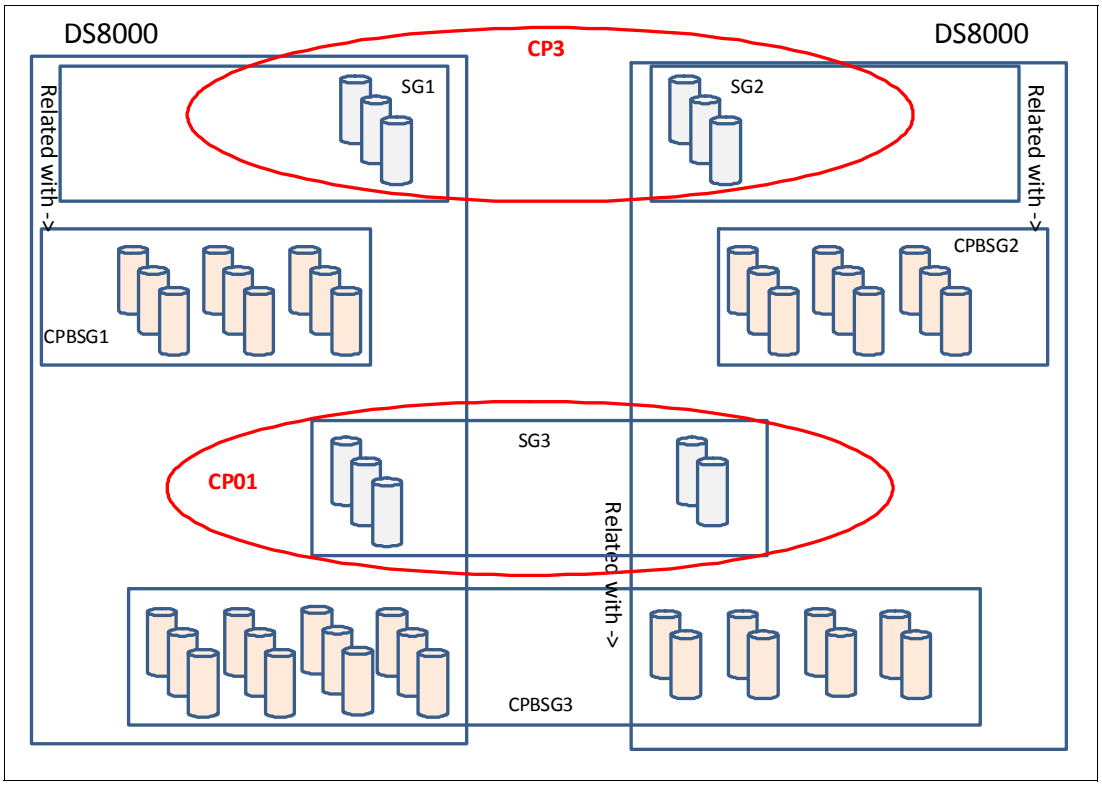

Figure 3-10 SMS constructs that span storage controllers

3.5.3 Extend and overflow storage group types

The extend and overflow storage group types that were introduced in z/OS V1.3 enable data sets to be allocated on or extended onto volumes that are not a part of a main source storage group.

Extended storage group is a feature of the pool storage group type that is used for secondary allocation when the primary storage group has insufficient available space. Without this support, extended processing can select only volumes from within the same storage group as the initial allocation.

Overflow storage groups are used for the initial data set creation when insufficient space is available in the primary storage group for the first extent of a data set. If an overflow storage group is defined and the ACS routines allow the use of the overflow storage group for this data set, a data set will be directed to the overflow storage group if all volumes in the primary storage groups are over their high allocation threshold.

Figure 3-9 on page 39 shows Overflow and Extend SG Name fields in the Pool Storage Group Alter panel.

If you list all of the storage groups, you will find that OVERFLOW in column 41 and Extend SG Name at column 42 contain valid values if you implemented SMS extended or overflow storage groups.

If you implemented SMS extended or overflow storage groups in your environment, you must ensure that all extended and overflow storage groups are included in the storage group list of the appropriate copy pools.

Important: Extend or overflow storage groups must be used only if all source storage groups that use a particular extend or overflow storage group and the extend or overflow storage group are all contained within the same copy pool. Extend and overflow storage groups must not be used if the source storage groups that use them are contained within different copy pools.

DFSMS does not verify that extend and overflow storage groups that are associated with the main source storage groups are included in the copy pool definition. Source volumes that are contained in overflow and extend storage groups also require target volumes to be set aside for their use in the CPBSG. A backup of each volume is made whether or not it contains any data.

3.5.4 GRSplex

A resource will be obtained that prevents a copy pool from being processed by two separate tasks in the GRSplex:

QNAME ARCENQG
RNAME COPYPOOL&&cpname
SCOPE SYSTEMS

The scope of this resource extends beyond an HSMplex because a copy pool is defined at the SMSplex level, so we must prevent all DFSMShsm hosts, regardless of which HSMplex they reside in, from processing the same copy pool. This resource will be obtained by all functions that are processing a copy pool. The resource will be obtained unconditionally; that is, if the resource is not immediately available, the function will wait:

- The functions that will obtain this resource exclusively are FRBACKUP and FRDELETE.
- LIST, QUERY, and FRRECOV will obtain the resource as shared.

Before processing either a backup or recover of a volume, DFSMShsm serializes the source and target volumes to prevent concurrent DFSMShsm tasks in the HSMplex from processing the same volumes.

Another resource will be obtained for the dumping of copy pools:

QNAME ARCENQG
RNAME CPDUMP&&cpname&&V*nnn*
SCOPE SYSTEMS

The *nnn* is the version that is being dumped. Only a single host can dump a particular disk version at a time.

3.5.5 Sysplex with multiple DFSMS levels

You can work with control data sets (CDS) that are shared across a sysplex. If different systems in the sysplex have different versions of DFSMS, certain features are not available to all systems. If you try to modify a control data set from a system that does not have the most current version of DFSMS that is used in the sysplex, you will see the panel that is shown in Figure 3-11 on page 43.

```
                              UPLEVEL CDS WARNING
Command ===>

  To Confirm Operation on the following CDS:

     CDS Name . . : SYS1.SMS.SCDS

  Specify the following:
      Perform Operation  . . N          (Y or N)


  IBM recommends modifying the SCDS on the highest level of DFSMS.
   The SCDS being modified was found to have been modified by a
   later release level of DFSMS.  New features available in the
   later release levels cannot be modified on this release.
   Validation of the SCDS on this release will not validate new
   features known only to later release levels.
  It is recommended that you have a current backup of the SCDS before
   modifying the SCDS on this release.

Use Enter to Perform Operation;
```

Figure 3-11 Uplevel CDS warning

This message is merely a warning. You can change the default value *N* in the Perform Operation field to continue with your changes and modify the SCDS.

3.6 NaviQuest changes for DFSMShsm fast replication

Storage administration tasks that are performed by using ISMF options can also be performed in batch with JCL, CLISTs, and REXX EXECs that are provided by NaviQuest. For more information, see NaviQuest in Appendix E.5, “Performing Storage Administration Tasks in Batch” in the manual *DFSMSdfp Storage Administration Reference*, SC26-7402.

ISMF supports copy pools as part of the application, Enhanced ACS Management - NaviQuest.

The following actions are supported:

- Create Copy Pool List
- Generate Copy Pool Report
- Create Copy Pool List and Generate Report
- Define/Alter/Display Copy Pool
- Define/Alter Copy Pool Backup Storage Group
- Delete Copy Pool

Figure 3-12 shows the Saved ISMF List Operations Batch Samples Selection Menu that lists these actions.

```
Panel  Help ------------------------------------------------------------
 SAVED ISMF LIST OPERATIONS BATCH SAMPLES SELECTION MENU
 Command ===>
Select an option by typing '/' or enter Data Set to Edit and press Enter:
                                                          More:
      Create   Storage Class List
      Generate Storage Class Report
      Create   Storage Class List and Generate Report
      Create   Storage Group List
      Generate Storage Group Report
      Create   Storage Group List and Generate Report
      Create   Aggregate Group List
      Generate Aggregate Group Report
      Create   Aggregate Group List and Generate report
      Create   Copy Pool List
      Generate Copy Pool Report
      Create   Copy Pool List and Generate Report

 Data Set to Edit . .

 Use HELP Command for Help; Use END Command to Exit.
```

Figure 3-12 ISMF NaviQuest panel

The following JCL execs in data set SYS1.SACBCNTL relate to DFSMShsm fast replication:

ACBJBAJI List
ACBJBAJJ, ACBJBAJK Reports
ACBJBAJL Delete
ACBJBAP1 Define/alter/display

The following REXX execs in data set SYS1.DGTCLIB relate to DFSMShsm fast replication:

ACBHELP Help
ACBQBAIJ List
ACBQBAP1 Define/alter/display
ACBQBAP2 Define/alter
ACBQBAP3 Display
ACBQBARL, ACBQBARM Reports

The Redbooks publication, *Maintaining Your SMS Environment,* SG24-5484, covers the use of NaviQuest in detail.

3.7 Lab environment for our tests

For the examples in this section, we used the following lab environment. Storage groups of type pool were populated with only one volume in most cases to limit the number of messages. Most of our copy pools are associated with only one storage group for the same reason.

We defined two copy pools that were intended for tests that related to fast replication DASD backup without background copy (Example 3-2 on page 45). Both of the copy pools use the same storage group. The copy pools are prepared for copying the backups to tape during the DFSMShsm automatic dump.

Example 3-2 Copy pools for tests without background copy

```
  ------------------------------------------------------------------
  --                     ISMF Copy Pool List                      --
  --                                                              --
  -- Printed: 10/10/12                              At: 12:39 Hrs.  --
  --      By: MHLRES1                                Page No.:    1 --
  --                                                              --
  ------------------------------------------------------------------

        COPY POOL NAME
-------------(2)--------------

CPSE1
   (3)   # BACKUP VERSIONS  -         0
   (4)   AUTO DUMP          -       YES
   (9)   DUMP CLASS         -   DCFR112
  (16)   CATINFO            - PREFERRED
  (17)   ALLOW FCFRR        -       YES
  (18)   STORAGE GRP NAME   -       SG0
  (19)   STORAGE GRP NAME   -  --------

CPSE2
   (3)   # BACKUP VERSIONS  -         0
   (4)   AUTO DUMP          -       YES
   (9)   DUMP CLASS         -   DCFR112
  (16)   CATINFO            - PREFERRED
  (17)   ALLOW FCFRR        -       YES
  (18)   STORAGE GRP NAME   -       SG0
  (19)   STORAGE GRP NAME   -  --------
```

Another set of copy pools was defined for the testing of the backups with background copy. One of the copy pools spans the storage controllers (Example 3-3). These copy pools are not prepared for automatic dump. We show that a copy to tape can be performed in any case by providing the necessary information as part of the FRBACKUP command.

All copy pools are prepared to use the fast reverse restore during the FRRECOV processing because fast reverse restore is one of the major enhancements with z/OS DFSMS V1.12.

Example 3-3 Copy pools for tests with background copy

```
  ------------------------------------------------------------------
  --                     ISMF Copy Pool List                      --
  --                                                              --
  -- Printed: 10/10/12                              At: 12:39 Hrs.  --
  --      By: MHLRES1                                Page No.:    1 --
  --                                                              --
  ------------------------------------------------------------------

        COPY POOL NAME
-------------(2)--------------

CPNSPANBOX07
   (3)   # BACKUP VERSIONS  -         2
   (4)   AUTO DUMP          -        NO
   (9)   DUMP CLASS         -  --------
```

```
  (16)   CATINFO            - PREFERRED
  (17)   ALLOW FCFRR        -       YES
  (18)   STORAGE GRP NAME   -       SG1
  (19)   STORAGE GRP NAME   -       SG2

CP1
   (3)   # BACKUP VERSIONS  -         2
   (4)   AUTO DUMP          -        NO
   (9)   DUMP CLASS         -  --------
  (16)   CATINFO            - PREFERRED
  (17)   ALLOW FCFRR        -       YES
  (18)   STORAGE GRP NAME   -       SG1
  (19)   STORAGE GRP NAME   -  --------
CP2
   (3)   # BACKUP VERSIONS  -         1
   (4)   AUTO DUMP          -        NO
   (9)   DUMP CLASS         -  --------
  (16)   CATINFO            - PREFERRED
  (17)   ALLOW FCFRR        -       YES
  (18)   STORAGE GRP NAME   -       SG1
  (19)   STORAGE GRP NAME   -  --------
```

Example 3-4 shows a list of the storage groups that we use for our tests. This list is based on the information that no overflow and extend storage groups were defined. We chose to use a one-to-one mapping of storage groups and CPBSGs, which is considered the preferred practice.

Each of the storage groups, SG0 and SG1, in our environment are populated by only one volume. SG2 contains two volumes.

CPBSG CPBSG0 contains FlashCopy Space Efficient (SE) volumes. CPBSG1 and CPBSG2 contain standard volumes.

Example 3-4 List of storage groups

```
  ------------------------------------------------------------------
  --                   ISMF Storage Group List                    --
  --                                                              --
  -- Printed: 10/10/06                              At: 23:06 Hrs.  --
  --      By: MHLRES1                                Page No.:    1 --
  --                                                              --
  ------------------------------------------------------------------

STORGRP           EXTEND   CP BCKP
NAME     OVERFLOW SG NAME  SG NAME
--(2)--- --(41)-- --(42)-- --(43)--
SG0      NO       -------- CPBSG0..
SG1      NO       -------- CPBSG1..
SG2      NO       -------- CPBSG2..
-----------------------------------------------------------------
No. of Entries  -  3
```

Figure 3-13 provides an overview of the lab environment.

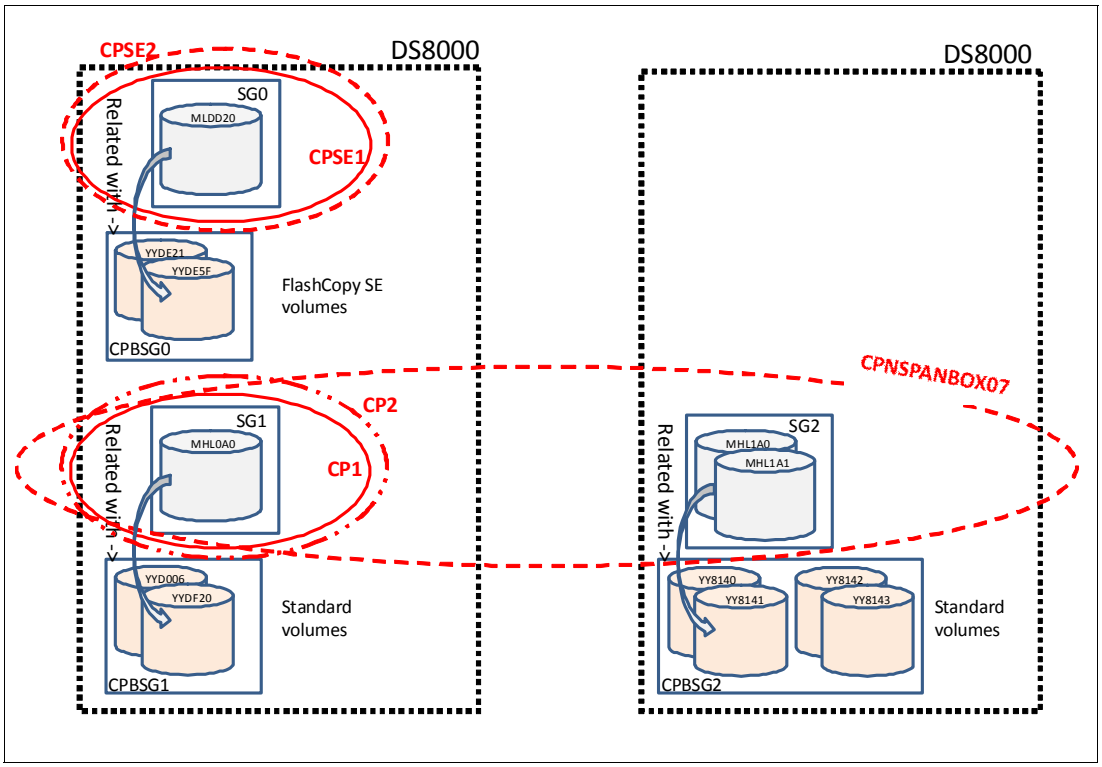

Figure 3-13 Overview of the lab environment

Copy pools CPSE1 and CPSE2 are both configured for the use of fast replication without background copy. By using two copy pools that are dedicated to the same set of storage groups (which is only one storage group in our environment), you can keep two backup versions of the same set of storage groups. The two backup versions of the same set of storage groups represent two different point-in-time backups on different sets of target volumes at the same time. The target volumes are SE volumes because the FlashCopy relationship is the NOCOPY type.

Copy pool CP1 is a typical copy pool for use of non-incremental fast replication with background copy. The number of backup copies setting is 2, which is advised for this type of backup. The same rule applies to copy pool CPNSPANBOX07. The only difference is that the storage groups are in different storage controllers.

Copy pool CP2 is a typical copy pool for the use of incremental fast replication with background copy. The backup copy setting is set to 1 based on advice for this type of backup.

4

DFSMSdss interface considerations

DFSMSdss is the data mover in z/OS and provides all data copying and moving functions.

This chapter describes several interface considerations for how DFSMShsm invokes DFSMSdss, but also how DFSMSdss invokes DS8000 FlashCopy functions. DFSMSdss provides the actual fast replication function for DFSMShsm for FRBACKUP and FRRECOV.

DFSMShsm is overall in charge to control all invocations of DFSMSdss. For its various functions, DFSMShsm calls or transfers to DFSMSdss. DFSMShsm interfaces through z/OS cross-memory services with DFSMSdss, which then executes in additional address spaces that are created.

4.1 DFSMSdss functions that are used by DFSMShsm

Due to the use of FlashCopy and SnapShot functions, although we focus on DS8000 FlashCopy functions only, DFSMSdss is used to invoke DS8000 FlashCopy functions on behalf of DFSMShsm, as depicted in Figure 4-1. In this diagram, the FlashCopy source volumes are the application volumes that are grouped in a copy pool. This copy pool can be spread across multiple DS8000 storage subsystems. All corresponding FlashCopy target volumes are grouped together in a copy pool backup storage group (CPBSG). The FlashCopy source-to-target relationship is necessary within each involved DS8000 storage subsystem.

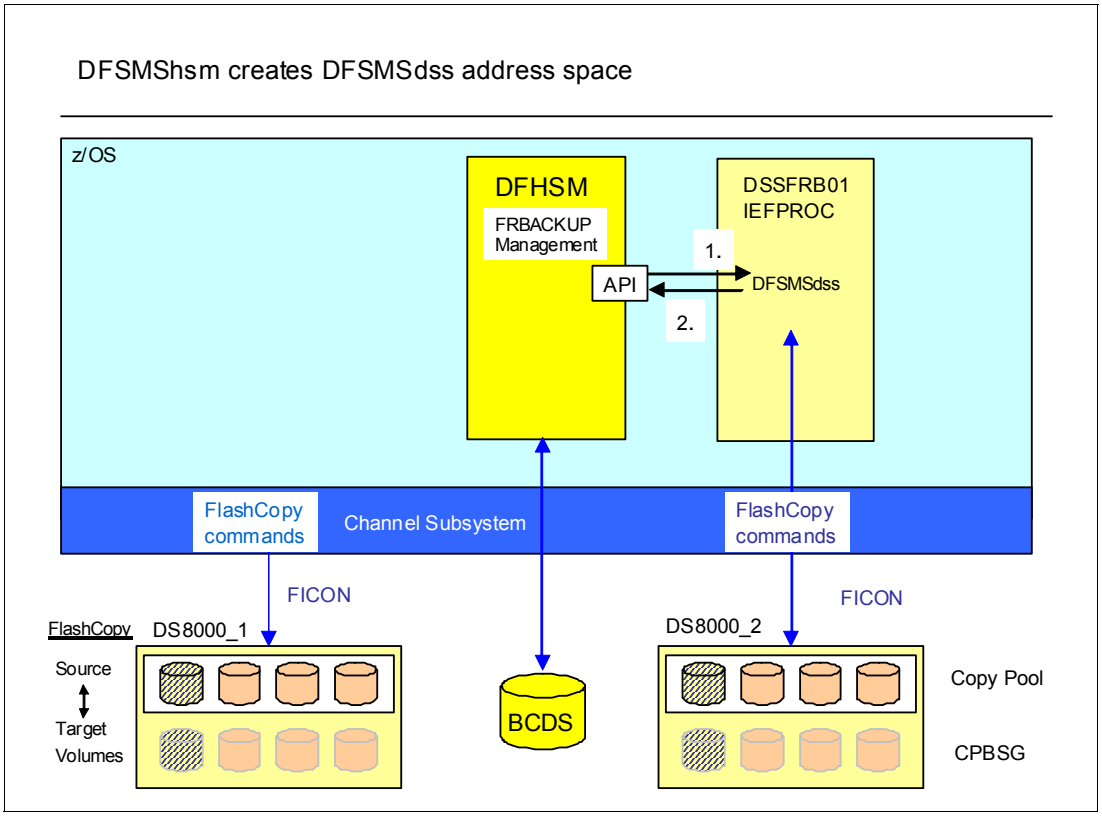

Figure 4-1 DFSMShsm interfaces with DFSMSdss

In Figure 4-1, the following processing occurs:

1. DFSMShsm invokes DFSMSdss to ask for the actual fast replication support after DFSMShsm selected the FlashCopy source volumes in the copy pool and the corresponding FlashCopy target volumes from the CPBSG to create the FlashCopy volume pairs. DFSMSdss provides the communication of the DS8000 Copy Services functions and invokes FlashCopy through an in-band approach by way of Fibre Channel connection (FICON) channels.
2. The control is returned from DFSMSdss back to DFSMShsm after the fast replication is initiated for all of the FlashCopy volume pairs. This initiation happens within a few seconds for hundreds of FlashCopy volume pairs. If a FlashCopy pairing attempt fails, DFSMShsm issues ARC18*xxx* messages, which now include the DFSMSdss error message and the volume serial number (VOLSER) that had the problem. As soon as one more FlashCopy pairing fails, the entire FRBACKUP process fails. When all FlashCopy pairs are successfully established, DFSMShsm documents these copy pairs in its backup control data set (BCDS), including the new BACKUP version.

DFSMSdss is enhanced to support the following functions:

- Individual data set restore can be used for extended format Virtual Storage Access Method (VSAM) data sets, including extended format linear striped data sets (LDS) (since Data Facility Storage Management Subsystem (DFSMS) V1.11). DB2 mainly uses LDS.
- A new FASTREPLICATION(REQUIRED) keyword, FR(REQ), is provided (since DFSMS V1.12).
- DFSMShsm specifies NOVTOCENQ to indicate no volume serialization by DFSMSdss on the FlashCopy source volume.

> **Important:** NOVTOCENQ must only be used when another utility, such as DB2 or DFSMShsm, provides the serialization. If NOVTOCENQ is used incorrectly, the results can lead to corrupted and inconsistent data.

- Bypass security verification options are available during the full volume copy.

A typical DFSMSdss invocation by DFSMShsm, which is slightly edited for explanatory purposes, is shown in Example 4-1.

Example 4-1 FRBACKUP DFSMSdss command example

```
ARC1801I FAST REPLICATION BACKUP IS STARTING FOR COPY POOL DSN$DBXA$DB, AT 14:33:10 ON
2010/10/20
........
ARC0640I ARCFRTM - ADR050I (001)-PRIME(02), DFSMSDSS INVOKED VIA CROSS MEMORY APPLICATION
INTERFACE
.......
ARC0640I ARCFRTM -  COPY IDY(DB1984) ODY(XX1984) DUMPCOND FR(REQ) PUR FCINCREMENTAL     -
ARC0640I ARCFRTM -  FCFVR -
ARC0640I ARCFRTM -  DEBUG(FRMSG(DTL))
......
ARC0640I ARCFRTM - ADR806I (001)-TOMI (02), VOLUME DB1984 WAS COPIED USING A FAST REPLICATION
FUNCTION
```

DFSMShsm invokes DFSMSdss by way of cross-memory services.

As shown in Example 4-1, DFSMSdss dynamically allocates a DB2 database volume DB1984 from copy pool DSN$DBXA$DB and selects the FlashCopy target volume XX1984 from the corresponding CPBSG.

This example is obviously an incremental FlashCopy, and DFSMSdss enforces a complete copy of all tracks from source volume DB1984 to the target volume XX1984 on the *first* invocation of an incremental FlashCopy command. Otherwise, FlashCopy only replicates the changed tracks since the last incremental FlashCopy from the DB1984 volume to the XX1984 volume. FlashCopy Full Volume Relation (FCFVR) instructs DFSMSdss to establish a single FlashCopy relationship from the first track of the volume to the last track of the volume. Otherwise, DFSMSdss attempts not to copy free tracks and eventually establish the multiple FlashCopy relationship of used extents.

An interesting parameter is DUMPCONDITIONING. DUMPCOND allows the FlashCopy target volume to be kept online after the DFSMSdss full volume copy operation completed. DFSMSdss puts the original label from the source volume on track zero on the target volume. But DFSMSdss also keeps the original label from the target volume, which allows the target volume to stay online.

Note: DFSMSdss can only access volumes that are online to the system on which DFSMSdss executes.

So, the target volume is ready for the next FlashCopy operation that is triggered and managed through DFSMSdss.

COPYVOLID is also an option for DFSMSdss to perform a full physical volume copy in a system-managed environment. At the end of the copy process, DFSMSdss puts the source volume label on the target volume and sets the target volume offline. Therefore, this option is not an option for FRBACKUP.

Because DUMPCOND plays such an important role in the FRBACKUP solution, the following section describes the purpose of DUMPCOND and how it works.

4.1.1 DFSMSdss full copy with DUMPCONDITIONING

Physical full volume DASD copies were not useful in a system-managed storage environment, particularly for FlashCopy target volumes. However, this situation changed with DFSMSdss and DUMPCONDITIONING.

DFSMSdss took advantage of FlashCopy from early on through its DUMPCONDITIONING or DUMPCOND approach. Because this approach is used by FRBACKUP, a brief review of DFSMSdss dump conditioning is provided.

Overview

In a global resource serialization (GRS)-controlled z/OS monoplex or sysplex, all devices must have unique labels or VOLSERs to stay online to the systems. FlashCopy does not understand the concept of labels or VOLSERs and always copies everything from the source FlashCopy volume to a corresponding target volume.

When FlashCopy is directly performed through Device Support Facilities (ICKDSF) or TSO commands, it addresses z/OS device numbers and whether the volume is ONLINE or OFFLINE is not relevant. DFSMSdss, however, can only perform I/O to ONLINE volumes. Therefore, DFSMSdss needs to use ONLINE volumes with unique VOLSERs to perform FlashCopy triggered full physical volume copies. Figure 4-2 on page 53 shows the flow of DFSMSdss steps that control full physical volume copy and dump through DFSMSdss COPY/DUMP and DS8000 FlashCopy.

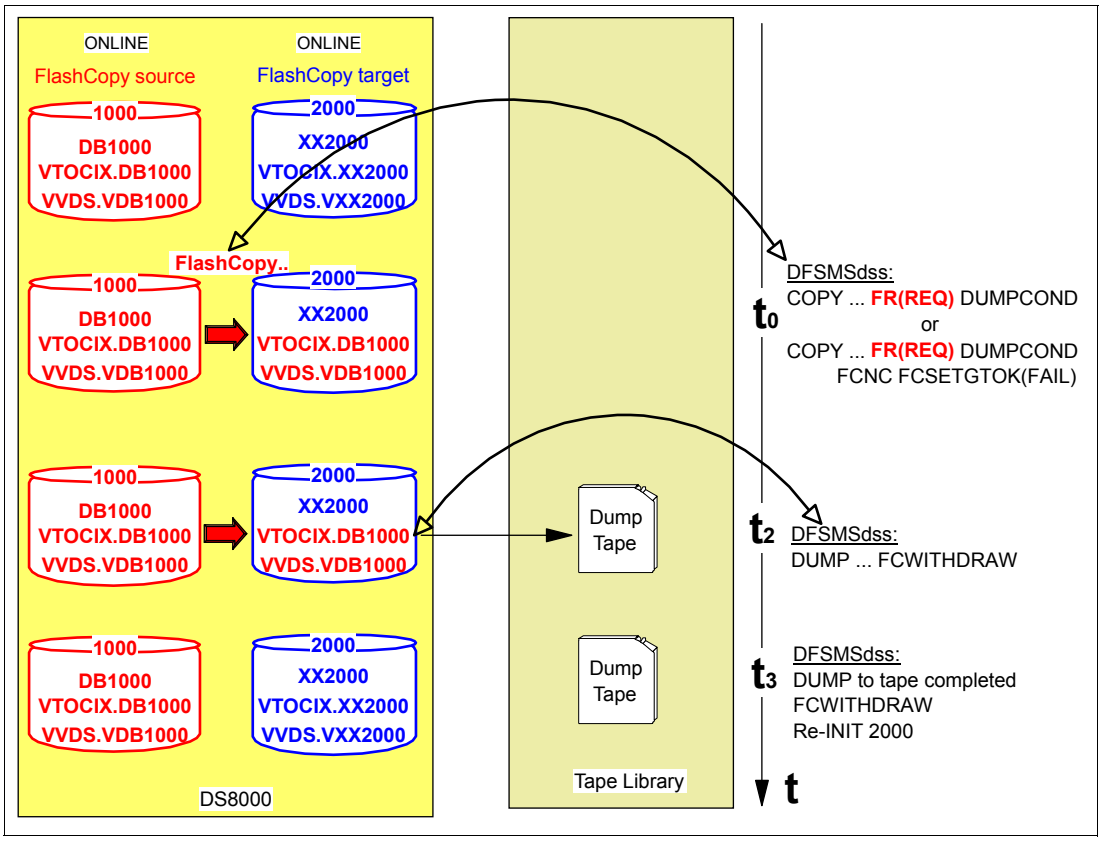

Figure 4-2 DFSMSdss and DUMPCONDITIONING

Procedure

Two distinct DFSMSdss steps are used to create a full dump by using full copy with DUMPCONDITIONING and FlashCopy FR(REQ):

1. At t_0 in Figure 4-2, a full DFSMSdss copy uses FlashCopy through FASTREPLICATION(REQUIRED) or shortened to FR(REQ), which requires the use of DS8000 FlashCopy. This full copy step also uses DUMPCOND to achieve two goals:

   – Keep the original target volume VOLSER after the full copy completed.

   – Also, store the source volume VOLSER in a protected field on the target volume.

   In the example in Figure 4-2, the FlashCopy target can be either a fully provisioned volume or a Space Efficient (SE) FlashCopy target volume. No background copy (FCNC) is applicable to a Space Efficient (SE) FlashCopy target volume, which is referred to as a SE target volume and indicated by the parameter FCSETGTOK. The actual full copy through FlashCopy in t_0 takes only a few milliseconds. After the FlashCopy is logically completed, I/O can continue to the source volume and to the target volume. See also 2.3.1, “Full volume FlashCopy” on page 13.

   After the full copy step completes, the target volume keeps its original VOLSER and stays online because DFSMSdss needs the FlashCopy target volume to be online for its subsequent full dump operation. But, the data sets on this FlashCopy target volume cannot be used by applications. This type of FlashCopy target volume serves mainly for backup and availability purposes.

   DFSMShsm FRBACKUP uses this particular step (step1), as shown in Example 4-1 on page 51.

2. At t_2 in Figure 4-2 on page 53, a subsequent DFSMSdss full dump step then copies the data from the FlashCopy target volume to create a full copy on tape. The actual data can reside on the 2000 device number in the case of a previously completed background FlashCopy. Data might still reside on the 1000 device and a FlashCopy background copy is still going. Or, the data is on the 1000 device when no background copy is used in the previous full volume copy step.

   At t_3, when the physical dump to tape is complete, DFSMSdss removes the FlashCopy relationship between the two volumes. DFSMSdss also re-initializes the FlashCopy target volume to its original layout and prepares the volume to be reused for any other general purpose. In the case of a FRBACKUP configuration, this FlashCopy target belongs to a CPBSG and is only used to serve as a FlashCopy target volume.

   In a FRBACKUP configuration, a DFSMShsm dump class that is set in an involved copy pool automatically creates a dump during the DFSMShsm backup cycle.

   Again, FRBACKUP uses only step 1 to create a FlashCopy copy in the CPBSG.

4.1.2 Other DFSMSdss COPY parameters

With DFSMSdss COPY FULL, several additional parameters trigger different FlashCopy functions. Figure 4-3 shows the most important parameters in relation to FRBACKUP. All instances contain DUMPCONDITIONING.

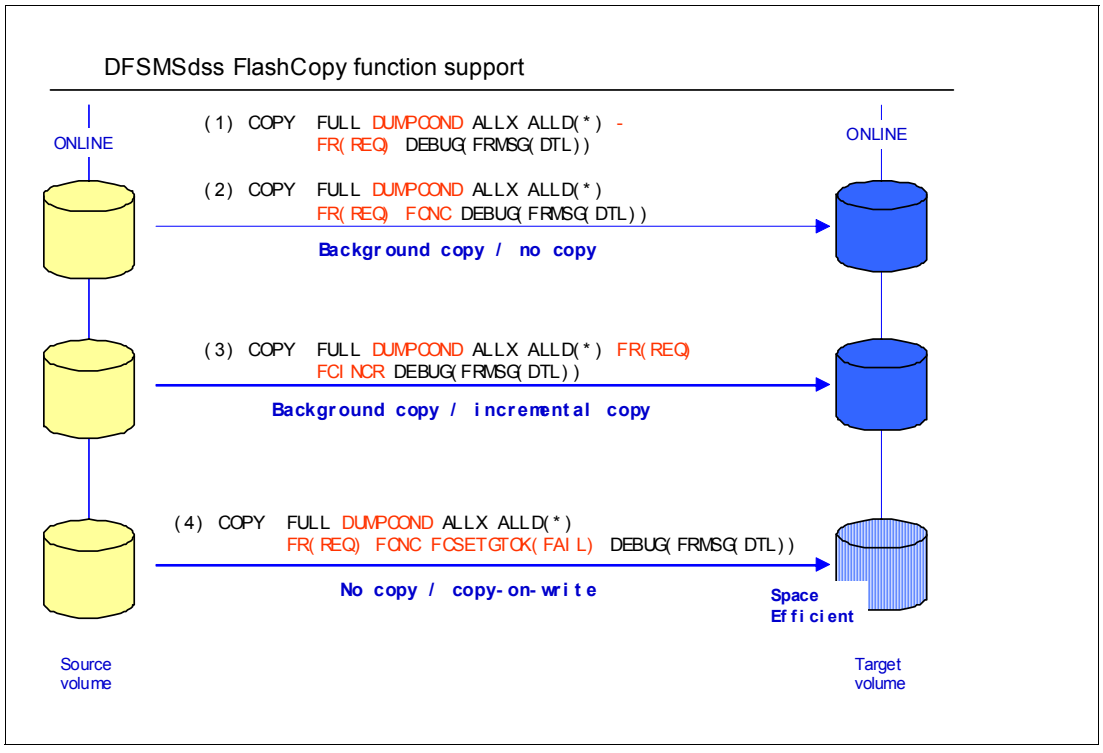

Figure 4-3 DFSMSdss FlashCopy support

The various approaches (the numbers refer to the numbers in Figure 4-3 on page 54) for the FlashCopy operation are described:

1. COPY FULL triggers a FlashCopy operation that logically completes in single-digit milliseconds. After FlashCopy is logically completed, both volumes are available again. DS8000 firmware starts a background copy operation to physically copy all tracks from the source volume to the target volume. When all tracks are copied, the FlashCopy relationship ends. Because of DUMPCONDITIONING, DFSMSdss is responsible for preserving the target VOLSER and copies the source VOLSER in a protected field on the target volume.
2. This approach is similar to approach 1, but it does not start a background copy process. After FlashCopy logically completes, both volumes are available. Again, due to DUMPCONDITIONING, the target VOLSER is preserved through DFSMSdss. The FlashCopy relationship does not end and stays active until *all* tracks on the source volume are changed. This approach might be the same as a complete background copy, but the background copy happens through Copy-on-Write operations. Also, a Copy-on-Write happens only one time for each source track.
3. This approach is different compared to approaches 1 and 2. Incremental FlashCopy always starts with a full background copy and therefore, requires a fully provisioned FlashCopy target volume also. After the first full copy completes, the DS8000 only maintains bitmaps on changed tracks. So, there is no Copy-on-Write or any other background-initiated I/O operations until the next FlashCopy or DFSMSdss COPY FULL command. Then, only the changed tracks since the last FlashCopy are copied in a background copy operation. This process is also logically completed in only a few milliseconds, independently of the number of changed tracks that need to be copied.

   From a performance point of view, this FlashCopy approach performs best. Remember, only one incremental FlashCopy relationship can exist between a FlashCopy volume pair. Other full volume FlashCopy relationships might be active outside of the incremental FlashCopy relationship. Also, an incremental FlashCopy relationship does not allow you to reverse the FlashCopy relationship through a Fast Reverse FlashCopy operation or command but only through a simple Reverse FlashCopy operation or command.
4. Approach 4 is similar to approach 2. This FlashCopy approach uses an SE FlashCopy target volume. From a DS8000 viewpoint, only Track Space Efficient (TSE) volumes are usable as FlashCopy target volumes. These FlashCopy SE volumes require a repository within their extent pool. All FlashCopy SE volumes share the same repository within their extent pool. Only volumes from the same extent pool can reside in the repository of the same extent pool. SE volumes do not take any real space until the first write operation is targeted to these SE volumes, which is usually a Copy-on-Write.

4.1.3 Remote Pair FlashCopy (RPFC)

DFSMSdss with z/OS 1.12 offers new support for Remote Pair FlashCopy. This support has consequences for FRBACKUP when the conventional SMS storage groups are replicated by Metro Mirror and also the FlashCopy target volumes within the CPBSG.

Figure 4-4 shows the concept of Remote Pair FlashCopy (RPFC), which is also called *Preserve Mirror* (PMR).

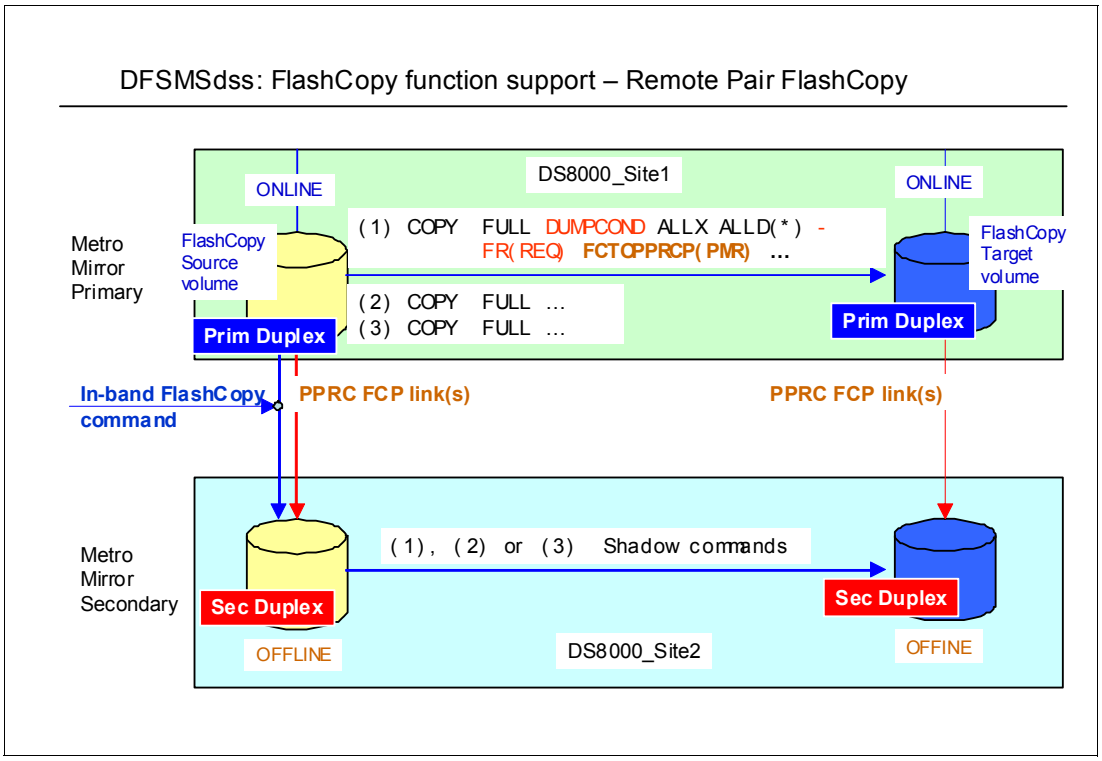

Figure 4-4 Remote Pair FlashCopy support in DFSMSdss

The volumes in DS8000_Site1 are the Metro Mirror primary volumes. The FlashCopy source volume represents the application volumes in conventional SMS storage groups, which can be grouped in a copy pool.

The FlashCopy target volume in Figure 4-4 represents the volumes in the involved CPBSG.

Usually, the application volumes within the SMS storage groups are replicated for disaster recovery. When you need to replicate the volumes in the CPBSG with Metro Mirror and FRBACKUP, a DFSMSdss COPY FULL needs to indicate that Remote Pair FlashCopy must be used to preserve the DUPLEX status of the Metro Mirror volumes and the entire disk configuration. DFSMSdss uses the parameter FlashCopy TO PPRC Primary (FCTOPPRCP) with Preserve Mirror (PMR).

All other FlashCopy commands, such as Reverse FlashCopy or Fast Reverse Restore FlashCopy, are also transferred through the PPRC links as in-band FlashCopy commands to the related Metro Mirror secondary volume. No FlashCopy triggered data copy I/O exists between the Metro Mirror primary and its related Metro Mirror secondary volume. Therefore, you can keep the FULL DUPLEX state for all Metro Mirror volumes and not expose the disaster recovery readiness at any time.

4.1.4 Count key data volume FlashCopy support

Table 4-1 on page 57 shows that most of the relevant FlashCopy functions that relate to count key data (CKD) volumes are supported through DFSMSdss (since z/OS 1.12, DFSMS V1.12).

Table 4-1 FlashCopy function that is supported through different interfaces

FlashCopy function	DFSMSdss	TSO	ICKDSF	API	DSCLI
Full volume - COPY/NOCOPY	Yes	Yes	Yes	Yes	Yes
NOCOPY to COPY	Yes	Yes	Yes	Yes	Yes
Data set level	Yes	No	No	Yes	No
Incremental FlashCopy	Yes	Yes	Yes	Yes	Yes
Consistency Group	Yes	Yes	No	Yes	Yes
Fast Reverse Restore (FRR)	Yes	Yes	Yes	Yes	Yes
Make persistent	No	No	No	Yes	Yes
Multiple relationships	Yes	Yes	Yes	Yes	Yes
In-band FlashCopy commands	No	Yes	Yes	Yes	Yes
Open logical unit number (LUN) support	No	Yes	No	Yes	Yes

Although in-band FlashCopy commands are not directly supported by DFSMSdss, some indirect support is available through the FCTOPPRCP parameter in DFSMSdss.

4.1.5 DFSMSdss COPY options that are invoked by DFSMShsm

DFSMShsm invokes DFSMSdss when executing FRBACKUP or FRRECOV functions. DFSMShsm uses the ADRXMAIA application programming interface (API) to invoke DFSMSdss functions on behalf of DFSMShsm.

DFSMShsm reports in its logs the DFSMSdss control statements that are used by DFSMSdss to execute the requested function. For example, when DFSMShsm requests a FRBACKUP with the INCREMENTAL keyword, DFSMSdss returns its used control statements back to the DFSMShsm log. The coding fragment that is shown in Example 4-2 illustrates the DFSMSdss content in the DFSMShsm logs.

Example 4-2 DFSMSdss acts on behalf of DFSMShsm and reports back to DFSMShsm

```
ARC1801I FAST REPLICATION BACKUP IS STARTING FOR COPY POOL DSN$DBXA$DB, AT 14:33:10 ON
2010/10/20
ARC0640I ARCFRTM - PAGE 0001     5695-DF175  DFSMSDSS V1R12.0 DATA SET SERVICES     2010.293
14:33
ARC0640I ARCFRTM - COPY IDY(DB1984) ODY(XX1984) DUMPCOND FR(REQ) PUR FCINCREMENTAL   -
ARC0640I ARCFRTM -  FCFVR -
ARC0640I ARCFRTM -  DEBUG(FRMSG(DTL))
........
ARC0640I ARCFRTM - ADR806I (001)-TOMI (02), VOLUME DB1984 WAS COPIED USING A FAST REPLICATION
FUNCTION
......
ARC0640I ARCFRTM - ADR012I (SCH)-DSSU (01), 2010.293 14:33:11 DFSMSDSS PROCESSING COMPLETE.
HIGHEST RETURN CODE IS 0000
.....
```

In Example 4-2 on page 57, DFSMShsm message numbers and DFSMSdss messages are shown. This example also shows translating DFSMSdss into its control statements. Due to FRBACKUP... INCREMENTAL, DFSMSdss includes its FCINCREMENTAL keyword, which translates into an incremental DS8000 FlashCopy operation when the involved storage subsystem is a DS8000. DFSMSdss requires either a COPYVOLID or a DUMPCOND when it performs a full volume copy operation against system-managed volumes.

4.1.6 FRBACKUP invokes DFSMSdss for full volume copy

DFSMShsm invokes DFSMSdss for its full volume operations during FRBACKUP or FRRECOV. Example 4-2 on page 57 shows the DFSMSdss statement in a FRBACKUP operation. DFSMSdss uses a COPY statement for each FlashCopy pair and executes these commands in parallel.

DFSMShsm also transfers to DFSMSdss for data set-level recovery from a full volume copy.

4.1.7 Full DUMP from FRBACKUP target volumes

DFSMShsm can create backups on tape from FlashCopy target volumes that are in a CBPSG.

Example 4-3 shows the DFSMShsm logs and the DFSMSdss DUMP statement to create a volume copy on tape. This example is based on the DUMPCONDITION approach.

Example 4-3 DFSMShsm controlled full dump from target volumes to tape

```
ARC0622I FULL VOLUME DUMP STARTING ON VOLUME DB1984(SMS) AT 18:11:50 ON 2010/10/20, SYSTEM SC70,
TASK ID=ARCDVOL1 ,
 TO DUMP CLASS(ES)=   DCFR112
.....
ARC0640I ARCDVOL1 - PAGE 0001     5695-DF175  DFSMSDSS V1R12.0 DATA SET SERVICES     2010.293
18:11
ARC0640I ARCDVOL1 - ADR035I (SCH)-PRIME(06), INSTALLATION EXIT ALTERED BYPASS FAC CLASS CHK
DEFAULT TO YES

ARC0640I ARCDVOL1 -  DUMP FULL INDDNAME(SYS00329)          -
ARC0640I ARCDVOL1 -  OUTDDNAME(SYS00330) -
ARC0640I ARCDVOL1 -  ALLEXCP ALLDATA(*) OPTIMIZE(3) TOLERATE(IOERROR)
.....
ARC0640I ARCDVOL1 - ADR050I (001)-PRIME(02), DFSMSDSS INVOKED VIA CROSS MEMORY APPLICATION
INTERFACE
.....
ARC0640I ARCDVOL1 - ADR006I (001)-STEND(01), 2010.293 18:11:51 EXECUTION BEGINS
ARC0120I DUMP VOLUME VT0002 ADDED, RC= 0, REAS= 0
ARC0640I ARCDVOL1 - ADR006I (001)-STEND(02), 2010.293 18:11:52 EXECUTION ENDS
ARC0640I ARCDVOL1 - ADR013I (001)-CLTSK(01), 2010.293 18:11:52 TASK COMPLETED WITH RETURN CODE
0000
ARC0640I ARCDVOL1 - ADR012I (SCH)-DSSU (01), 2010.293 18:11:52 DFSMSDSS PROCESSING COMPLETE.
HIGHEST RETURN CODE IS 0000
.....
ARC0637I DUMP COPY OF VOLUME DB1984 COMPLETE, DCLASS=DCFR112, EXPDT=2010/11/19
ARC0623I FULL VOLUME DUMP OF VOLUME DB1984 ENDING AT 18:11:52, PROCESSING SUCCESSFUL
```

Example 4-3 on page 58 shows the start of a full volume dump to tape based on a DFSMShsm DUMP CLASS, which is DCFR112. DFSMShsm uses the application volume DB1984, which is the FlashCopy source volume in a previous FRBACKUP operation. This example also shows that the DFSMSdss DUMP statement refers to DD-statements, which point to the input device, volume, and output device. Follow the input device. Example 4-3 on page 58 has a DD-name of SYS00329. Example 4-4 connects this DD-name to the MVS™ device number D361.

Example 4-4 Allocated and used devices in the course of an automatic dump

```
IEF237I D361 ALLOCATED TO SYS00329

IGD100I 0474 ALLOCATED TO DDNAME SYS00330 DATACLAS (        )
IEC205I SYS00330,DFHSM70,JV,FILESEQ=1, COMPLETE VOLUME LIST,
DSN=HSM.DMP.DCFR112.VDB1984.D10293.T471018,VOLS=VT0002,TOTALBLOCKS=163
IEF285I   HSM.DMP.DCFR112.VDB1984.D10293.T471018       KEPT
IEF285I   VOL SER NOS= VT0002.

DS P,D361
IEE459I 08.01.36 DEVSERV PATHS 318
 UNIT DTYPE  M CNT VOLSER  CHPID=PATH STATUS
      RTYPE  SSID CFW TC   DFW PIN DC-STATE CCA DDC       CYL CU-TYPE
0D361,33909 ,0,000,XX1984,84=+ 9D=+ 86=+ A5=+
      2107   89E3  Y  YY.  YY.  N  SIMPLEX   61  61     10017 2107
*********************** SYMBOL DEFINITIONS ************************
0 = ONLINE                          + = PATH AVAILABLE

DS QT,0474
IEE459I 08.02.30 DEVSERV QTAPE 322
UNIT DTYPE  DSTATUS CUTYPE  DEVTYPE  CU-SERIAL  DEV-SERIAL ACL LIBID
0474 3590   ON-NRD  3592J70 3592J1A* 0178-C4006 0178-C4006
****      1 DEVICE(S) MET THE SELECTION CRITERIA
****      1 DEVICE(S) WITH DEVICE EMULATION ACTIVE
```

Example 4-4 also shows the connection between the MVS device number D361. Example 4-4 shows in a DS command that the input volume is a FlashCopy target volume from the CPBSG with the volume serial number XX1984. Because we named all FlashCopy target volume serial numbers in the CPBSG with a preceding XX, the corresponding FlashCopy target volume is revealed, which pairs with the FlashCopy source volume serial number DB1984.

The full volume backup to tape happens from XX1984 as the DUMP FULL input. Therefore, the information that Example 4-3 on page 58 shows as the first row with a full dump for DB1984 is correct because volume XX1984 is a dump conditioned volume from VOLSER DB1984.

The device number 0474, which is referred to in the OUTDDNAME in Example 4-3 on page 58, points to a tape drive as the device service command with query tape (DS QT) as shown in Example 4-4.

Example 4-5 reveals an interesting detail. The DUMP FULL input volume XX1984 is a complete copy of the application volume DB1984, including the VTOC index data set name and VSAM volume data set name from DB1984.

Example 4-5 FlashCopy target volume

```
DSLIST - Data Sets on volume XX1984                              Row 1 of
 Command ===>                                                 Scroll ===> CSR

 Command - Enter "/" to select action              Message          Volume
 -------------------------------------------------------------------------------
          SYS1.VTOCIX.DB1984                                          XX1984
          SYS1.VVDS.VDB1984                                           XX1984
          DSNCAT.DB1A.LOGCOPY1.DSO2                                   *VSAM*
          DSNCAT.DB1A.LOGCOPY1.DSO2.DAT                               XX1984
          .........
          UCAT.DSNCAT                                                 XX1984
          UCAT.DSNCAT.CATINDEX                                        XX1984
 ****************************** End of Data Set list ****************************
```

The data on volume XX1984 cannot be accessed through any standard application. This rule applies to all data sets when the volume is system-managed because all data sets also have a VVDS entry, but this VVDS does not match the VOLSER.

Example 4-6 shows the application volume DB194, which is the FlashCopy source volume at the time that the last FRPACKUP was performed. This volume contains the same data as in Example 4-5, as expected.

Example 4-6 FlashCopy source volume = application volume

```
DSLIST - Data Sets on volume DB1984                              Row 1 of
Command ===>                                                  Scroll ===> CSR

Command - Enter "/" to select action              Message          Volume
-------------------------------------------------------------------------------
          SYS1.VTOCIX.DB1984                                          DB1984
          SYS1.VVDS.VDB1984                                           DB1984
          DSNCAT.DB1A.LOGCOPY1.DSO2                                   *VSAM*
          DSNCAT.DB1A.LOGCOPY1.DSO2.DAT                               DB1984
          .........
          UCAT.DSNCAT                                                 DB1984
          UCAT.DSNCAT.CATINDEX                                        DB1984
****************************** End of Data Set list ****************************
```

This structure, which is created and maintained through DFSMShsm, allows the intelligent and useful usage of full volume FlashCopy within a z/OS configuration in the course of FRBACKUP. The following section describes DFSMSdss activity during FRRECOV.

4.1.8 FRRECOV invokes DFSMSdss

With FRRECOV, you can recover a complete copy pool from a FlashCopy backed-up CPBSG. FRRECOV also provides the option to recover an application volume that belongs to a copy pool from the correct CPBSG or an individual physical data set recover out of the involved CPBSG.

As long as FRRECOV refers to volumes in the CPBSG, DFSMSdss handles all these requests through its COPY function and uses FlashCopy in the DS8000 for the data movement. This approach is advantageous to relieve any I/O load on host FICON channels and host CPU cycles for the data movement in a recovery operation within a FRBACKUP configuration.

As soon as DFSMShsm requests a recover from a dump tape, DFSMSdss creates a RESTORE command and satisfies the recovery for an entire copy pool or an individual application volume or a data set from the correct set of backup tapes.

FRRECOV from FlashCopy target invokes DFSMSdss full volume COPY

When DFSMShsm submits a FRRECOV for a copy pool from FlashCopy target volumes in the related CPBSG, DFSMShsm invokes DFSMSdss. DFSMSdss creates physical full volume copy statements to copy the data from the CPBSG volumes to the copy pool volumes by using FlashCopy. Example 4-7 shows an edited example of the creation through a FRRECOV command.

Example 4-7 FRRECOV from FlashCopy target through DFSMSdss

```
ARC1801I FAST REPLICATION RECOVERY IS STARTING FOR COPY POOL CP1, AT 17:29:17 ON 2010/10/20
.......
ARC0640I ARCFRTM - PAGE 0001     5695-DF175  DFSMSDSS V1R12.0 DATA SET SERVICES     2010.293
17:29

ARC0640I ARCFRTM -  COPY IDY(XX1984) ODY(DB1984) DUMPCOND FR(REQ) PUR ALLX ALLD(*)      -
ARC0640I ARCFRTM -  DEBUG(FRMSG(DTL))
.......

ARC0640I ARCFRTM - ADR050I (001)-PRIME(02), DFSMSDSS INVOKED VIA CROSS MEMORY APPLICATION
INTERFACE
.....

ARC0640I ARCFRTM - ADR806I (001)-TOMI (02), VOLUME XX1984 WAS COPIED USING A FAST REPLICATION
FUNCTION
ARC0640I ARCFRTM - ADR006I (001)-STEND(02), 2010.293 17:29:17 EXECUTION ENDS
.......

ARC0640I ARCFRTM - ADR012I (SCH)-DSSU (01), 2010.293 17:29:17 DFSMSDSS PROCESSING COMPLETE.
HIGHEST RETURN CODE IS 0000

ARC1805I THE FOLLOWING 00001 VOLUME(S) WERE SUCCESSFULLY PROCESSED BY FAST REPLICATION RECOVERY
OF COPY POOL CP1
ARC1805I (CONT.) DB1984
ARC1802I FAST REPLICATION RECOVERY HAS COMPLETED FOR COPY POOL CP1, AT 17:29:17 ON 2010/10/20,
FUNCTION RC=0000,
 MAXIMUM VOLUME RC=0000
```

DFSMShsm identifies the correct volume pairs out of its BCDS and its mapping from CBPSG volumes to CP/SMS storage group volumes and forwards this list to DFSMSdss. DFSMSdss creates its corresponding control statements.

Example 4-7 shows the DFSMSdss COPY statement that recovers all volumes for copy pool CP1. This example is only a volume pair with XX1984 as the CPBSG volume and DB1984 as the CP, SMS storage group volume. All these volumes are dynamically allocated.

FlashCopy is required and DUMPCOND leaves the FlashCopy target volume label, DB1984, untouched. Therefore, DB1984 has the same content as the last FRBACKUP for CP1. The entire recovery process happens within less than a second and the data is available immediately. This example in Example 4-7 on page 61 is only a volume pair, XX1984 → DB1984; however, hundreds of volume pairs are recovered in a few seconds.

FRRECOV from dump volume invokes DFSMSdss RESTORE

When DFSMShsm FRRECOV recovers a particular application volume from tape, DFSMSdss is invoked again to conventionally copy the data volume. This time, the data comes from tape back to the involved application volume. The copy on tape was created through a previous FRBACKUP operation and an associated dump class to the copy pool CP1 to create automatic dumps to tape through DFSMShsm.

Example 4-8 shows an example of a volume recovery from tape. This example is a bit more complex due to invoking other utility functions in the course of this volume recovery.

Example 4-8 Restore an application volume from a full volume dump from tape

```
DFSMSHSM DUMP LOG, TIME 18:11:52,  DATE 10/10/20
ARC0622I FULL VOLUME RESTORE STARTING ON VOLUME DB1984 AT 18:53:31 ON 2010/10/20, SYSTEM SC70,
TASK ID=GRVOL01
ARC0640I GRVOL01 - PAGE 0001     5695-DF175  DFSMSDSS V1R12.0 DATA SET SERVICES     2010.293
18:53

ARC0640I GRVOL01 -  RESTORE FULL INDDNAME(SYS00345) OUTDDNAME(SYS00344) -
ARC0640I GRVOL01 -  PURGE COPYVOLID CANCELERROR
.......

ARC0640I GRVOL01 - ADR050I (001)-PRIME(01), DFSMSDSS INVOKED VIA APPLICATION INTERFACE
.......
ARC0640I GRVOL01 - ADR006I (001)-STEND(01), 2010.293 18:53:31 EXECUTION BEGINS
ARC0640I GRVOL01 - ADR780I (001)-TDFP (01),
 THE INPUT DUMP DATA SET BEING PROCESSED IS IN FULL VOLUME FORMAT AND WAS CREATED BY DFSMSDSS
VERSION 1
ARC0640I GRVOL01 -                          RELEASE 12 MODIFICATION LEVEL 0 ON 2010.293 18:11:51
ARC0640I GRVOL01 - ADR808I (001)-TDFP (01),
 THE INPUT DUMP DATA SET BEING PROCESSED WAS CREATED FROM A CONDITIONED VOLUME

ARC0640I GRVOL01 - ADR460I (001)-UTMSG(01), UTILITY GENERATED MESSAGES FOLLOW FOR VOLUME DB1984

ARC0640I GRVOL01 -  ICKDSF - MVS/ESA    DEVICE SUPPORT FACILITIES 17.0               TIME:
18:53:33        10/20/10

ARC0640I GRVOL01 -       BUILDIX DDNAME(SYS00344) IXVTOC
ARC0640I GRVOL01 -  ICK01502I BUILDIX FUNCTION STARTED
ARC0640I GRVOL01 -  ICK00700I DEVICE INFORMATION FOR D103 IS CURRENTLY AS FOLLOWS:
ARC0640I GRVOL01 -            PHYSICAL DEVICE = 3390
ARC0640I GRVOL01 -            STORAGE CONTROLLER = 2107
ARC0640I GRVOL01 -            STORAGE CONTROL DESCRIPTOR = E8
ARC0640I GRVOL01 -            DEVICE DESCRIPTOR = 0C
ARC0640I GRVOL01 -            ADDITIONAL DEVICE INFORMATION = 4A00003C
ARC0640I GRVOL01 -            TRKS/CYL = 15, # PRIMARY CYLS = 10017
ARC0640I GRVOL01 -  ICK04000I DEVICE IS IN SIMPLEX STATE
ARC0640I GRVOL01 -  ICK03091I EXISTING VOLUME SERIAL READ = DB1984
ARC0640I GRVOL01 -  ICK01503I D103 REQUEST RECEIVED TO CONVERT VTOC TO IXFORMAT
ARC0640I GRVOL01 -  ICK01504I D103 VTOC FORMAT IS CURRENTLY OSFORMAT, REQUEST ACCEPTED
ARC0640I GRVOL01 -  ICK01513I D103  BUILDIX PROCESSING COMPLETED:  VTOC IS NOW IN IXFORMAT
```

```
ARC0640I GRVOL01 -  ICK01317I VTOC-INDEX IS LOCATED AT CCHH=X'0001 0000' AND IS    30 TRACKS.
ARC0640I GRVOL01 -            18:53:40    10/20/10
ARC0640I GRVOL01 -
ARC0640I GRVOL01 -  ICK00002I ICKDSF PROCESSING COMPLETE. MAXIMUM CONDITION CODE WAS 0
.......

ARC0640I GRVOL01 - PAGE 0002     5695-DF175  DFSMSDSS V1R12.0 DATA SET SERVICES     2010.293
18:53
ARC0640I GRVOL01 - ADR006I (001)-STEND(02), 2010.293 18:53:40 EXECUTION ENDS
ARC0640I GRVOL01 - ADR013I (001)-CLTSK(01), 2010.293 18:53:40 TASK COMPLETED WITH RETURN CODE
0000

ARC0640I GRVOL01 - ADR012I (SCH)-DSSU (01), 2010.293 18:53:40 DFSMSDSS PROCESSING COMPLETE.
HIGHEST RETURN CODE IS 0000

ARC0623I FULL VOLUME RESTORE OF VOLUME DB1984 ENDING AT 18:53:40, DCLASS=DCFR112, DGEN=001,
DATE=2010/10/20,
 PROCESSING SUCCESSFUL

ARC1802I FAST REPLICATION RECOVERY FROM DUMP HAS COMPLETED FOR VOLUME DB1984, AT 18:53:40 ON
2010/10/20,
 FUNCTION RC=0000, MAXIMUM VOLUME RC=0000
```

Example 4-8 on page 62 starts with a full volume restore from a tape copy that was created previously through FRBACKUP, which directly created a tape copy for DB1984. After DFSMShsm identified the correct device address for DB1984 and also the correct tape, which has the volume copy DFSMShsm, it invokes DFSMSdss through its standard application interface.

Example 4-9 shows the corresponding device numbers that are dynamically allocated to the DD-Names, which are referred to in DFSMSdss and ICKDSF in Example 4-8 on page 62.

Example 4-9 Restore from tape - used devices

```
IEF237I D103 ALLOCATED TO SYS00344
IEF237I 040D ALLOCATED TO SYS00345

DS QD,D103,1
IEE459I 14.28.39 DEVSERV QDASD 702
 UNIT VOLSER SCUTYPE DEVTYPE       CYL  SSID SCU-SERIAL DEV-SERIAL EFC
0D103 DB1984 2107922 2107900     10017  89E1 0175-BALB1 0175-BALB1 *OK

DS QT,040D,1
IEE459I 14.28.47 DEVSERV QTAPE 709
UNIT DTYPE  DSTATUS CUTYPE  DEVTYPE  CU-SERIAL  DEV-SERIAL ACL LIBID
040D 3590   ON-RDY  3592J70 3592J1A* 0178-C4006 0178-C4006
```

Example 4-8 on page 62 shows that the volume dump on tape is coming from a CONDITIONED volume.

DFSMSdss then invokes ICKDSF to build a VTOC index after the data is restored from tape. This process to recover an application volume, DB1984, from a dump tape volume, which was created through FRBACKUP, is complete. The process was a dump to tape through the dump class-triggered tape processing.

4.2 Application interfaces

Several DFSMSdss application interfaces are updated to support the DFSMShsm fast replication function. For more information, see Appendix C, “Application Programming Interface,” in *DFSMSdss Storage Administration Reference*, SC35-0424.

This appendix provides information that you might need when you use the user interaction modules. General-use programming interface and associated guidance information is contained in this appendix. Programming interface information is also included and is explicitly marked:

- User interactions
- System programming information
- User Interaction module exit option descriptions
- Application Interface summary
- ADREID0 data area
- Example: Invoking DFSMSdss by Using an Application Program

4.2.1 ADREID0 mapping macro

The DFSMSdss ADREID0 mapping macro has two new flags that enable DFSMSdss to use the DFSMShsm FRBACKUP COPYPOOL NOVTOCENQ option for no volume serialization and to bypass security verification for physical volume processing during a full-volume copy for a FRBACKUP COPYPOOL command.

When the no volume serialization flag is on, DFSMSdss does not serialize the input volumes for physical COPY and DUMP functions.

For physical data set DUMP operations against multiple logical volumes, the same volume serialization preference is in effect for all input volumes throughout the operation. The bypass security verification flag improves performance during full volume COPY operations by enabling DFSMSdss to bypass authorization checks on volumes that were already checked during DFSMShsm FRBACKUP COPYPOOL processing. In addition to the flag being set on, the application program must be authorized to bypass IBM RACF® and security processing.

DFSMSdss provides the volume serial number (VOLSER) of the copy pool source volume to the user interaction module (UIM) during copy pool processing so that any volumes that fail can be identified.

4.2.2 ADRUFO mapping macro

The ADRUFO mapping macro has the addition of a new field, UFO5FLGS, with new flags for the DFSMSdss FASTREPLICATION keyword and options. This macro is in SYS1.MACLIB.

4.2.3 ADRUIXIT installation exit

The ADRUIXIT installation exit is enhanced to enable you to change the FASTREPLICATION option.

5

DFSMShsm fast replication commands

This chapter introduces the commands that support DFSMShsm fast replication.

We first describe the considerations for fast replication. Then, we document the commands and their best use, and show where the output of the commands is written. Sample command outputs are provided and we explain how to interpret the results.

5.1 FRBACKUP techniques

When you specify the FRBACKUP command, you must decide whether an incremental FlashCopy relationship must be established (a persistent relationship), or if the relationship ends after the background copy finishes. As part of the copy pool definition, no fixed setting for later use of incremental FlashCopy during FRBACKUP is supported.

An incremental backup is also a backup with background copy. On the first request for incremental backup, a full background copy is applied (but with change recording of the source volumes in separate bitmaps being enabled). Beginning with the first refresh of such a backup, only changed tracks of the source volumes will be copied to the target volumes.

5.1.1 Non-incremental DASD backup

We explain non-incremental fast replication backups with background copy.

With every FRBACKUP ... EXECUTE command that is applied, another backup version that includes a full background copy is being created. If the maximum number of backup versions is already present, the oldest version is being rolled off before the copy process for the new fast replication DASD backup version starts. Therefore, if your copy pool allows only for a maximum of one backup version, you will temporarily have no backup version that is available for recovery. The elapsed time until recoverability is reestablished can vary from seconds to hours, depending on whether the copy pool settings include a request for fast reverse restore. With fast reverse restore, a few seconds might pass until you are able to recover your copy pool by using this new backup version.

If you cannot be temporarily without any backup version, you need to consider requesting at least two backup versions.

Tip: DFSMShsm can keep up to 85 backup versions for each copy pool. Keeping at least two versions is best. Before a new version is created, the oldest version is invalidated and the target volumes from that version are used as targets for the new version. If the new version fails, only *n*-1 valid versions are available, where *n* is the number of requested versions. Maintaining two versions ensures that at least one valid version is always available.

To ensure recoverability under all circumstances, the best plan if *n* backups are required is to keep *n*+1 backups.

5.1.2 Incremental DASD backup

If you use a copy pool that requests more than one fast replication DASD backup versions (n = 2, 3, and so on), only one of these backup versions can use incremental FlashCopy.

Support: Due to restrictions in the microcode of DS8000, only one incremental FlashCopy relationship is supported with the same source volume.

Assuming that you start with an incremental FRBACKUP, the FlashCopy relationships are established and the first execution is a full background copy (including all tracks).

The next FRBACKUP command cannot create an incremental backup (because there is already one established). Also, the next FRBACKUP command cannot request a refresh of the existing incremental version. The second FRBACKUP creates a non-incremental DASD backup with background copy. If the maximum number of backup versions is greater than two, the same applies to the subsequent FRBACKUP commands (Table 5-1).

Table 5-1 Incremental fast replication DASD backup

FRBACKUP	Request	Type of execution
1	FCINCREMENTAL	Full background copy
2	EXECUTE	Full background copy
n	EXECUTE	Full background copy
n+1	EXECUTE	Incremental
n+2	EXECUTE	Full background copy
2*n*	EXECUTE	Full background copy
2*n*+1	EXECUTE	Incremental

As you can see in this example, only every *n*+1 execution of FRBACKUP, where *n* is the maximum number of backups, refreshes the incremental backup version. If you want to refresh an incremental backup with every execution of FRBACKUP, you must choose *n*=1.

5.1.3 DASD backup without background copy

If you request zero DASD backup versions, DFSMShsm creates a DASD backup version without background copy. This action might seem confusing, but the number that you specify in the Number of Fast Replication DASD Backup copies with Background Copy field is the number of backups with background copies. If you request zero DASD backup versions, DFSMShsm creates a backup version without background copy.

If you request no background copy, only one backup version at a time is supported by the copy pool. With repeated FRBACKUP commands, the new backup version always replaces the existing backup version instantaneously.

Several good reasons exist for requesting a backup without background copy:

- If you want to create a full volume dump on tape for the copy pool volumes and you do not want to keep the DASD backup version after the dump completes.
- If you want to use the DASD backup copy for recovering the copy pool by using fast reverse restore. After the FlashCopy relationships are established (within seconds), the backup version is available for recovery.
- If you want to use FlashCopy Space Efficient (SE) volumes as target volumes.
- If you want to use any combination of the previously mentioned aspects.

Important: The copy pool definition specifies whether a full background copy occurs during FlashCopy. No keyword is available with FRBACKUP to override this setting.

5.1.4 Metro Mirror and FlashCopy

You can avoid the physical movement of data from the Metro Mirror primary to the Metro Mirror secondary when the Metro Mirror primary becomes the target of a FlashCopy. An in-band FlashCopy command is generated to trigger a FlashCopy operation on the remote site rather than mirroring the data that is associated with the operation.

You need to specify the fast reverse restore capability as part of the copy pool definition for two reasons:

- Because normal execution of DFSMSdss COPY FULL does not copy free space (as described in the volume table of contents (VTOC)), we typically must expect multiple FlashCopy relationships during the execution of FRBACKUP. A prerequisite for the successful use of fast reverse restore during FRRECOV is an existing single FlashCopy relationship that covers the entire volume. On calling DFSMSdss during the execution of the FRBACKUP command, DFSMShsm generates the parameter FCFULLVOLUMERELATION to suppress the occurrence of multiple FlashCopy relationships if the copy pool requires fast reverse restore.
- DFSMShsm tracks the ability of a backup copy for fast reverse restore, and a LIST CP(...) command will return information about the ability for fast reverse restore of a particular fast replication backup copy.

5.1.5 FlashCopy consistency groups

When logically related data spans across multiple volumes, a FlashCopy consistency group is useful to create consistent copies while minimizing the impact to the application. The process “freezes” the source volumes as each volume pair within the copy pool is copied with FlashCopy. After a consistent copy pool backup version is created, the volumes are “thawed”.

During this window, the freeze option puts the source volume control unit into a state that causes I/O activities to be held at the host.

For more information, see *z/OS V2R1 DFSMS Advanced Copy Services*, SC23-6847, and Chapter 6, “Managing volume backups with fast replication” in the *z/OS DFSMShsm Storage Administration Guide*, SC23-6871.

5.2 DFSMShsm fast replication commands

The commands that are used to manage DFSMShsm fast replication and practical examples of how to use these commands are described. The commands can be issued from the operator console and by authorized users.

For detailed descriptions of command syntax and required and optional keywords, see *z/OS DFSMShsm Storage Administration*, SC35-0421.

Fast replication commands can be protected by RACF FACILITY class profiles. See Chapter 6, “DFSMShsm fast replication security” on page 149 for details about implementing the RACF profiles.

FRBACKUP and FRRECOV commands are executed by calling DFSMSdss by way of ADRXMAIA (Figure 5-1).

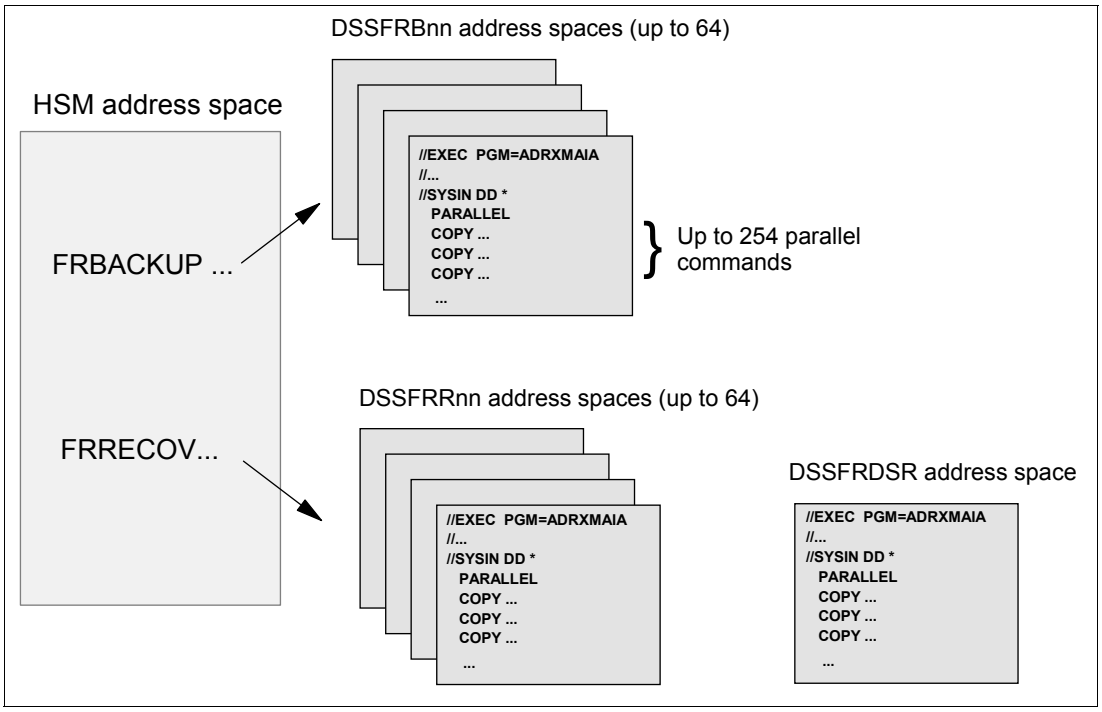

Figure 5-1 Environment for execution of FRBACKUP and FRRECOV commands

Multitasking and parallel execution of the DFSMSdss COPY command provides a powerful environment to process many volume pairs concurrently.

DFSMShsm processes FRBACKUP COPYPOOL commands serially. To maximize throughput, DFSMShsm creates the fast replication backup for the volumes in a copy pool in parallel. Two levels of parallelism exist. The first level is that DFSMShsm invokes DFSMSdss with the PARALLEL option and up to 254 volume pairs. The second level of parallelism is the number of DFSMSdss invocations that DFSMShsm processes concurrently. DFSMShsm processes between 1 and 64 DFSMSdss invocations concurrently; the default is 15.

The number of concurrent DFSMSdss invocations that are processed and the number of parallel volumes that are passed to DFSMSdss can be modified with the SETSYS MAXCOPYPOOLTASKS(FRBACKUP(*nn*) DSS(*nnn*)) command.

The SETSYS parameter MAXCOPYPOOLTASKS (Example 5-1) controls the detailed setup.

Example 5-1 SETSYS MAXCOPYPOOLTASKS syntax

```
SETSYS MAXCOPYPOOLTASKS(FRBACKUP(bkpnn) FRRECOV(rcvnn) DSS(dssnn))
```

The various parts of this expression have the following values:

bkp*nn* The maximum number of DFSMSdss invocations for each FRBACKUP command that DFSMShsm can process is from 1 to 64; the default is 15.

rcv*nn* The maximum number of DFSMSdss invocations for each FRRECOV command that DFSMShsm can process is from 1 to 64; the default is 15.

dss*nn* The maximum number of volume pairs that DFSMShsm passes to each DFSMSdss invocation concurrently for backup and recover functions. The default is 24. Specify a number from 1 to 254.

Specifying the maximum settings can affect performance. You can start with the defaults and adjust according to your needs to avoid any performance problems.

In particular, take care if you want to increase the setting of DSS(dss*nn*) above the default of 24, which can negatively affect throughput.

The resulting address spaces from FRBACKUP or FRRECOV commands as shown in Figure 5-1 on page 69 are started automatically when needed and remain active until the next restart of DFSMShsm.

You see the instances of these address spaces when you issue the **DA OSTC** command in SDSF (Figure 5-2).

```
SDSF DA SC70     SC70     PAG  0  CPU/L/Z   3/  3/  0  LINE 34-59 (78)
COMMAND INPUT ===>                                        SCROLL ===> CSR
NP   JOBNAME  StepName ProcStep JobID    Owner    C Pos DP Real Paging    SIO
     IEESYSAS DSSFRR01 IEFPROC  STC19583 STC        NS  F2  808   0.00   0.00
     IEESYSAS DSSFRB01 IEFPROC  STC19580 STC        NS  F2  809   0.00   0.00
```

Figure 5-2 Result of command DA OSTC in SDSF

Typically, you do not need to monitor these address spaces or check the output. You can check for messages that follow the execution of a fast replication command by looking at the following logs:

- JESMSGLG data set of the output of the main DFSMShsm address space
- DFSMShsm backup log
- DFSMShsm dump log
- z/OS syslog (also referred to as the operlog) that can be displayed by using the **log** command in SDSF

5.2.1 FRBACKUP command

The FRBACKUP command is used for the following purposes:

- To verify the environment after changes were applied or before you start to back up a copy pool for the first time
- To create a fast replication backup version only on DASD for a copy pool
- To create a fast replication backup version on DASD and tape for a copy pool

- To copy an existing fast replication backup version of a copy pool from DASD to tape
- To withdraw FlashCopy relationships that were being applied by a former use of FRBACKUP

5.2.2 FRRECOV command

The FRRECOV command is used for the following purposes:

- To recover a whole copy pool from DASD or dump (tape) volumes
- To recover a single volume of a copy pool from DASD or dump (tape) volumes
- To recover a single data set that resided on one of the volumes of a copy pool from a DASD or dump (tape) volume

Important: Two major FRRECOV restrictions are removed with the next two features in z/OS DFSMShsm V2R1.0:

- To recover a physical data set to any volume
- To recover a physical data set with RENAME specified

For security considerations for recovering with a NEWNAME, see Table 6-2 on page 151.

5.2.3 FRDELETE command

The FRDELETE command is used to delete fast replication backups: either all existing versions of a copy pool or a few of them.

5.2.4 SETSYS for specifying fast replication methods

An additional SETSYS command defines how specific fast replication functions process the following functions within fast replication:

- SETSYS FASTREPLICATION(DATASETLEVELRECOVERY(none) - FCRELATION(EXTENT) VOLUMEPAIRMESSAGES(NO)
- DATASETLEVELRECOVERY (DSR)

  DATASETLEVELRECOVERY determines whether to use fast replication:

  - NONE: Fast replication is not used. NONE is the *default*.
  - PREFERRED: Fast replication is used for data set-level recovery. If fast replication is unavailable for some reason, traditional methods are used.
  - REQUIRED: Fast replication must always be used. If it cannot be used, the data set-level recovery request fails.
- FCRELATION (FCREL)

  FlashCopy establish is at the extent level or full volume level:

  - The FULL setting allows up-front establish to take less time, but overall the FlashCopy process can take slightly longer.
  - The EXTENT-level setting causes the establish to take longer and the overall FlashCopy process might be shorter because only changed data is traced. The extent level is the *default*.
- VOLUMPAIRMESSAGES (VPM)

Issue ARC1809I diagnostic messages to help resolve volume pairing issues:

- YES: FlashCopy volume pairing debug message ARC1809I is enabled.
- NO: The messages are not issued; NO is the *default*.

Example 5-2 shows all of the parameters used together.

Example 5-2 SETSYS FASTREPLICATION parameters

```
SETSYS FASTREPLICATION(DATASETRECOVERY(PREFERRED) FCRELATION(FULL)
VOLUMEPAIRMESSAGES(YES)
```

Example 5-3 uses the abbreviated terms.

Example 5-3 SETSYS with abbreviated parameters

```
SETSYS FR(DSR(PREFERRED) FCREL(FULL) VPM(YES))
```

Note: The use of VOLUMEPAIRMESSAGES is set to a default of NO. When YES is specified, additional ARC1809I diagnostic messages are issued, as described in 11.3.2, “Preparing for problems with source to target volume pairing” on page 232.

5.3 Examples of DFSMShsm fast replication tasks

Examples of fast replication commands that are used in typical daily tasks are described.

We start with verification tasks that use FRBACKUP PREPARE. Then, we look at copy pool backup and recovery by using full background copies. Next, we describe incremental backups and the use of backups without background copy.

Recovery at the level of individual volumes or data sets is described elsewhere.

5.3.1 Verification of a copy pool environment

Executing FRBACKUP PREPARE is an important first activity to validate the fast replication environment when it is set up or when any changes are applied.

If we start from scratch with a copy pool, DFSMShsm has no information about fast replication backups or any preassigned volumes. By using a LIST command (Example 5-4), we confirm that DFSMShsm has no information (Figure 5-3).

Example 5-4 LIST command for copy pool

```
HSEND LI CP(CP1) TERM
```

Message ARC0138I is received when a LIST or HLIST command is issued to list the backup control data set (BCDS) information about a data set, volume key, dump class, aggregate group, or copy pool key, as shown in Figure 5-3.

```
ARC0138I NO BCDS INFORMATION FOUND FOR COPYPOOL CP1
ARC0140I LIST COMPLETED,        0 LINE(S) OF DATA OUTPUT
```

Figure 5-3 Output of LIST CP(CP1) ALLVOL

We set up the environment for copy pool CP1 in the storage management subsystem (SMS) configuration, including storage group SG1 and requesting two fast replication DASD backup versions with background copy.

Storage group SG1 is associated with copy pool backup storage group (CPBSG) that is named CPBSG1, so we can expect that volume pairing occurs between the volume in SG1 as a source and volumes in CPBSG1 as targets (Figure 5-4).

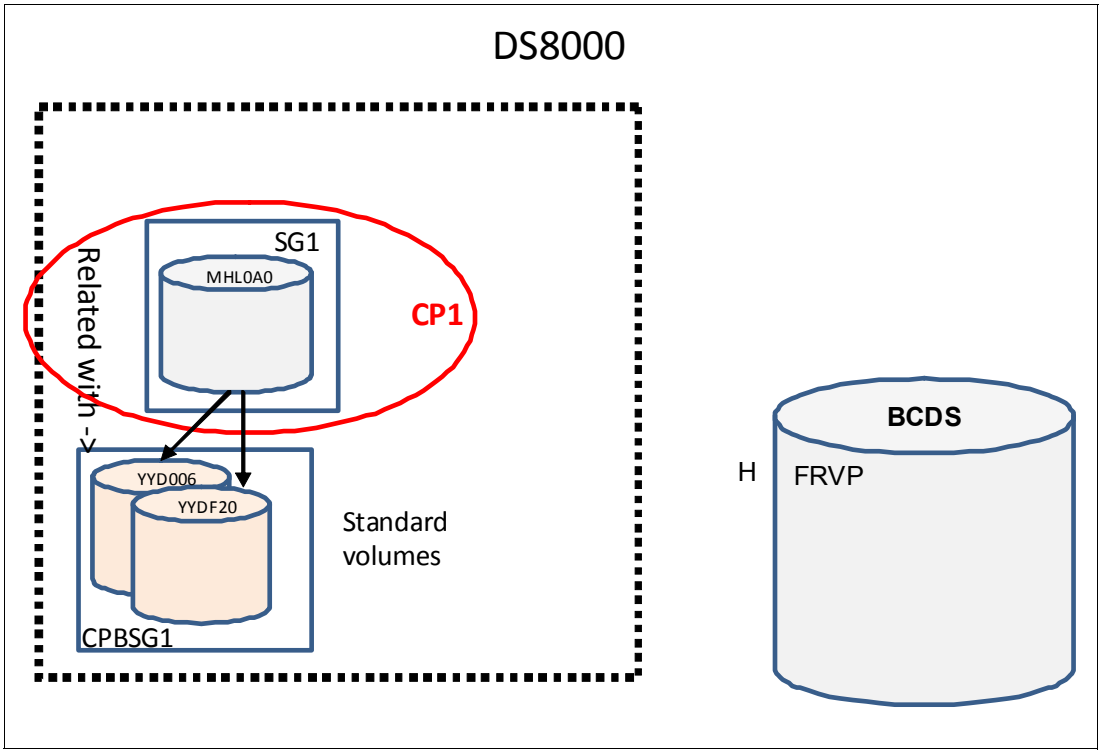

Figure 5-4 FRBACKUP CP(...) PREPARE

We start fast replication prepare processing by using the command that is shown in Example 5-5.

Example 5-5 FRBACKUP using PREPARE command to verify environment

```
HSEND FRBACKUP CP(CP1) PREPARE
```

The messages ARC1801I, ARC1802I, and optionally ARC1827I are in SYSLOG as a result of the FRBACKUP PREPARE command (Figure 5-5).

```
ARC1801I FAST REPLICATION PREPARE IS STARTING FOR COPY 811
ARC1801I (CONT.) POOL CP1, AT 21:13:20 ON 2010/10/07
ARC1827I NONPREFERRED FAST REPLICATION CANDIDATE 812
ARC1827I (CONT.) VOLUME YYD006 SELECTED FOR LO VOLUME MHL0A0,
ARC1827I (CONT.) VERSION=0002, RC=0004
ARC1802I FAST REPLICATION PREPARE HAS COMPLETED FOR 813
ARC1802I (CONT.) COPY POOL CP1, AT 21:13:21 ON 2010/10/07, FUNCTION
ARC1802I (CONT.) RC=0000, MAXIMUM VOLUME RC=0000
```

Figure 5-5 Output in SYSLOG that results from FRBACKUP PREPARE

The same messages are written in the backup log and in JESMSGLG of DFSMShsm.

5.3.2 Volume preferencing

Message ARC1827I provides the information that one of the assigned target volumes is nonpreferred. Return code 4 is explained in the following message description: `No eligible copy pool backup storage group volumes were found in the same cluster as the source volume`.

DFSMShsm fast replication volume pairing processing is enhanced to prefer CPBSG volumes that reside in the same cluster of a storage controller as the source volume. This enhancement is included in z/OS Data Facility Storage Management Subsystem (DFSMS) V1.12 and is enabled by default.

Volume preferencing is available for z/OS DFSMS V1.10 and V1.11 by authorized program analysis report (APAR) OA32494 but must be disabled by default. Volume preferencing can be enabled by issuing the PATCH command as shown in Example 5-6.

Example 5-6 PATCH command to enable DFSMShsm fast replication volume preferencing

```
PATCH .FRGCB.+A BITS(....1...)
```

To disable the ARC1827I message for the copy pool, issue the command that is shown in Example 5-7.

Example 5-7 FIXCDS command to disable ARC1827I message for the copy pool

```
FIXCDS F cpname PATCH(X'F' X'FF')
```

To re-enable the ARC1827I message for the copy pool, issue the command that is shown in Example 5-8 on page 74.

Example 5-8 FIXCDS command to re-enable ARC1827I message for the copy pool

```
FIXCDS F cpname PATCH(X'F' X'00')
```

You can display the result of the preparing process by using a LIST command (Example 5-9).

Example 5-9 LIST command for copy pool

```
HSEND LI CP(CP1) ODS(MHLRES1.OUT.LIST)
```

The output of the LIST command is shown in Figure 5-6.

```
-- DFSMShsm CONTROL DATASET --COPY POOL--LISTING --------- AT 21:23:30 ON
10/10/07

COPYPOOL=CP1
ALLOWPPRCP FRB=NO FRR=NO

VERSION  VTOCENQ     DATE           TIME     FASTREPLICATIONSTATE  DUMPSTATE

SGNAME   SOURCE - TARGET  SOURCE - TARGET  SOURCE - TARGET  SOURCE - TARGET
SG1      MHLOA0 - YYD006      1

VERSION  VTOCENQ     DATE           TIME     FASTREPLICATIONSTATE  DUMPSTATE

SGNAME   SOURCE - TARGET  SOURCE - TARGET  SOURCE - TARGET  SOURCE - TARGET
SG1      MHLOA0 - YYDF20      2

----- END OF -- COPY POOL -- LISTING -----
```

Figure 5-6 Output of LIST CP(CP1) command

The output of the LIST command shows no further details but the volume pairs. Based on the requested number of fast replication DASD backup versions with background copy in our copy pool definition (2), prepare processing preassigned volume pairs for two backup versions (1 and 2 in Figure 5-6). Because this process was successful, we received return code zero.

If you are interested in a list of nonpreferred volumes that are part of volume pairs, you can use a LIST command as shown in Example 5-10.

Example 5-10 LIST command for copy pool that includes the SELECT option

```
HSEND LI CP(CP1) SELECT(NONPREFERREDFRVOLS)TERM
```

Figure 5-7 is the output of the list of the nonpreferred volumes. We added asterisks (*) so you can focus on specific information in the output. No backups were created at this point.

```
 COPYPOOL=CP1                          ,ALLOWPPRCP FRB=NO FRR=NO
 VER=***,VTOCENQ=*,MADE ON ********** AT ********,FRS=***************,DPS=******
*****
 TKN(C)=C''
 TKN(H)=X''
 TOTAL NUM OF VOLUMES=00001,INCREMENTAL=N,CATINFO=N,FCFRR=Y,RECOVERYINCOMPLETE=N
 SGNAME=SG1       SOURCE=MHLOA0  TARGET=YYD006
 COPYPOOL=CP1                          ,ALLOWPPRCP FRB=NO FRR=NO
 VER=***,VTOCENQ=*,MADE ON ********** AT ********,FRS=***************,DPS=******
*****
 TKN(C)=C''
 TKN(H)=X''
 TOTAL NUM OF VOLUMES=00001,INCREMENTAL=N,CATINFO=N,FCFRR=Y,RECOVERYINCOMPLETE=N
 ARC0140I LIST COMPLETED,       15 LINE(S) OF DATA OUTPUT
```

Figure 5-7 Output of LIST CP(CP1) SELECT(NONPREFERREDVOLS) command

Be careful when you change your volume configuration. You might think that it is acceptable if you replace one of the preassigned target volumes with another volume with a different

volume serial number. However, DFSMShsm cannot change preassigned volume pairs automatically. When we varied volume YYDF20 offline and started a FRBACKUP command with EXECUTE (Example 5-11), the command failed.

Example 5-11 FRBACKUP command

```
HSEND FRBACKUP CP(CP1) EXECUTE
```

The excerpt from the DFSMShsm backup log that is shown in Figure 5-9 on page 77 proves that fast replication strictly follows the path of preassigned volume pairs. Either the result is volume MLDF20 or you must correct the assigned volume pairs of the prepared backup version according to the new environment (Figure 5-8).

```
ARC1801I FAST REPLICATION BACKUP IS STARTING FOR COPY POOL CP1, AT 14:51:31 ON 2010/10/08
ARC0640I ARCFRTM - PAGE 0001     5695-DF175  DFSMSDSS V1R12.0 DATA SET SERVICES     2010.281 14:51
ARC0640I ARCFRTM - ADR035I (SCH)-PRIME(06), INSTALLATION EXIT ALTERED BYPASS FAC CLASS CHK DEFAULT TO YES
ARC0640I ARCFRTM -  COPY IDY(MHLOA0) ODY(YYDF20) DUMPCOND FR(REQ) PUR ALLX ALLD(*)      -
ARC0640I ARCFRTM -  FCFVR -
ARC0640I ARCFRTM -  DEBUG(FRMSG(DTL))
ARC0640I ARCFRTM - ADR101I (R/I)-RI01 (01), TASKID 001 HAS BEEN ASSIGNED TO COMMAND 'COPY '
ARC0640I ARCFRTM - ADR109I (R/I)-RI01 (01), 2010.281 14:51:31 INITIAL SCAN OF USER CONTROL STATEMENTS COMPLETED
ARC0640I ARCFRTM - ADR405E (001)-DYNA (02),
 DYNAMIC ALLOCATION OF VOLUME YYDF20 FAILED. ERROR CODE 0218. INFORMATION CODE 0000
ARC0640I ARCFRTM - ADR017E (001)-CLTSK(01), 2010.281 14:51:31 TASK NOT SCHEDULED DUE TO ERROR. TASK RETURN CODE 0008
ARC0640I ARCFRTM - ADR012I (SCH)-DSSU (01),
2010.281 14:51:31 DFSMSDSS PROCESSING COMPLETE. HIGHEST RETURN CODE IS 0008 FROM:
ARC0640I ARCFRTM -                          TASK    001
ARC1812I OPERATION=CAPTURE FOR CATALOG INFORMATION DATA SET=HSM.HSMCIDS.D10281.T145131.C001 FOR COPY POOL=CP1 HAS
 COMPLETED WITH RETURN CODE=0004 AND REASON CODE=0012
ARC1803E THE FOLLOWING 00001 VOLUME(S) FAILED DURING FAST REPLICATION BACKUP OF COPY POOL CP1
ARC1803E (CONT.) MHLOA0, ADR****
ARC1802I FAST REPLICATION BACKUP HAS COMPLETED FOR COPY POOL CP1, AT 14:51:34 ON 2010/10/08, FUNCTION RC=0008,
 MAXIMUM VOLUME RC=0008, CAPTURE CATALOG RC=0004
```

Figure 5-8 Excerpt from DFSMShsm backup log after an unsuccessful FRBACKUP CP(CP1) EXECUTE

To correct mismatching preassigned volume pairs, repeat the PREPARE as shown in Example 5-5 on page 73 and DFSMShsm fixes the volume pair preassignments.

The behavior of PREPARE processing differs if VERSIONS=0 is defined for the copy pool. DASD backup volumes are not preassigned, but PREPARE checks that sufficient target volumes are available.

The syntax diagram in *z/OS DFSMShsm Storage Administration*, SC35-0421, contains a FORCE parameter that can be used on the FRBACKUP ... PREPARE command. Use of this parameter is not needed in almost all situations when you use PREPARE. We identified only one special environment where you might benefit from its use. See 5.3.7, “Changing the number of backup copies setting on copy pools” on page 138.

5.3.3 Copy pool backup with background copy

The usage of copy pools that are defined to hold 1 - 85 fast replication DASD backup versions with background copy is described.

By using this type of copy pool, you can create non-incremental and incremental backups, depending on the parameters that you specify with the FRBACKUP command.

Non-incremental fast replication backup

The FRBACKUP ... EXECUTE command creates fast replication DASD backups by establishing FlashCopy relationships (that are automatically withdrawn as soon as the background copy completes) between the source and target volumes.

The command that is shown in Example 5-12 starts the fast replication backup process for copy pool CP1.

Example 5-12 FRBACKUP command that includes EXECUTE

```
HSEND FRBACKUP CP(CP1)EXECUTE
```

The messages in the backup log describe the details (Figure 5-9).

```
ARC1801I FAST REPLICATION BACKUP IS STARTING FOR COPY POOL CP1, AT 20:46:05 ON 2010/10/08
ARC0640I ARCFRTM - PAGE 0001     5695-DF175  DFSMSDSS V1R12.0 DATA SET SERVICES     2010.281 20:46
ARC0640I ARCFRTM - ADR035I (SCH)-PRIME(06), INSTALLATION EXIT ALTERED BYPASS FAC CLASS CHK DEFAULT TO YES
ARC0640I ARCFRTM -  COPY IDY(MHLOA0) ODY(YYDF20) DUMPCOND FR(REQ) PUR ALLX ALLD(*)      -
ARC0640I ARCFRTM -  FCFVR - b
ARC0640I ARCFRTM -  DEBUG(FRMSG(DTL))
ARC0640I ARCFRTM - ADR101I (R/I)-RI01 (01), TASKID 001 HAS BEEN ASSIGNED TO COMMAND 'COPY '
ARC0640I ARCFRTM - ADR109I (R/I)-RI01 (01), 2010.281 20:46:05 INITIAL SCAN OF USER CONTROL STATEMENTS COMPLETED
ARC0640I ARCFRTM - ADR050I (001)-PRIME(02), DFSMSDSS INVOKED VIA CROSS MEMORY APPLICATION INTERFACE a
ARC0640I ARCFRTM - ADR016I (001)-PRIME(01), RACF LOGGING OPTION IN EFFECT FOR THIS TASK
ARC0640I ARCFRTM - ADR006I (001)-STEND(01), 2010.281 20:46:05 EXECUTION BEGINS
ARC0640I ARCFRTM - ADR241I (001)-DDTFP(01), TARGET VTOC BEGINNING AT 000000003:00 AND ENDING AT 000000008:14 IS OVERLAID
ARC0640I ARCFRTM - ADR806I (001)-TOMI (02), VOLUME MHLOA0 WAS COPIED USING A FAST REPLICATION FUNCTION
ARC0640I ARCFRTM - ADR006I (001)-STEND(02), 2010.281 20:46:06 EXECUTION ENDS
ARC0640I ARCFRTM - ADR013I (001)-CLTSK(01), 2010.281 20:46:06 TASK COMPLETED WITH RETURN CODE 0000
ARC0640I ARCFRTM - ADR012I (SCH)-DSSU (01), 2010.281 20:46:06 DFSMSDSS PROCESSING COMPLETE. HIGHEST RETURN CODE IS 0000
ARC1805I THE FOLLOWING 00001 VOLUME(S) WERE SUCCESSFULLY PROCESSED BY FAST REPLICATION BACKUP OF COPY POOL CP1
ARC1805I (CONT.) MHLOA0
ARC1802I FAST REPLICATION BACKUP HAS COMPLETED FOR COPY POOL CP1, AT 20:46:06 ON 2010/10/08, FUNCTION RC=0000,
 MAXIMUM VOLUME RC=0000, CAPTURE CATALOG RC=0000 c
```

Figure 5-9 Excerpt from the DFSMShsm backup log that shows FRBACKUP ... EXECUTE details

Fast replication backup always results in execution of the DFSMSdss COPY FULL command, which is physical processing. DFSMSdss is being called by using ADRXMAIA (a). The target volumes look exactly like the source volumes because COPY FULL occurs together with the parameter DUMPCONDITIONING. The only part that is not being copied is the volume serial number of the source volume (Figure 5-10).

When a target volume is being dumped to tape, the result looks exactly as though the source volume was dumped directly.

Target data sets are not cataloged. Because the DFSMSdss COPY FULL during fast replication backup was a physical processing, no catalog information was captured by DFSMSdss. To support the individual recovery of moved or deleted data sets from a fast replication backup, DFSMShsm captures the catalog information during fast replication backup (c). Catalog information is captured only if it is requested by the copy pool definition.

The captured catalog information can be displayed by using the COPY FULL DUMPCONDITIONING command as shown in Example 5-15 on page 79.

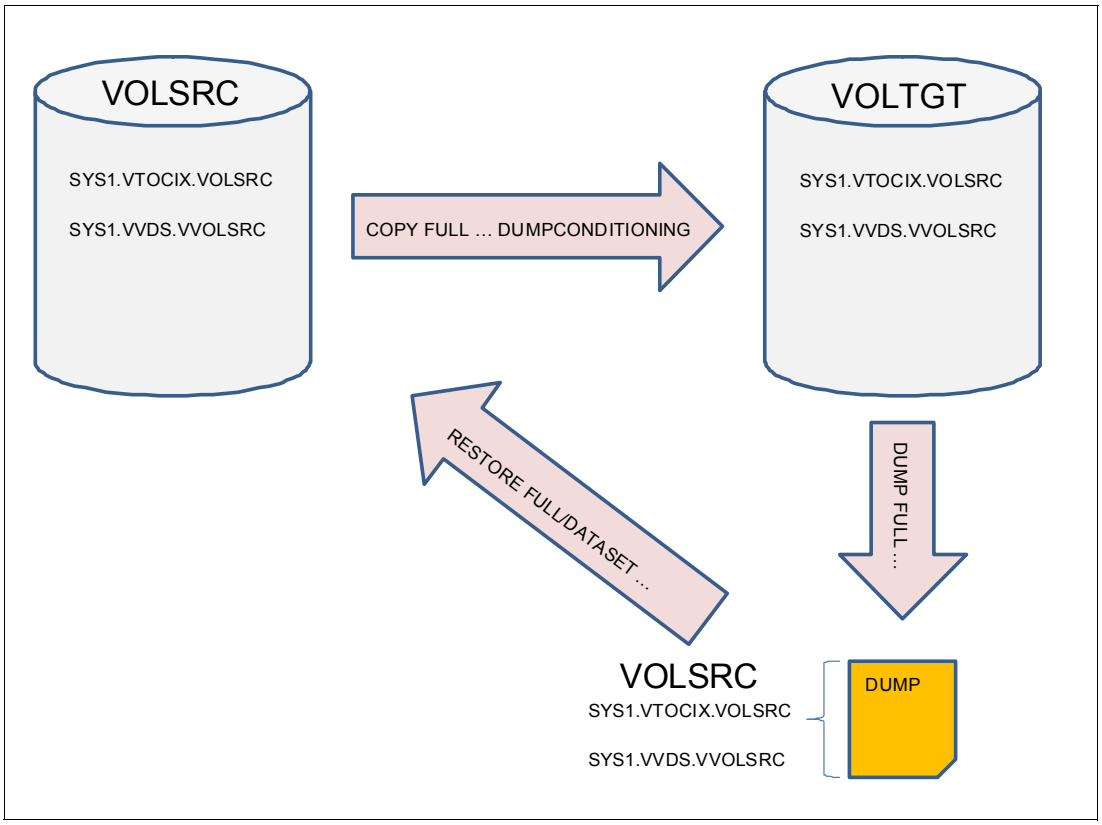

Figure 5-10 DFSMSdss COPY DUMPCONDITIONING

Because the copy pool definition includes a request for fast reverse restore, the FCFULLVOLUMERELATION parameter (2) is used. Therefore, the FlashCopy relationships can be reversed even before the relationships are ending and enables recoverability for the copy pool after the FlashCopy relationships are being established.

DFSMSdss processing ends after successful establishment of FlashCopy relationships, which usually only takes seconds.

You can query active FlashCopy relationships due to the fast replication processing of a copy pool by using the QUERY command (Example 5-13).

Example 5-13 QUERY CP command

```
HSEND Q CP(CP1)
```

The output of a QUERY CP command shows all active FlashCopy relationships that are associated with the requested copy pool. The display includes the progress (1) for each volume pair (Figure 5-11).

```
ARC1820I THE FOLLOWING VOLUMES IN COPY POOL CP1, VERSION 001, HAVE AN ACTIVE
ARC1820I (CONT.) FLASHCOPY BACKGROUND COPY
ARC1820I (CONT.) SGNAME   FR-PRIMARY FR-BACKUP  PCT-COMP 1
ARC1820I (CONT.) SG1      MHL0A0     YYDF20     009
***
```

Figure 5-11 Q CP command output

A LIST COPYPOOL command (as shown in Example 5-14) returns status information about the newly created backup version as soon as the FlashCopy relationships are being established.

Example 5-14 LIST COPYPOOL command

```
HSEND LIST CP(CP1) ALLVOL ODS(MHLRES1.OUT.LIST)
```

Because we specified ALLVOL, which includes a default for GEN(0), only status information of the latest backup version with volume pairs is displayed (Figure 5-12).

```
-- DFSMShsm CONTROL DATASET --COPY POOL--LISTING -------- AT 20:47:35 ON 10/10/

COPYPOOL=CP1
ALLOWPPRCP FRB=NO FRR=NO

VERSION  VTOCENQ     DATE           TIME     FASTREPLICATIONSTATE  DUMPSTATE
  001      Y      2010/10/08      20:46:05   RECOVERABLE           NONE
TOKEN(C)=C''
TOKEN(H)=X''
TOTAL NUM OF VOLUMES=00001,INCREMENTAL=N,CATINFO=Y,FCFRR=Y,RECOVERYINCOMPLETE=N

SGNAME   SOURCE - TARGET  SOURCE - TARGET  SOURCE - TARGET  SOURCE - TARGET
SG1      MHL0A0 - YYDF20

----- END OF -- COPY POOL -- LISTING -----
```

Figure 5-12 Output of LIST COPYPOOL command

Another example of how to use the **LIST CP** command to gather information about copy pool backups is to request data set information (Example 5-15).

Example 5-15 LIST COPYPOOL DATASETS command

```
HSEND LI CP(CP1) DATASETS ODS(MHLRES1.OUT.LIST)
```

The output is created from catalog-captured information but returns only data set names that are sorted by catalog (Figure 5-13).

```
-- DFSMShsm CONTROL DATA SET -- COPY POOL -- LISTING -- AT 21:11:54 ON 10/10/08

COPYPOOL=CP1                            ,VER=001,GEN=000,CATINFO=Y
CATALOG INFORMATION DATA SET NAME=HSM.HSMCIDS.D10281.T204605.C001  1 ,
TKN(C)=C''
TKN(H)=X''

CATALOG NAME = UCAT.TESTFR

DATA SET NAME
TESTFR.CMD.CLIST
TESTFR.CMD.CLIST.NEW
TESTFR.CNTL.JCL
TESTFR.CX

TOTAL NUMBER OF DATA SETS =          4
```

Figure 5-13 Output of LIST COPYPOOL DATASETS command

Catalog information is captured in a data set (1) during fast replication backup. The naming convention for a catalog information data set (CIDS) is shown:

BPREFIX.HSMCIDS.D*yyddd*.T*hhmmss*.C*numseq*

The various parts of this expression have the following meanings:

BPREFIX	The value of the BACKUPPREFIX parameter of the SETSYS command, if specified. Otherwise, BPREFIX is the DFSMShsm default user identifier (UID).
yyddd	The year and day of the backup.
hhmmss	The time in hours, minutes, and seconds when the fast replication backup was created.
numseq	The qualifier that ensures that the data set name is unique. The qualifier is a three-digit number in the range 001 - 255 that is increased by 1 in a data set name collision.

During the processing of the FRBACKUP command, one CIDS is created for each copy pool version. Each CIDS is allocated on an ML1 volume and cataloged. Figure 5-14 on page 81 is a list of CIDS that were available after the FRBACKUP command that is shown in Example 5-12 on page 77 was executed. The catalog data sets are treated similarly to the way that VTOC copy data sets are treated. Catalog information data sets are deleted when their associated versions are rolled off, deleted, expired, or withdrawn.

CIDS: A CIDS might contain information from up to 10 catalogs. The actual size of a CIDS depends on the type and number of catalog entries that are contained in each catalog. CIDS are allocated on 50 primary and 50 secondary cylinders, unless this setting is modified by patches as described in the *z/OS V1R12.0 DFSMShsm Implementation and Customization Guide*, SC35-0418.

```
DSLIST - Data Sets Matching HSM.HSMCIDS                          Row 1 of 9
Command ===>                                                  Scroll ===> PAGE

Command - Enter "/" to select action              Message           Volume
-------------------------------------------------------------------------------
         HSM.HSMCIDS.D10235.T160051.C001                              SBXHS5
         HSM.HSMCIDS.D10235.T160207.C001                              SBXHS5
         HSM.HSMCIDS.D10267.T212439.C001                              SBXHS5
         HSM.HSMCIDS.D10267.T213136.C001                              SBXHS5
         HSM.HSMCIDS.D10267.T213801.C001                              SBXHS5
         HSM.HSMCIDS.D10274.T130019.C001                              SBXHS5
         HSM.HSMCIDS.D10280.T124026.C001                              SBXHS5
         HSM.HSMCIDS.D10280.T124229.C001                              SBXHS5
         HSM.HSMCIDS.D10281.T204605.C001                              SBXHS5
```

Figure 5-14 List of CIDS

Incremental fast replication backup

The FRBACKUP ... FCINCREMENTAL command creates fast replication DASD backups by establishing FlashCopy relationships between source and target volumes that will be persistent with change recording.

For the next example, we used copy pool CP2. By setting the number of backup versions to 1 in the copy pool construct, we can refresh the incremental backup of the copy pool with every future execution of FRBACKUP.

By using the command that is shown in Example 5-16, we can start the fast replication backup process for copy pool CP2.

Example 5-16 FRBACKUP command that includes FCINCREMENTAL

```
HSEND FRBACKUP CP(CP2) FCINCREMENTAL
```

The messages in the backup log describe the details of the process (Figure 5-15).

```
ARC1801I FAST REPLICATION BACKUP IS STARTING FOR COPY POOL CP2, AT 21:50:29 ON 2010/10/13
ARC0640I ARCFRTM - PAGE 0001     5695-DF175  DFSMSDSS V1R12.0 DATA SET SERVICES     2010.286 21:50
ARC0640I ARCFRTM - ADR035I (SCH)-PRIME(06), INSTALLATION EXIT ALTERED BYPASS FAC CLASS CHK DEFAULT TO YES
ARC0640I ARCFRTM -  COPY IDY(MHLOA0) ODY(YYDF20) DUMPCOND FR(REQ) PUR FCINCREMENTAL     -
ARC0640I ARCFRTM -  FCFVR -
ARC0640I ARCFRTM -  DEBUG(FRMSG(DTL))
ARC0640I ARCFRTM - ADR101I (R/I)-RI01 (01), TASKID 001 HAS BEEN ASSIGNED TO COMMAND 'COPY '
ARC0640I ARCFRTM - ADR109I (R/I)-RI01 (01), 2010.286 21:50:29 INITIAL SCAN OF USER CONTROL STATEMENTS COMPLETED
ARC0640I ARCFRTM - ADR050I (001)-PRIME(02), DFSMSDSS INVOKED VIA CROSS MEMORY APPLICATION INTERFACE
ARC0640I ARCFRTM - ADR016I (001)-PRIME(01), RACF LOGGING OPTION IN EFFECT FOR THIS TASK
ARC0640I ARCFRTM - ADR006I (001)-STEND(01), 2010.286 21:50:29 EXECUTION BEGINS
ARC0640I ARCFRTM - ADR241I (001)-DDTFP(01), TARGET VTOC BEGINNING AT 000000003:00 AND ENDING AT 000000008:14 IS OVERLAID
ARC0640I ARCFRTM - ADR806I (001)-TOMI (02), VOLUME MHLOA0 WAS COPIED USING A FAST REPLICATION FUNCTION
ARC0640I ARCFRTM - ADR006I (001)-STEND(02), 2010.286 21:50:29 EXECUTION ENDS
ARC0640I ARCFRTM - ADR013I (001)-CLTSK(01), 2010.286 21:50:29 TASK COMPLETED WITH RETURN CODE 0000
ARC0640I ARCFRTM - ADR012I (SCH)-DSSU (01), 2010.286 21:50:29 DFSMSDSS PROCESSING COMPLETE. HIGHEST RETURN CODE IS 0000
ARC1805I THE FOLLOWING 00001 VOLUME(S) WERE SUCCESSFULLY PROCESSED BY FAST REPLICATION BACKUP OF COPY POOL CP2
ARC1805I (CONT.) MHLOA0
ARC1802I FAST REPLICATION BACKUP HAS COMPLETED FOR COPY POOL CP2, AT 21:50:29 ON 2010/10/13, FUNCTION RC=0000,
 MAXIMUM VOLUME RC=0000, CAPTURE CATALOG RC=0000
```

Figure 5-15 Excerpt from the DFSMShsm backup log on FRBACKUP ... FCINCREMENTAL command

The LIST CP command (Example 5-17) returns a display (Figure 5-16) that confirms that incremental backup (a) processing is in use.

Example 5-17 LIST CP command

```
HSEND LI CP(CP2)
```

```
 -- DFSMShsm CONTROL DATASET --COPY POOL--LISTING --------- AT 21:52:45 ON
10/10/13 FOR SYSTEM=SC70

 COPYPOOL=CP2
 ALLOWPPRCP FRB=NO FRR=NO

 VERSION  VTOCENQ     DATE           TIME     FASTREPLICATIONSTATE  DUMPSTATE
   005       Y      2010/10/13      21:50:29   RECOVERABLE           NONE
 TOKEN(C)=C''
 TOKEN(H)=X''
 TOTAL NUM OF
VOLUMES=00001,INCREMENTAL=Y,CATINFO=Y,FCFRR=Y,RECOVERYINCOMPLETE=N
                          a
 SGNAME   SOURCE - TARGET  SOURCE - TARGET  SOURCE - TARGET  SOURCE - TARGET
 SG1      MHLOA0 - YYDF20

0----- END OF -- COPY POOL -- LISTING -----
```

Figure 5-16 Output of LIST CP command with incremental backup

5.3.4 DASD fast replication backup without background copy

We describe how to use copy pools that are defined to hold 0 (zero) fast replication DASD backup versions with background copy. By using this type of copy pools, you can create backups on target volumes that are FlashCopy Space Efficient (SE) volumes or standard volumes (fully provisioned).

When you use a copy pool with zero fast replication DASD backup versions on the FRBACKUP command, DFSMSdss is always called in NOCOPY mode. No option is available on the command level to override this setting.

Support: Space Efficient FlashCopy is supported in NOCOPY mode only. Space Efficient FlashCopy cannot be used in combination with the Preserve Mirror operation.

Whether you can use a NOCOPY fast replication DASD backup version for restore from DASD is determined by the setting of the ALLOW FAST REVERSE RESTORE field in the copy pool:

N You cannot recover from the DASD backup copy.
Y This value enables recoverability from the DASD backup.

You cannot create an incremental backup in NOCOPY mode because an incremental relationship is always based on a full background copy.

Backup version example

We prepared copy pools CPSE1 and CPSE2 in our lab environment with a VERSIONS value of 0.

To create a new backup version of CPSE1, use the command that is shown in Example 5-18.

Example 5-18 FRBACKUP CP(CPSE1) EXECUTE command

```
HSEND FRBACKUP CP(CPSE1) EXECUTE
```

After you issue the FRBACKUP CP EXECUTE command, the related messages appear in the DFSMShsm backup log (Figure 5-17).

```
ARC1801I FAST REPLICATION BACKUP IS STARTING FOR COPY POOL CPSE1, AT 20:49:34 ON 2010/10/12
ARC1827I NONPREFERRED FAST REPLICATION CANDIDATE VOLUME YYDE21 SELECTED FOR LO VOLUME MLDD20, VERSION=0001, RC=0004
ARC0640I ARCFRTM - PAGE 0001     5695-DF175  DFSMSDSS V1R12.0 DATA SET SERVICES     2010.285 20:49
ARC0640I ARCFRTM - ADR035I (SCH)-PRIME(06), INSTALLATION EXIT ALTERED BYPASS FAC CLASS CHK DEFAULT TO YES
ARC0640I ARCFRTM -  COPY IDY(MLDD20) ODY(YYDE21) DUMPCOND FR(REQ) PUR ALLX ALLD(*) FCNC -
ARC0640I ARCFRTM -  FCSETGTOK(FAIL) -                                                  1
ARC0640I ARCFRTM -  FCFVR - 2
ARC0640I ARCFRTM -  DEBUG(FRMSG(DTL))
ARC0640I ARCFRTM - ADR101I (R/I)-RI01 (01), TASKID 001 HAS BEEN ASSIGNED TO COMMAND 'COPY '
ARC0640I ARCFRTM - ADR109I (R/I)-RI01 (01), 2010.285 20:49:34 INITIAL SCAN OF USER CONTROL STATEMENTS COMPLETED
ARC0640I ARCFRTM - ADR050I (001)-PRIME(02), DFSMSDSS INVOKED VIA CROSS MEMORY APPLICATION INTERFACE
ARC0640I ARCFRTM - ADR016I (001)-PRIME(01), RACF LOGGING OPTION IN EFFECT FOR THIS TASK
ARC0640I ARCFRTM - ADR006I (001)-STEND(01), 2010.285 20:49:34 EXECUTION BEGINS
ARC0640I ARCFRTM - ADR241I (001)-DDTFP(01), TARGET VTOC BEGINNING AT 000000000:01 AND ENDING AT 000000000:14 IS OVERLAID
ARC0640I ARCFRTM - ADR806I (001)-TOMI (02), VOLUME MLDD20 WAS COPIED USING A FAST REPLICATION FUNCTION
ARC0640I ARCFRTM - ADR006I (001)-STEND(02), 2010.285 20:49:34 EXECUTION ENDS
ARC0640I ARCFRTM - ADR013I (001)-CLTSK(01), 2010.285 20:49:34 TASK COMPLETED WITH RETURN CODE 0000
ARC0640I ARCFRTM - ADR012I (SCH)-DSSU (01), 2010.285 20:49:34 DFSMSDSS PROCESSING COMPLETE. HIGHEST RETURN CODE IS 0000
ARC1805I THE FOLLOWING 00001 VOLUME(S) WERE SUCCESSFULLY PROCESSED BY FAST REPLICATION BACKUP OF COPY POOL CPSE1
ARC1805I (CONT.) MLDD20
ARC1802I FAST REPLICATION BACKUP HAS COMPLETED FOR COPY POOL CPSE1, AT 20:49:34 ON 2010/10/12, FUNCTION RC=0000,
 MAXIMUM VOLUME RC=0000, CAPTURE CATALOG RC=0000
```

Figure 5-17 Excerpt from the DFSMShsm backup log on the execution of FRBACKUP CP(CPSE1)

NOCOPY mode results from the generated keyword FCNOCOPY (FCNC, 1) as part of the DFSMSdss COPY function command. Because the copy pool was defined with ALLOW FAST REVERSE RESTORE=Y, the keyword FCFULLVOLUMERELATION (FCFVR, 2) is mandatory. Otherwise, the resulting DASD backup copy cannot be used for recovery of the copy pool.

A QUERY command that is shown in Example 5-19 checks for active FlashCopy relationships with this copy pool.

Example 5-19 QUERY CP(CPSE1) command

```
HSEND Q CP(CPSE1)
```

Typically, the messages that are generated (Figure 5-18 on page 84) show on repeated executions of the QUERY command based on small changes in the value of percent completed (PCT-COMP, a) for the background copy. Application write behavior determines how quickly the value of percent complete grows because, in NOCOPY mode, only updated tracks are copied on the occurrence of the first write.

```
ARC1820I THE FOLLOWING VOLUMES IN COPY POOL CPSE1, VERSION 001, HAVE AN ACTIVE
ARC1820I (CONT.) FLASHCOPY BACKGROUND COPY
ARC1820I (CONT.) SGNAME   FR-PRIMARY FR-BACKUP  PCT-COMP
ARC1820I (CONT.) SG0      MLDD20     YYDE21     001  a
***
```

Figure 5-18 Panel messages about the QUERY CP(CPSE1) command

Fast reverse restore

If the copy pool was defined with an ALLOW FAST REVERSE RESTORE value of Y, FlashCopy relationships are withdrawn only in the following situations:

- On the next FRBACKUP CP(...) EXECUTE command
- On successful completion of a FRRECOV CP(...) FROMDASD command
- On execution of a FRBACKUP CP(...) WITHDRAW command

If the copy pool was defined with an ALLOW FAST REVERSE RESTORE value of N, FlashCopy relationships are withdrawn only in the following situations:

- On the next FRBACKUP CP(...) EXECUTE command
- On successful creation of a dump copy by automatic dump or command
- On execution of a FRBACKUP CP(...) WITHDRAW command

By using the LIST command that is shown in Example 5-20, you can check the status of the fast replication backup copy.

Example 5-20 LIST CP(CPSE1) command

```
HSEND LI CP(CPSE1)
```

If the copy pool was defined with an ALLOW FAST REVERSE RESTORE value of Y, the output of the LIST command (as shown in Figure 5-19) gives no hint of the NOCOPY mode in use.

```
-- DFSMShsm CONTROL DATASET --COPY POOL--LISTING --------- AT 17:10:06 ON
10/10/14 FOR SYSTEM=SC70

 COPYPOOL=CPSE1
 ALLOWPPRCP FRB=NO FRR=NO

 VERSION  VTOCENQ     DATE           TIME     FASTREPLICATIONSTATE  DUMPSTATE
   001       Y      2010/10/12      20:49:34   RECOVERABLE           NONE
 TOKEN(C)=C''
 TOKEN(H)=X''
 TOTAL NUM OF
VOLUMES=00001,INCREMENTAL=N,CATINFO=Y,FCFRR=Y,RECOVERYINCOMPLETE=N

 SGNAME   SOURCE - TARGET  SOURCE - TARGET  SOURCE - TARGET  SOURCE - TARGET
 SG0      MLDD20 - YYDE21
```

Figure 5-19 Output of LIST CP(CPSE1) command

If the copy pool was defined with an ALLOW FAST REVERSE RESTORE value of N, the output of the LIST command (as shown in Figure 5-20) reports a fast replication status of NONE because the DASD backup copy cannot be used for recovery.

```
-- DFSMShsm CONTROL DATASET --COPY POOL--LISTING --------- AT 17:15:06 ON
10/10/14 FOR SYSTEM=SC70

 COPYPOOL=CPSE9
 ALLOWPPRCP FRB=NO FRR=NO

 VERSION  VTOCENQ     DATE           TIME     FASTREPLICATIONSTATE  DUMPSTATE
   001       Y      2010/10/12      20:55:34   NONE                  NONE
 TOKEN(C)=C''
 TOKEN(H)=X''
 TOTAL NUM OF
VOLUMES=00001,INCREMENTAL=N,CATINFO=Y,FCFRR=N,RECOVERYINCOMPLETE=N

 SGNAME   SOURCE - TARGET  SOURCE - TARGET  SOURCE - TARGET  SOURCE - TARGET
 SG0      MLDD20 - YYDE21
```

Figure 5-20 Output of LIST CP(CPSE9) command

Note: Do not capture catalog information with this kind of copy pool because recovery at the data set level is not supported. You can request the catalog information (as we did in our examples), but you can use this captured catalog information for display only by using the LIST CP(...) DATASETS command (Example 5-15 on page 79 and Figure 5-13 on page 80).

5.3.5 Dumping a fast replication backup to tape

Fast replication DASD backup copies are always created by using DUMPCONDITIONING (Figure 5-21 on page 86).

DUMPCONDITIONING is advantageous because when you dump a target volume, it looks exactly as though you are dumping the source volume. You can use this dump copy for the recovery of the entire source volume or single data sets on the source volume.

Because DUMP to tape processing is performed with z/OS DFSMSdss, z/OS DFSMShsm uses the zEnterprise Data Compression (zEDC).

.

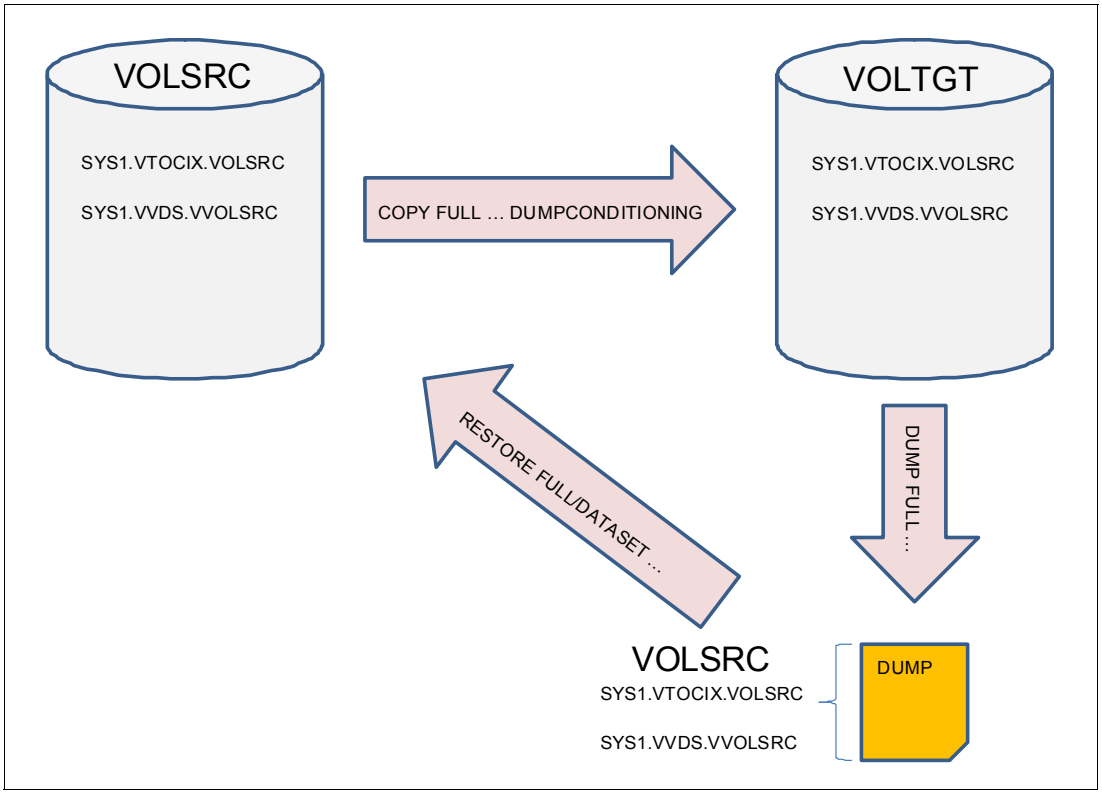

Figure 5-21 Fast replication DASD backup with DUMPCONDITIONING

You can dump fast replication DASD backup copies to tape. You can create these dumps on tape through the FRBACKUP command or through automatic dump processing.

The FRBACKUP command offers two optional keywords to request additional dump copies:

DUMP This keyword creates a new fast replication DASD backup version, which is immediately dumped to tape.

DUMPONLY This keyword dumps an existing fast replication DASD backup version to tape.

If you did not include settings for one or more dump classes in the copy pool definition, or if you want to override this setting, you can specify up to five dump classes on the FRBACKUP command.

Dump class

Although creating new dump classes might not be required for any technical reason, creating new dump classes for exclusive use with fast replication dump processing is a good idea. Unique dump classes for copy pools ensure that copy pool volumes are dumped as a set.

You can also stack volumes from multiple copy pools to the same tape when the copy pools share the same set of dump classes.

If you want z/OS DFSMShsm to use the zEDC compression during dump processing, specify ZCOMPRESS(PREFERRED) on the DEFINE command as shown Example 5-21 on page 87.

Example 5-21 DEFINE DUMPCLASS command with ZCOMPRESS(PREFERRED)

```
DEFINE DUMPCLASS ZCOMPRESS(PREFERRED)
```

Note: Use of this keyword requires the Field Programmable Gate Array (FPGA) compression feature for the zHelix processor.

This feature allows z/OS DFSMShsm to use the ZCOMPRESS keyword when it passes DUMP parameters to z/OS DFSMSdss.

On the DEFINE DUMPCLASS command, keywords are available that are relevant only for use with copy pools:

FRDUMP(REQUIRED) The default setting of FRDUMP(REQUIRED) indicates that every volume in a copy pool was successfully dumped before the DASD backup version that is being dumped can be replaced with a more recent backup copy.

FRDUMP(OPTIONAL) The alternative setting allows you to replace the DASD backup version of a copy pool even if one or more volumes were not successfully dumped.

FRRECOV(AFM(NO)) The default setting (if not specified on the DEFINE DCLASS) of FASTREPLICATIONRECOVER(AVAILABLEFORMOUNT(NO)) specifies that the dump copy is available for mount and does not need to be specified on the FRRECOV command to be used.

FRRECOV(AFM(YES)) The alternative setting specifies that a dump class copy must be explicitly referenced by a FRRECOV command to be used.

The FASTREPLICATIONRECOVER dump class setting applies to tape processing at the data set and volume levels.

DUMP

The DUMP keyword requests a new fast replication DASD backup and a dump copy on tape on the same command (Example 5-22).

Example 5-22 FRBACKUP ... DUMP command

```
HSEND FRBACKUP CP(CP2) DUMP DCLASS(DCFR112)
```

By using the DUMP keyword, a fast replication DASD backup version is created first. As soon as the fast replication DASD backup is created successfully, DFSMShsm dumps the DASD copy to tape. The time stamp of the dump copies reflects the time that the DASD copy is created.

The messages on the panel show a quick overview of the activity (Figure 5-22).

```
ARC1814I FAST REPLICATION BACKUP HAS COMPLETED SUCCESSFULLY AND DUMP MWES HAVE
ARC1814I (CONT.) BEEN QUEUED FOR COPY POOL CP2, VERSION 3
ARC1000I COPY POOL CP2 FRBACKUP PROCESSING ENDED
ARC0622I FULL VOLUME DUMP STARTING ON VOLUME MHLOA0(SMS) AT 12:48:51 ON
ARC0622I (CONT.) 2010/10/13, SYSTEM SC70, TASK ID=ARCDVOL1 , TO DUMP CLASS(ES)=
ARC0622I (CONT.)   DCFR112
ARC0728I VTOC FOR VOLUME MHLOA0 COPIED TO DATA SET
ARC0728I (CONT.) HSM.DUMPVTOC.T514812.VMHLOA0.D10286 ON VOLUME SBXHS5
ARC0637I DUMP COPY OF VOLUME MHLOA0 COMPLETE, DCLASS=DCFR112, EXPDT=2010/11/12
ARC0623I FULL VOLUME DUMP OF VOLUME MHLOA0 ENDING AT 12:48:53, PROCESSING
ARC0623I (CONT.) SUCCESSFUL
ARC1000I VOL=MHLOA0 FRBACKUP DUMP PROCESSING ENDED
```

Figure 5-22 Messages on the execution of the FRBACKUP ... DUMP command

A summary of the fast replication dump process is in DFSMShsm JESMSGLG data set (Figure 5-23).

```
12.48.51 STC20651  ARC1801I FAST REPLICATION DUMP IS STARTING FOR COPY  470
   470             ARC1801I (CONT.) POOL CP2, AT 12:48:51 ON 2010/10/13
12.48.51 STC20651  ARC1805I THE FOLLOWING 00001 VOLUME(S) WERE  471
   471             ARC1805I (CONT.) SUCCESSFULLY PROCESSED BY FAST REPLICATION BACKUP OF
   471             ARC1805I (CONT.) COPY POOL CP2
12.48.51 STC20651  ARC1805I (CONT.) MHLOA0
12.48.51 STC20651  ARC0622I FULL VOLUME DUMP STARTING ON VOLUME  473
   473             ARC0622I (CONT.) MHLOA0(SMS) AT 12:48:51 ON 2010/10/13, SYSTEM SC70,
   473             ARC0622I (CONT.) TASK ID=ARCDVOL1 , TO DUMP CLASS(ES)=   DCFR112
12.48.52 STC20651 *IEC501A M 040C,PRIVAT,SL,COMP,DFHSM70,DFHSM70,HSM.DMP.DCFR112.VMHLOA0.D10286.T514812
12.48.52 STC20651  IEC705I TAPE ON 040C,VT0003,SL,COMP,DFHSM70,DFHSM70,HSM.DMP.DCFR112.VMHLOA0.D10286.T514812,MEDIA5
12.48.52 STC20651  ARC0120I DUMP VOLUME VT0003 ADDED, RC= 0, REAS= 0
12.48.53 STC20651  IEC205I SYS00273,DFHSM70,DFHSM70,FILESEQ=1, COMPLETE VOLUME LIST,  481
   481             DSN=HSM.DMP.DCFR112.VMHLOA0.D10286.T514812,VOLS=VT0003,TOTALBLOCKS=163
12.48.53 STC20651  ARC1802I FAST REPLICATION BACKUP DUMP HAS COMPLETED  483
   483             ARC1802I (CONT.) FOR COPY POOL CP2, AT 12:48:53 ON 2010/10/13,
   483             ARC1802I (CONT.) FUNCTION RC=0000, MAXIMUM VOLUME RC=0000, CAPTURE
   483             ARC1802I (CONT.) CATALOG RC=0000
12.48.53 STC20651  IEF234E K 040C,VT0003,PVT,DFHSM70,DFHSM70
12.48.53 STC20651  ARC0637I DUMP COPY OF VOLUME MHLOA0 COMPLETE,  486
   486             ARC0637I (CONT.) DCLASS=DCFR112, EXPDT=2010/11/12
12.48.53 STC20651  ARC0623I FULL VOLUME DUMP OF VOLUME MHLOA0 ENDING AT  487
   487             ARC0623I (CONT.) 12:48:53, PROCESSING SUCCESSFUL
```

Figure 5-23 Excerpt from DFSMShsm JESMSGLG from the FRBACKUP ... DUMP command

Further details about the creation of a fast replication DASD backup version are in the DFSMShsm backup log (Figure 5-24 on page 89).

```
ARC1801I FAST REPLICATION DUMP IS STARTING FOR COPY POOL CP2, AT 12:48:51 ON 2010/10/13
ARC0640I ARCFRTM - PAGE 0001     5695-DF175  DFSMSDSS V1R12.0 DATA SET SERVICES     2010.286 12:48
ARC0640I ARCFRTM - ADR035I (SCH)-PRIME(06), INSTALLATION EXIT ALTERED BYPASS FAC CLASS CHK DEFAULT TO YES
ARC0640I ARCFRTM -  COPY IDY(MHL0A0) ODY(YYDF20) DUMPCOND FR(REQ) PUR FCINCREMENTAL     -
ARC0640I ARCFRTM -  FCFVR -
ARC0640I ARCFRTM -  DEBUG(FRMSG(DTL))
ARC0640I ARCFRTM - ADR101I (R/I)-RI01 (01), TASKID 001 HAS BEEN ASSIGNED TO COMMAND 'COPY '
ARC0640I ARCFRTM - ADR109I (R/I)-RI01 (01), 2010.286 12:48:51 INITIAL SCAN OF USER CONTROL STATEMENTS COMPLETED
ARC0640I ARCFRTM - ADR050I (001)-PRIME(02), DFSMSDSS INVOKED VIA CROSS MEMORY APPLICATION INTERFACE
ARC0640I ARCFRTM - ADR016I (001)-PRIME(01), RACF LOGGING OPTION IN EFFECT FOR THIS TASK
ARC0640I ARCFRTM - ADR006I (001)-STEND(01), 2010.286 12:48:51 EXECUTION BEGINS
ARC0640I ARCFRTM - ADR241I (001)-DDTFP(01), TARGET VTOC BEGINNING AT 000000003:00 AND ENDING AT 000000008:14 IS OVERLAID
ARC0640I ARCFRTM - ADR806I (001)-TOMI (02), VOLUME MHL0A0 WAS COPIED USING A FAST REPLICATION FUNCTION
ARC0640I ARCFRTM - ADR006I (001)-STEND(02), 2010.286 12:48:51 EXECUTION ENDS
ARC0640I ARCFRTM - ADR013I (001)-CLTSK(01), 2010.286 12:48:51 TASK COMPLETED WITH RETURN CODE 0000
ARC0640I ARCFRTM - ADR012I (SCH)-DSSU (01), 2010.286 12:48:51 DFSMSDSS PROCESSING COMPLETE. HIGHEST RETURN CODE IS 0000
ARC1805I THE FOLLOWING 00001 VOLUME(S) WERE SUCCESSFULLY PROCESSED BY FAST REPLICATION BACKUP OF COPY POOL CP2
ARC1805I (CONT.) MHL0A0
ARC1802I FAST REPLICATION BACKUP DUMP HAS COMPLETED FOR COPY POOL CP2, AT 12:48:53 ON 2010/10/13, FUNCTION RC=0000,
 MAXIMUM VOLUME RC=0000, CAPTURE CATALOG RC=0000
```

Figure 5-24 DFSMShsm backup log on execution of FRBACKUP ... DUMP command

Further details of the dump process are in the DFSMShsm dump log (Figure 5-25).

```
ARC0622I FULL VOLUME DUMP STARTING ON VOLUME MHL0A0(SMS) AT 12:48:51 ON 2010/10/13, SYSTEM SC70, TASK ID=ARCDVOL1 ,
 TO DUMP CLASS(ES)=   DCFR112
ARC0728I VTOC FOR VOLUME MHL0A0 COPIED TO DATA SET HSM.DUMPVTOC.T514812.VMHL0A0.D10286 ON VOLUME SBXHS5
ARC0640I ARCDVOL1 - PAGE 0001     5695-DF175  DFSMSDSS V1R12.0 DATA SET SERVICES     2010.286 12:48
ARC0640I ARCDVOL1 - ADR035I (SCH)-PRIME(06), INSTALLATION EXIT ALTERED BYPASS FAC CLASS CHK DEFAULT TO YES
ARC0640I ARCDVOL1 -  DUMP FULL INDDNAME(SYS00272)          -
ARC0640I ARCDVOL1 -  OUTDDNAME(SYS00273) -
ARC0640I ARCDVOL1 -  ALLEXCP ALLDATA(*) OPTIMIZE(3) TOLERATE(IOERROR)
ARC0640I ARCDVOL1 - ADR101I (R/I)-RI01 (01), TASKID 001 HAS BEEN ASSIGNED TO COMMAND 'DUMP '
ARC0640I ARCDVOL1 - ADR109I (R/I)-RI01 (01), 2010.286 12:48:52 INITIAL SCAN OF USER CONTROL STATEMENTS COMPLETED
ARC0640I ARCDVOL1 - ADR050I (001)-PRIME(01), DFSMSDSS INVOKED VIA APPLICATION INTERFACE
ARC0640I ARCDVOL1 - ADR016I (001)-PRIME(01), RACF LOGGING OPTION IN EFFECT FOR THIS TASK
ARC0640I ARCDVOL1 - ADR006I (001)-STEND(01), 2010.286 12:48:52 EXECUTION BEGINS
ARC0120I DUMP VOLUME VT0003 ADDED, RC= 0, REAS= 0
ARC0640I ARCDVOL1 - ADR006I (001)-STEND(02), 2010.286 12:48:53 EXECUTION ENDS
ARC0640I ARCDVOL1 - ADR013I (001)-CLTSK(01), 2010.286 12:48:53 TASK COMPLETED WITH RETURN CODE 0000
ARC0640I ARCDVOL1 - ADR012I (SCH)-DSSU (01), 2010.286 12:48:53 DFSMSDSS PROCESSING COMPLETE. HIGHEST RETURN CODE IS 0000
ARC1802I FAST REPLICATION BACKUP DUMP HAS COMPLETED FOR COPY POOL CP2, AT 12:48:53 ON 2010/10/13, FUNCTION RC=0000,
 MAXIMUM VOLUME RC=0000, CAPTURE CATALOG RC=0000
ARC0637I DUMP COPY OF VOLUME MHL0A0 COMPLETE, DCLASS=DCFR112, EXPDT=2010/11/12
ARC0623I FULL VOLUME DUMP OF VOLUME MHL0A0 ENDING AT 12:48:53, PROCESSING SUCCESSFUL
```

Figure 5-25 Excerpt from the DFSMShsm dump log on the execution of the FRBACKUP ... DUMP command

A LIST command that includes the keyword ALLVOL, as shown in Example 5-23, returns information about all copies of the latest fast replication backup (DASD and tape copies).

Example 5-23 LIST CP ... ALLVOL TERM command

```
HSEND LI CP(CP2) ALLVOL TERM
```

The output of the LIST command (Figure 5-26) contains status information about both types of backup copies:

- DASD (FRS, fast replication state **a**)
- Tape (DPS, dump state **b**)

```
COPYPOOL=CP2                              ,ALLOWPPRCP FRB=NO FRR=NO
VER=003,VTOCENQ=Y,MADE ON 2010/10/13 AT 12:48:51,FRS=RECOVERABLE    ,DPS=ALLCOM
PLETE                                                a                b
TKN(C)=C''
TKN(H)=X''
TOTAL NUM OF VOLUMES=00001,INCREMENTAL=Y,CATINFO=Y,FCFRR=Y,RECOVERYINCOMPLETE=N
SGNAME=SG1       SOURCE=MHL0A0  TARGET=YYDF20
DUMPCLASS=DCFR112 , REQUIRED=Y, DUMPSTATE=COMPLETE, VOLSSUC=00001, EXPDATE=2010
11/12, AVAILABLE=Y
HWCOMP=N    ENCRYPT=NONE   ENCRYPT_TYPE= *********  ENC_KEY=******************
****************************************
SOURCE=MHL0A0, DUMPVOL=VT0003                                    DEVICE TYPE=
3590-1
FILE SEQ=00, DSNAME=HSM.DMP.DCFR112.VMHL0A0.D10286.T514812
ARC0140I LIST COMPLETED,       12 LINE(S) OF DATA OUTPUT
```

Figure 5-26 Output of LIST CP... ALLVOL TERM command

The lines that start from `DUMPCLASS=` up to `FILE SEQ=` describe a dump copy. These lines are reported several times if more than one dump copy for this particular fast replication backup version exists.

A dump status of `ALLCOMPLETE` means that all dump copies were created successfully.

DUMPONLY

Another option is to create one or more dump copies of an existing fast replication DASD backup version. Dumping a fast replication DASD backup to tape only after the background copy finishes might be a preferred method to avoid any impact on application data at the time when the dump to tape occurs. If the dump to tape starts while the background copy is still happening, the reading of tracks from the target volume will probably impose additional load on the source volume because all tracks that are not yet copied to the target volume will be read from the source volume by the dump task.

To create a dump copy of an existing fast replication DASD backup, you can use the command that is shown in Example 5-24. Because we did not specify the name of a dump class on the copy pool settings, we must provide the name of one or more dump classes on the command. If multiple fast replication DASD backup versions are available, the latest version is copied to tape, by default. By using one of the mutually exclusive parameters VERSION, DATE, TOKEN, or GENERATION, you can describe the version that must be dumped to tape.

Example 5-24 FRBACKUP... DUMPONLY command

```
HSEND FRBACKUP CP(CP2) DUMPONLY DCLASS(DCFR112)
```

Only valid fast replication DASD backup versions can be dumped to tape. If the DUMPONLY request is being issued against a version with an invalid DASD copy, the command fails.

You can review the status of existing DASD backup versions by using the LIST command (Example 5-14 on page 79 and Figure 5-12 on page 79). The FASTREPLICATIONSTATE field must report RECOVERABLE to indicate a valid fast replication DASD backup version.

You can check whether the background copy completed by using the HSEND QUERY CP(*cpname*) command (Example 5-13 on page 78 and Figure 5-11 on page 78). If multiple copy pools are associated with a particular storage group, you need to query all associated copy pools.

On issuing the FRBACKUP ... DUMPONLY command, messages appear in several places:

- The JESMSGLG data set contains mount and keep messages (Figure 5-27).
- The DFSMShsm backup log contains messages about the start and completion of the dump process.
- The DFSMShsm dump log contains the details of the dump processing.

```
18.14.51 STC20651  ARC1801I FAST REPLICATION DUMPONLY IS STARTING FOR  886
   886             ARC1801I (CONT.) COPY POOL CP2, AT 18:14:51 ON 2010/10/13
18.14.51 STC20651  ARC0622I FULL VOLUME DUMP STARTING ON VOLUME  887
   887             ARC0622I (CONT.) MHLOA0(SMS) AT 18:14:51 ON 2010/10/13, SYSTEM SC70,
   887             ARC0622I (CONT.) TASK ID=ARCDVOL1 , TO DUMP CLASS(ES)=   DCFR112
18.14.51 STC20651 *IEC501A M 0458,PRIVAT,SL,COMP,DFHSM70,DFHSM70,HSM.DMP.DCFR112.VMHLOA0.D10286.T401118
18.14.52 STC20651  IEC705I TAPE ON 0458,VT0004,SL,COMP,DFHSM70,DFHSM70,HSM.DMP.DCFR112.VMHLOA0.D10286.T401118,MEDIA5
18.14.52 STC20651  ARC0120I DUMP VOLUME VT0004 ADDED, RC= 0, REAS= 0
18.14.53 STC20651  IEC205I SYS00336,DFHSM70,DFHSM70,FILESEQ=1, COMPLETE VOLUME LIST,895
   895           DSN=HSM.DMP.DCFR112.VMHLOA0.D10286.T401118,VOLS=VT0004,TOTALBLOCKS=163
18.14.53 STC20651  ARC1802I FAST REPLICATION BACKUP DUMPONLY HAS  897
   897             ARC1802I (CONT.) COMPLETED FOR COPY POOL CP2, AT 18:14:53 ON
   897             ARC1802I (CONT.) 2010/10/13, FUNCTION RC=0000, MAXIMUM VOLUME RC=0000
18.14.53 STC20651  IEF234E K 0458,VT0004,PVT,DFHSM70,DFHSM70
18.14.53 STC20651  ARC0637I DUMP COPY OF VOLUME MHLOA0 COMPLETE,  900
   900             ARC0637I (CONT.) DCLASS=DCFR112, EXPDT=2010/11/12
18.14.53 STC20651  ARC0623I FULL VOLUME DUMP OF VOLUME MHLOA0 ENDING AT  901
   901             ARC0623I (CONT.) 18:14:53, PROCESSING SUCCESSFUL
```

Figure 5-27 Excerpt from DFSMShsm JESMSGLG on the FRBACKUP ... DUMPONLY command

The messages in the DFSMShsm backup log (Figure 5-28) confirm the start and completion of the fast replication DUMPONLY process.

```
ARC1801I FAST REPLICATION DUMPONLY IS STARTING FOR COPY POOL CP2, AT 18:14:51 ON 2010/10/13
ARC1802I FAST REPLICATION BACKUP DUMPONLY HAS COMPLETED FOR COPY POOL CP2, AT 18:14:53 ON 2010/10/13, FUNCTION RC=0000,
 MAXIMUM VOLUME RC=0000
```

Figure 5-28 Excerpt from DFSMShsm backup log on the FRBACKUP ... DUMPONLY command

The DFSMShsm dump log contains detailed messages about the dump process (Figure 5-29 on page 92).

```
DFSMSHSM DUMP LOG, TIME 12:48:53,  DATE 10/10/13
ARC0622I FULL VOLUME DUMP STARTING ON VOLUME MHLOA0(SMS) AT 18:14:51 ON 2010/10/13, SYSTEM SC70, TASK ID=ARCDVOL1,
 TO DUMP CLASS(ES)=   DCFR112
ARC0728I VTOC FOR VOLUME MHLOA0 COPIED TO DATA SET HSM.DUMPVTOC.T401118.VMHLOA0.D10286 ON VOLUME SBXHS5
ARC0640I ARCDVOL1 - PAGE 0001     5695-DF175  DFSMSDSS V1R12.0 DATA SET SERVICES     2010.286 18:14
ARC0640I ARCDVOL1 - ADR035I (SCH)-PRIME(06), INSTALLATION EXIT ALTERED BYPASS FAC CLASS CHK DEFAULT TO YES
ARC0640I ARCDVOL1 -  DUMP FULL INDDNAME(SYS00335)          -
ARC0640I ARCDVOL1 -  OUTDDNAME(SYS00336) -
ARC0640I ARCDVOL1 -  ALLEXCP ALLDATA(*) OPTIMIZE(3) TOLERATE(IOERROR)
ARC0640I ARCDVOL1 - ADR101I (R/I)-RI01 (01), TASKID 001 HAS BEEN ASSIGNED TO COMMAND 'DUMP '
ARC0640I ARCDVOL1 - ADR109I (R/I)-RI01 (01), 2010.286 18:14:51 INITIAL SCAN OF USER CONTROL STATEMENTS COMPLETED
ARC0640I ARCDVOL1 - ADR050I (001)-PRIME(01), DFSMSDSS INVOKED VIA APPLICATION INTERFACE
ARC0640I ARCDVOL1 - ADR016I (001)-PRIME(01), RACF LOGGING OPTION IN EFFECT FOR THIS TASK
ARC0640I ARCDVOL1 - ADR006I (001)-STEND(01), 2010.286 18:14:51 EXECUTION BEGINS
ARC0120I DUMP VOLUME VT0004 ADDED, RC= 0, REAS= 0
ARC0640I ARCDVOL1 - ADR006I (001)-STEND(02), 2010.286 18:14:53 EXECUTION ENDS
ARC0640I ARCDVOL1 - ADR013I (001)-CLTSK(01), 2010.286 18:14:53 TASK COMPLETED WITH RETURN CODE 0000
ARC0640I ARCDVOL1 - ADR012I (SCH)-DSSU (01), 2010.286 18:14:53 DFSMSDSS PROCESSING COMPLETE. HIGHEST RETURN CODE IS 0000
ARC1802I FAST REPLICATION BACKUP DUMPONLY HAS COMPLETED FOR COPY POOL CP2, AT 18:14:53 ON 2010/10/13, FUNCTION RC=0000,
 MAXIMUM VOLUME RC=0000
ARC0637I DUMP COPY OF VOLUME MHLOA0 COMPLETE, DCLASS=DCFR112, EXPDT=2010/11/12
ARC0623I FULL VOLUME DUMP OF VOLUME MHLOA0 ENDING AT 18:14:53, PROCESSING SUCCESSFUL
 DFSMSHSM DUMP LOG, TIME 18:14:53,  DATE 10/10/13
```

Figure 5-29 Excerpt from the DFSMShsm dump log on the FRBACKUP ... DUMPONLY command

A LIST command, which is shown in Example 5-25, that includes the keyword ALLVOL returns information about all copies of the latest fast replication backup (DASD and tape copies).

Example 5-25 LIST CP ... ALLVOL TERM command

```
HSEND LI CP(CP2) ALLVOL(ALLVERS) ODS(MHLRES1.OUT,LIST)
```

The output of the LIST command contains information about the DASD backup and the dump copies of all available fast replication backup versions.

Note: The time stamp of the dump copies reflects the time that the DASD copy is created (Figure 5-30).

```
 -- DFSMShsm CONTROL DATASET --COPY POOL--LISTING --------- AT 18:15:06 ON
10/10/13 FOR SYSTEM=SC70

 COPYPOOL=CP2
 ALLOWPPRCP FRB=NO FRR=NO

 VERSION  VTOCENQ     DATE           TIME     FASTREPLICATIONSTATE  DUMPSTATE
   004      Y      2010/10/13      18:11:40   RECOVERABLE           ALLCOMPLETE
 TOKEN(C)=C''
 TOKEN(H)=X''
 TOTAL NUM OF
VOLUMES=00001,INCREMENTAL=Y,CATINFO=Y,FCFRR=Y,RECOVERYINCOMPLETE=N

 SGNAME   SOURCE - TARGET  SOURCE - TARGET  SOURCE - TARGET  SOURCE - TARGET
 SG1      MHLOA0 - YYDF20
0
 DUMPCLASS   REQUIRED   DUMPSTATE   VOLSSUC     EXPDATE    AVAILABLE
 DCFR112        Y       COMPLETE     00001     2010/11/12      Y

             HWCOMP  ENCRYPT  ENCTYPE    RSAKEY/KPWD
             NO      NONE     *********  ************************************

 SOURCE   DUMPVOLS                                          DEVICE TYPE
 MHLOA0   VT0004                                              3590-1
 FILE SEQ=00, DSNAME=HSM.DMP.DCFR112.VMHLOA0.D10286.T401118

 VERSION  VTOCENQ     DATE           TIME     FASTREPLICATIONSTATE  DUMPSTATE
   003      Y      2010/10/13      12:48:51   NONE                  ALLCOMPLETE
 TOKEN(C)=C''                                  a
 TOKEN(H)=X''
 TOTAL NUM OF
VOLUMES=00001,INCREMENTAL=N,CATINFO=Y,FCFRR=N,RECOVERYINCOMPLETE=N

 SGNAME   SOURCE - TARGET  SOURCE - TARGET  SOURCE - TARGET  SOURCE - TARGET
 SG1      MHLOA0 - ******
0
 DUMPCLASS   REQUIRED   DUMPSTATE   VOLSSUC     EXPDATE    AVAILABLE
 DCFR112        Y       COMPLETE     00001     2010/11/12      Y

             HWCOMP  ENCRYPT  ENCTYPE    RSAKEY/KPWD
             NO      NONE     *********  ************************************

 SOURCE   DUMPVOLS                                          DEVICE TYPE
 MHLOA0   VT0003                                              3590-1
 FILE SEQ=00, DSNAME=HSM.DMP.DCFR112.VMHLOA0.D10286.T514812

0----- END OF -- COPY POOL -- LISTING -----
```

Figure 5-30 Output of the HSEND LI ... ALLVOL(ALLVERS) command

While the “number of fast replication DASD backup versions” setting of copy pool CP2 is 1, several dump copies of fast replication backup versions can be in a copy pool. Dump-only versions are marked by NONE in the FASTREPLICATONSTATE field (a). The maximum number of fast replication backup versions (DASD-only + dump-only + both) that can be held at a time is 85. See “Lifecycle of dump copies (roll-off processing)” on page 94.

Up to five dump copies of a fast replication DASD backup version can be created by using different dump classes.

Lifecycle of dump copies (roll-off processing)

Dump copies of fast replication backups are kept by DFSMShsm until they expire or roll off. When a fast replication DASD backup copy is being rolled off, non-expired dump copies are kept until either one of the following situations occurs:

- Their expiration dates are reached.
- They are rolled off because the total number of fast replication backup versions of a copy pool reached the limit of 85.

DFSMShsm maintains a table of fast replication backup versions for each copy pool. Each table can hold up to 85 versions. In the table that is shown in Figure 5-31, a new DASD backup version is added on top (for example, a new version might be number 86). Therefore, it might be necessary to remove another row (which is always the oldest row if the table holds the maximum number of entries). On the creation of a new DASD fast replication backup version for a copy pool, the following situations might occur:

- An existing DASD backup version might roll off because otherwise the maximum number of DASD backup versions as specified on the copy pool settings is exceeded.
- An existing fast replication backup version on tape might roll off because otherwise the maximum number of entries in the table is exceeded.

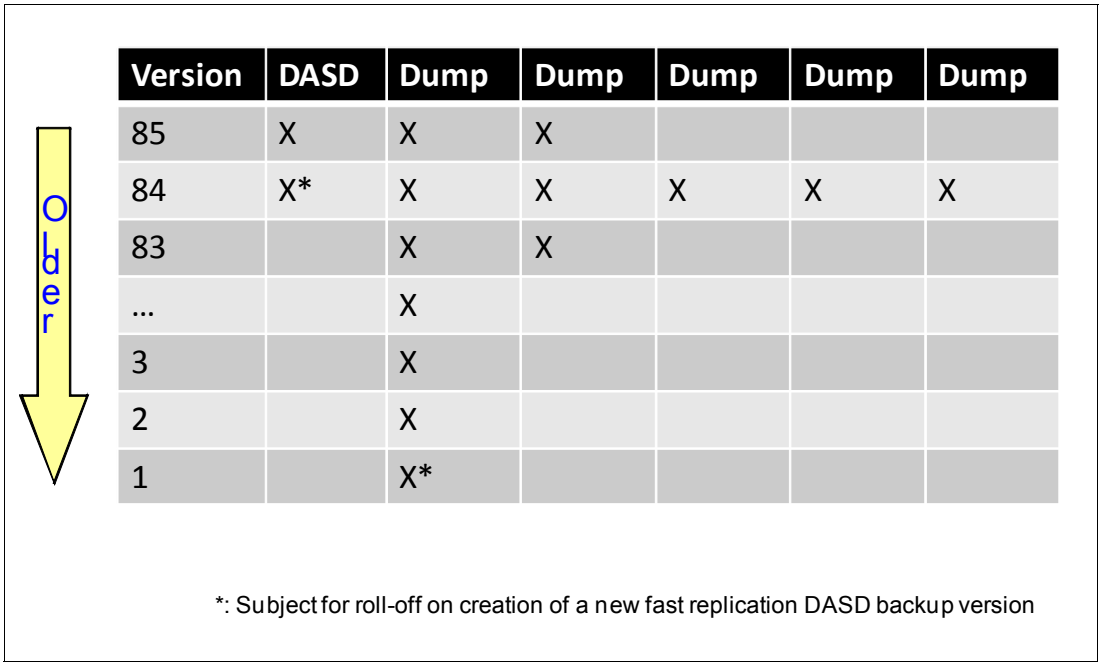

Figure 5-31 DFSMShsm internal table of backup versions of a copy pool

Due to the size of the table, we can expect that the expiration processing during DFSMShsm automatic dump will invalidate expired fast replication backup versions on tape according to their expiration dates before roll-off processing occurs. But if long-term retention periods are requested by the dump class, the roll-off processing of fast replication dump-only copies might occur.

Fast replication dump copies created during the automatic dump

The setting of a copy pool can request for a dump copy of target volumes on tape during the DFSMShsm automatic dump (Figure 5-32).

If the Auto Dump setting is `Y` and at least one dump class is specified, DFSMShsm includes the latest fast replication DASD backup version of this copy pool during the automatic dump.

```
                              COPY POOL DISPLAY                 Page 1 of 5
Command ===>

CDS Name  . . : SYS1.SMS.SCDS
Copy Pool Name: CPSE1

Description :

Auto Dump  . . . : Y
Dump Class . . . : DCFR112
Dump Class . . . :
Dump Class . . . :
Dump Class . . . :
Dump Class . . . :
Dump Sys/Sys Group Name :
Number of DASD Fast Replication Backup Versions with Background Copy : 0
FRBACKUP to PPRC Primary Volumes allowed :
FRRECOV to PPRC Primary Volumes allowed :


Use DOWN Command to View next Panel;
Use HELP Command for Help; Use END Command to Exit.
```

Figure 5-32 Copy pool settings for CPSE1

Three phases of automatic dump processing occur:

- Phase 1: Invalidation of dump generations
- Phase 2: Creation of new dump generations
- Phase 3: Deletion of excessive dump VTOC copy data sets

  In DFSMShsm V2R1, the default number of dump VTOC copies is changed from a value of 2 to a value of zero so they are no longer kept.

Phase 1 and Phase 3 work the same way with copy pool and non-copy pool volumes.

Note: DFSMShsm does not automatically delete the last and only remaining dump copy of a source volume. If you want to delete these copies, you must use one of the following commands:

```
DELVOL volser DUMP(LASTCOPY COPYPOOLCOPY PURGE)
FRDELETE CP(copypool) VERSIONS(...) DUMPONLY
```

Phase 2 of automatic dump works in the following manner with copy pools:

1. At the beginning of this phase, DFSMShsm obtains volume lists from storage groups that are being assigned to automatic dump-enabled copy pools.
2. Volumes of copy pools are considered candidates if the frequency requirement for the dump class to which the copy pool belongs is being met.
3. Volumes of copy pools are considered candidates even if they were processed by automatic dump within the last 14 hours.
4. If a DASD fast replication backup copy generation 0 exists and was not previously successfully dumped, the automatic dump uses the dump classes that are specified in the copy pool to determine whether the frequency requirement is being met. If the generation 0 dump copy is partially complete, the automatic dump skips all volumes that were successfully processed in the dump classes previously attempted.

   Tip: Automatic dump never considers fast replication backup copies other than generation 0. If you need to create a dump copy of generation 1 - 84, consider using the FRBACKUP CP(...) DUMPONLY command.

5. The automatic dump setting (Y/N) of the source volumes' storage groups are ignored by automatic dump when it is processing a copy pool.
6. Volumes that are associated with the same set of eligible dump classes, of which at least one enables dump stacking (parameter STACK(*nnn*) in dump class definition requests with *n* > 1), are always processed first. Within those volumes, the following order applies:
   - Affinity copy pool volumes
   - Non-affinity copy pool volumes
   - Affinity storage-management subsystem (SMS) volumes
   - Non-affinity SMS volumes
   - Non-SMS volumes
7. Volumes that are associated with copy pools are not stacked with non-copy pool volumes.

   Tip: If you want to ensure that only the volumes of one copy pool are stacked on the same tape volume, use different dump classes for each copy pool.

8. After all volumes that are eligible for stacking are dumped, the remaining volumes are dumped, with DFSMShsm selecting the order of processing as listed in step 6.

The messages that appear in DFSMShsm JESMSGLG during automatic dump are shown in Figure 5-33.

```
22.13.53 STC20651  ARC0620I AUTOMATIC DUMP STARTING
 22.13.53 STC20651  ARC0628I AUTOMATIC EXPIRATION OF DUMP VOLUMES STARTING
22.13.53 STC20651  ARC1831I DUMP VERSION NUMBER 57 OF COPY POOL  256
    256             ARC1831I (CONT.) DSN$DB9C$DB WAS DELETED SUCCESSFULLY
22.13.53 STC20651  ARC1831I DUMP VERSION NUMBER 59 OF COPY POOL  259
    259             ARC1831I (CONT.) DSN$DB9C$DB WAS DELETED SUCCESSFULLY
22.13.54 STC20651  ARC0629I AUTOMATIC EXPIRATION OF DUMP VOLUMES ENDING
22.17.14 STC20651  ARC1841I AUTOMATIC DUMP STARTING FOR COPY POOL CPSE2
 22.17.14 STC20651  ARC0622I FULL VOLUME DUMP STARTING ON VOLUME  373
    373             ARC0622I (CONT.) MLDD20(SMS) AT 22:17:14 ON 2010/10/13, SYSTEM SC70,
    373             ARC0622I (CONT.) TASK ID=ARCDVOL1 , TO DUMP CLASS(ES)=   DCFR112
 22.17.14 STC20651  ARC1841I AUTOMATIC DUMP STARTING FOR COPY POOL CPSE1
 22.17.14 STC20651  ARC0622I FULL VOLUME DUMP STARTING ON VOLUME  375
    375             ARC0622I (CONT.) MLDD20(SMS) AT 22:17:14 ON 2010/10/13, SYSTEM SC70,
    375             ARC0622I (CONT.) TASK ID=ARCDVOL2 , TO DUMP CLASS(ES)=   DCFR112
 22.17.14 STC20651  ARC0728I VTOC FOR VOLUME MLDD20 COPIED TO DATA SET  376
    376             ARC0728I (CONT.) HSM.DUMPVTOC.T500318.VMLDD20.D10286 ON VOLUME SBXHS5
 22.17.14 STC20651  ARC0728I VTOC FOR VOLUME MLDD20 COPIED TO DATA SET  377
    377             ARC0728I (CONT.) HSM.DUMPVTOC.T344920.VMLDD20.D10285 ON VOLUME SBXHS5
 22.17.14 STC20651 *IEC501A M 0405,PRIVAT,SL,COMP,DFHSM70,DFHSM70,HSM.DMP.DCFR112.VMLDD20.D10286.T500318
 22.17.14 STC20651 *IEC501A M 0438,PRIVAT,SL,COMP,DFHSM70,DFHSM70,HSM.DMP.DCFR112.VMLDD20.D10285.T344920
 22.17.15 STC20651  IEC705I TAPE ON 0405,VT0010,SL,COMP,DFHSM70,DFHSM70,HSM.DMP.DCFR112.VMLDD20.D10286.T500318,MEDIA5
 22.17.15 STC20651  ARC0120I DUMP VOLUME VT0010 ADDED, RC= 0, REAS= 0
 22.17.15 STC20651  IEC705I TAPE ON 0438,VT0011,SL,COMP,DFHSM70,DFHSM70,HSM.DMP.DCFR112.VMLDD20.D10285.T344920,MEDIA5
 22.17.15 STC20651  ARC0120I DUMP VOLUME VT0011 ADDED, RC= 0, REAS= 0
 22.17.17 STC20651  IEC205I SYS00456,DFHSM70,DFHSM70,FILESEQ=1, COMPLETE VOLUME LIST,  392
    392             DSN=HSM.DMP.DCFR112.VMLDD20.D10286.T500318,VOLS=VT0010,TOTALBLOCKS=493
 22.17.17 STC20651  ARC1842I AUTO DUMP HAS COMPLETED FOR COPY POOL CPSE2,  394
    394             ARC1842I (CONT.) AT 22:17:17 ON 2010/10/13, MAXIMUM VOLUME RC=0000
 22.17.17 STC20651  IEC205I SYS00457,DFHSM70,DFHSM70,FILESEQ=1, COMPLETE VOLUME LIST,  395
    395             DSN=HSM.DMP.DCFR112.VMLDD20.D10285.T344920,VOLS=VT0011,TOTALBLOCKS=493
 22.17.17 STC20651  IEF234E K 0405,VT0010,PVT,DFHSM70,DFHSM70
 22.17.17 STC20651  ARC0623I FULL VOLUME DUMP OF VOLUME MLDD20 ENDING AT  399
    399             ARC0623I (CONT.) 22:17:17, PROCESSING SUCCESSFUL
 22.17.17 STC20651  ARC1842I AUTO DUMP HAS COMPLETED FOR COPY POOL CPSE1,  400
    400             ARC1842I (CONT.) AT 22:17:17 ON 2010/10/13, MAXIMUM VOLUME RC=0000
 22.17.17 STC20651  IEF234E K 0438,VT0011,PVT,DFHSM70,DFHSM70
 22.17.17 STC20651  ARC0623I FULL VOLUME DUMP OF VOLUME MLDD20 ENDING AT  403
    403             ARC0623I (CONT.) 22:17:17, PROCESSING SUCCESSFUL
 22.17.17 STC20651  ARC0621I AUTOMATIC DUMP ENDING
```

Figure 5-33 Excerpt from DFSMShsm JESMSGLG on automatic dump

The messages that appear in the DFSMShsm dump log are shown in Figure 5-34.

```
 DFSMSHSM DUMP LOG, TIME 18:14:53,  DATE 10/10/13
 ARC0620I AUTOMATIC DUMP STARTING
 ARC0628I AUTOMATIC EXPIRATION OF DUMP VOLUMES STARTING
 ARC0639I DUMP VTOC COPY SCRATCHED, DATA SET NAME=HSM.DUMPVTOC.T133815.VMLDE65.D08085
 ARC0263I DUMP VOLUME THS010 DELETED, VOLUME STATUS=PURGED
 ARC0262I DUMP COPY INVALIDATED FOR VOLUME MLDE65, CREATION DATE=08/03/25
 ARC0262I DUMP GENERATION INVALIDATED FOR VOLUME MLDE65, CREATION DATE=08/03/25
 ARC0639I DUMP VTOC COPY SCRATCHED, DATA SET NAME=HSM.DUMPVTOC.T425123.VSBOX5S.D09289
ARC0629I AUTOMATIC EXPIRATION OF DUMP VOLUMES ENDING
ARC1841I AUTOMATIC DUMP STARTING FOR COPY POOL CPSE2
 ARC0622I FULL VOLUME DUMP STARTING ON VOLUME MLDD20(SMS) AT 22:17:14 ON 2010/10/13, SYSTEM SC70, TASK ID=ARCDVOL1 ,
  TO DUMP CLASS(ES)=   DCFR112
 ARC1841I AUTOMATIC DUMP STARTING FOR COPY POOL CPSE1
 ARC0622I FULL VOLUME DUMP STARTING ON VOLUME MLDD20(SMS) AT 22:17:14 ON 2010/10/13, SYSTEM SC70, TASK ID=ARCDVOL2 ,
  TO DUMP CLASS(ES)=   DCFR112
 ARC0728I VTOC FOR VOLUME MLDD20 COPIED TO DATA SET HSM.DUMPVTOC.T500318.VMLDD20.D10286 ON VOLUME SBXHS5
 ARC0640I ARCDVOL1 - PAGE 0001     5695-DF175  DFSMSDSS V1R12.0 DATA SET SERVICES     2010.286 22:17
 ARC0640I ARCDVOL1 - ADR035I (SCH)-PRIME(06), INSTALLATION EXIT ALTERED BYPASS FAC CLASS CHK DEFAULT TO YES
 ARC0640I ARCDVOL1 -  DUMP FULL INDDNAME(SYS00454)          -
 ARC0640I ARCDVOL1 -  OUTDDNAME(SYS00456) -
 ARC0640I ARCDVOL1 -  ALLEXCP ALLDATA(*) OPTIMIZE(3) TOLERATE(IOERROR)
 ARC0640I ARCDVOL1 - ADR101I (R/I)-RI01 (01), TASKID 001 HAS BEEN ASSIGNED TO COMMAND 'DUMP '
 ARC0640I ARCDVOL1 - ADR109I (R/I)-RI01 (01), 2010.286 22:17:14 INITIAL SCAN OF USER CONTROL STATEMENTS COMPLETED
 ARC0640I ARCDVOL1 - ADR050I (001)-PRIME(01), DFSMSDSS INVOKED VIA APPLICATION INTERFACE
 ARC0640I ARCDVOL1 - ADR016I (001)-PRIME(01), RACF LOGGING OPTION IN EFFECT FOR THIS TASK
 ARC0728I VTOC FOR VOLUME MLDD20 COPIED TO DATA SET HSM.DUMPVTOC.T344920.VMLDD20.D10285 ON VOLUME SBXHS5
 ARC0640I ARCDVOL2 - PAGE 0001     5695-DF175  DFSMSDSS V1R12.0 DATA SET SERVICES     2010.286 22:17
 ARC0640I ARCDVOL2 - ADR035I (SCH)-PRIME(06), INSTALLATION EXIT ALTERED BYPASS FAC CLASS CHK DEFAULT TO YES
 ARC0640I ARCDVOL2 -  DUMP FULL INDDNAME(SYS00455)          -
 ARC0640I ARCDVOL2 -  OUTDDNAME(SYS00457) -
 ARC0640I ARCDVOL2 -  ALLEXCP ALLDATA(*) OPTIMIZE(3) TOLERATE(IOERROR)
 ARC0640I ARCDVOL2 - ADR101I (R/I)-RI01 (01), TASKID 001 HAS BEEN ASSIGNED TO COMMAND 'DUMP '
 ARC0640I ARCDVOL2 - ADR109I (R/I)-RI01 (01), 2010.286 22:17:14 INITIAL SCAN OF USER CONTROL STATEMENTS COMPLETED
 ARC0640I ARCDVOL1 - ADR006I (001)-STEND(01), 2010.286 22:17:14 EXECUTION BEGINS
 ARC0640I ARCDVOL2 - ADR050I (001)-PRIME(01), DFSMSDSS INVOKED VIA APPLICATION INTERFACE
 ARC0640I ARCDVOL2 - ADR016I (001)-PRIME(01), RACF LOGGING OPTION IN EFFECT FOR THIS TASK
 ARC0640I ARCDVOL2 - ADR006I (001)-STEND(01), 2010.286 22:17:14 EXECUTION BEGINS
 ARC0120I DUMP VOLUME VT0010 ADDED, RC= 0, REAS= 0
 ARC0120I DUMP VOLUME VT0011 ADDED, RC= 0, REAS= 0
 ARC0640I ARCDVOL1 - ADR006I (001)-STEND(02), 2010.286 22:17:17 EXECUTION ENDS
 ARC0640I ARCDVOL1 - ADR013I (001)-CLTSK(01), 2010.286 22:17:17 TASK COMPLETED WITH RETURN CODE 0000
 ARC0640I ARCDVOL1 - ADR012I (SCH)-DSSU (01), 2010.286 22:17:17 DFSMSDSS PROCESSING COMPLETE. HIGHEST RETURN CODE IS 0000
 ARC1842I AUTO DUMP HAS COMPLETED FOR COPY POOL CPSE2, AT 22:17:17 ON 2010/10/13, MAXIMUM VOLUME RC=0000
 ARC0637I DUMP COPY OF VOLUME MLDD20 COMPLETE, DCLASS=DCFR112, EXPDT=2010/11/12
 ARC0640I ARCDVOL2 - ADR006I (001)-STEND(02), 2010.286 22:17:17 EXECUTION ENDS
 ARC0623I FULL VOLUME DUMP OF VOLUME MLDD20 ENDING AT 22:17:17, PROCESSING SUCCESSFUL
 ARC0640I ARCDVOL2 - ADR013I (001)-CLTSK(01), 2010.286 22:17:17 TASK COMPLETED WITH RETURN CODE 0000
 ARC0640I ARCDVOL2 - ADR012I (SCH)-DSSU (01), 2010.286 22:17:17 DFSMSDSS PROCESSING COMPLETE. HIGHEST RETURN CODE IS 0000
 ARC1842I AUTO DUMP HAS COMPLETED FOR COPY POOL CPSE1, AT 22:17:17 ON 2010/10/13, MAXIMUM VOLUME RC=0000
 ARC0637I DUMP COPY OF VOLUME MLDD20 COMPLETE, DCLASS=DCFR112, EXPDT=2010/11/12
 ARC0623I FULL VOLUME DUMP OF VOLUME MLDD20 ENDING AT 22:17:17, PROCESSING SUCCESSFUL
 ARC0648I AUTOMATIC DELETION OF EXCESS DUMP VTOC COPIES STARTING
 ARC0639I DUMP VTOC COPY SCRATCHED, DATA SET NAME=HSM.DUMPVTOC.T344920.VMLDD20.D10285
 ARC0649I AUTOMATIC DELETION OF EXCESS DUMP VTOC COPIES ENDING
 ARC0621I AUTOMATIC DUMP ENDING
```

Figure 5-34 Excerpt from the DFSMShsm Dump log on automatic dump

Two types of dump generations

DFSMShsm can create dump copies of Level 0 volumes by using one of the following methods:

- Automatic dump processing
- BACKVOL ... DUMP command
- FRBACKUP ... DUMP command
- FRBACKUP ... DUMPONLY command

In all cases, a dump generation record (DGN) in the BCDS describes each dump generation, and a dump volume record (DVL) in the BCDS describes each dump volume. Each dump generation record can hold up to five copies that are made from different dump classes.

You can use a LIST command (Example 5-26) to display all dump copies of a particular level 0 volume.

Example 5-26 Request for a list of all dump copies of a level 0 volume

```
HSEND LI PVOL(MLDD20) ALLDUMPS BCDS
```

Two different kinds of dump copies are presented on the display (Figure 5-35).

```
1- DFSMSHSM CONTROL DATASET - PRIMARY VOLUME-BCDS--- ALLDUMPS----- AT 13:40:30 ON 10/10/15 FOR SYSTEM=SC70

 SOURCE                                              SET OF DUMP
 VOLSER GEN SMS  DUMPED     TIME    CLASS     EXP DATE   VOLSERS  1

 MLDD20  00 YES 10/10/15  13:39:10  MHLRES2   10/10/22  VT0012 ****** ****** ****** ****** ****** ****** ****** ******
 FAST REPLICATION ASSOCIATED DATA FOR VOLUME MLDD20:
 COPY POOL                      GEN   DUMPED     TIME    CLASS     EXP DATE   SET OF DUMP VOLSERS  2

 CP01                            00 2010/10/01 13:00:19 DCFR112   2010/10/31  VT0013 ****** ****** ****** ****** ******
 CPSE1                           00 2010/10/12 20:49:34 DCFR112   2010/11/12  VT0011 ****** ****** ****** ****** ******
 CPSE2                           00 2010/10/13 18:03:50 DCFR112   2010/11/12  VT0010 ****** ****** ****** ****** ******
 ----- END OF - PRIMARY VOLUME - LISTING -----
```

Figure 5-35 Output of the LIST PVOL(...) ALLDUMPS BCDS command

The first part of the list (1) displays full volume dumps that were created from the source volume directly for one of the following reasons:

- The volume's storage group was automatic dump enabled.
- A BACKVOL ... DUMP command was issued for the source volume.

The second part of the list (2) displays full volume dumps that were created from one of the target volumes that contained a fast replication DASD backup of the source volume at the time that the dump copy was created. These dump copies were created for one of the following reasons:

- A copy pool setting included the source volume's storage group and the copy pool was automatic dump enabled.
- A FRBACKUP CP(...) DUMP command was issued against one of the copy pools with which the volume is being associated.
- A FRBACKUP CP(...) DUMPONLY command was issued against one of the copy pools with which the volume is being associated.

Dump copy comparison

The difference between the traditional full volume dump copies and the fast replication-associated full volume dump copies is that the fast replication-associated dump copies are created from volumes that were the target of a FULL COPY DUMPCONDITIONING operation. (See Figure 5-21 on page 86.) This difference results in an incorrect volume serial number (that of the target volume) being dumped from record 3 of cylinder 0 track 0. You do not need to worry about that at any time because during any reuse of a dump copy, such as this situation for full volume recovery purposes, DFSMSdss remembers that this copy is a dump copy of a conditioned volume. DFSMSdss takes the appropriate action to restore the volume label to the original source volume.

To learn more about DUMPCONDITIONING, see the following sources:

- *z/OS DFSMSdss Storage Administration*, SC26-0423
- *z/OS DFSMSdfp Storage Administration*, SC26-7402
- APAR OW48234

Working with full volume dumps

The two types of full volume dumps look similar but must be treated differently by DFSMShsm.

Dump generation records of dump copies that are *not* associated with fast replication backup are referenced by the BCDS-eligible volume record that is called the MCP record of the related volumes and can be used by the following commands only:

```
HRECOVER dsname
HSEND RECOVER dsname FROMDUMP
HSEND RECOVER * TOVOLUME(volser) FROMDUMP
```

In the case of a fast replication dump copy (that was created from a volume of a CPBSG), the dump generation records are not referenced by the BCDS-eligible volume record (MCP). These dump generations are referenced by the fast replication records (FRx) and are exclusively available for recovery by the FRRECOV command.

Table 5-2 provides a detailed comparison between the traditional dump copies that DFSMShsm provided for more than 20 years and the dump copies that are created from fast replication target volumes that are available since z/OS DFSMShsm V1.8.

Table 5-2 Comparison of fast replication dumps and other dumps

	Dump of pool storage group volumes	**Dump of copy pool backup storage group volumes**
Created by command	BACKVOL *volser* DUMP	FRBACKUP CP(*cpname*) {DUMP/DUMPONLY}
Created during automatic dump	Yes	Yes
Described by DGN record	Yes	Yes
Described by DVL record	Yes	Yes
Referenced by MCP record	Yes	No
Can be used by **RECOVER dsn**	Yes	No
Can be used by **RECOVER ***	Yes	No
Can be used by **HRECOVER dsn**	Yes	No
Can be used by **FRRECOV**	No	Yes

	Dump of pool storage group volumes	Dump of copy pool backup storage group volumes
Reported by **LIST DVOL**	Yes	Yes
Reported by **LI PVOL(*volser*) ALLDUMPS BCDS**	Yes	Yes
Reported by **LI CP(...) ALLVOLS**	No	Yes
Reported by **LI CP(...) DUMPVOLS**	No	Yes
Can be used by DFSMSdss directly in batch for the restore of volumes and data sets	Yes	Yes
Warning in case one of the volumes of a storage group was not successfully dumped	No	Yes*
Maximum number of dump copies	100 generations up to five copies per generation	85 generations up to five copies per generation
Maximum number of parallel processes during creation	SETSYS MAXDUMPTASKS(32)	SETSYS MAXDUMPTASKS(32)
Maximum number of parallel processes during recovery of volumes by DFSMShsm	SETSYS MAXDRT(64)**	SETSYS MAXDRT(64)**
Maximum number of parallel processes during recovery of data sets by DFSMShsm	SETSYS MAXDSTRT(64)***	SETSYS MAXDSTRT(64)***

* LIST CP(...) shows a DUMPREPLICATIONSTATE of REQUIREDCOMPLETE or PARTIAL
** SETSYS MAXDUMPRECOVERTASKS
*** SETSYS MAXDSTAPERECOVERTASKS

5.3.6 Recovery from fast replication backups

Fast replication backups can be used to recover the following entities:

- A copy pool with all of its volumes (including the catalogs)
- Single volumes of a copy pool
- Single data sets that existed in the copy pool at the time of the backup

Fast replication backup versions on DASD or on tape can be used for recovery.

Recovery at the copy pool level

Recovery at the copy pool level recovers all volumes of the copy pool to the point-in-time state as it was when the backup occurred (Figure 5-36 on page 102).

With z/OS DFSMS V1.12, all copy pools can be defined to allow fast reverse restore on the execution of a FRRECOV command. This approach allows for recovery at the copy pool level even if the background copy is not yet finished. *But, when you use fast reverse restore during recovery, the DASD backup version can be used only for this recovery and is deleted on the successful completion of the process.* This restriction applies to all types of fast replication DASD backups, whether they are operating in NOCOPY mode or in COPY mode.

Fast replication DASD backup versions that operate in COPY mode can be reused for fast replication recovery on the completion of the background copy. This recovery applies for copy pools that allowing fast reverse restore, as well. Fast reverse restore is only used during fast replication recovery if the background copy processing is still in progress for at least one of the volume pairs.

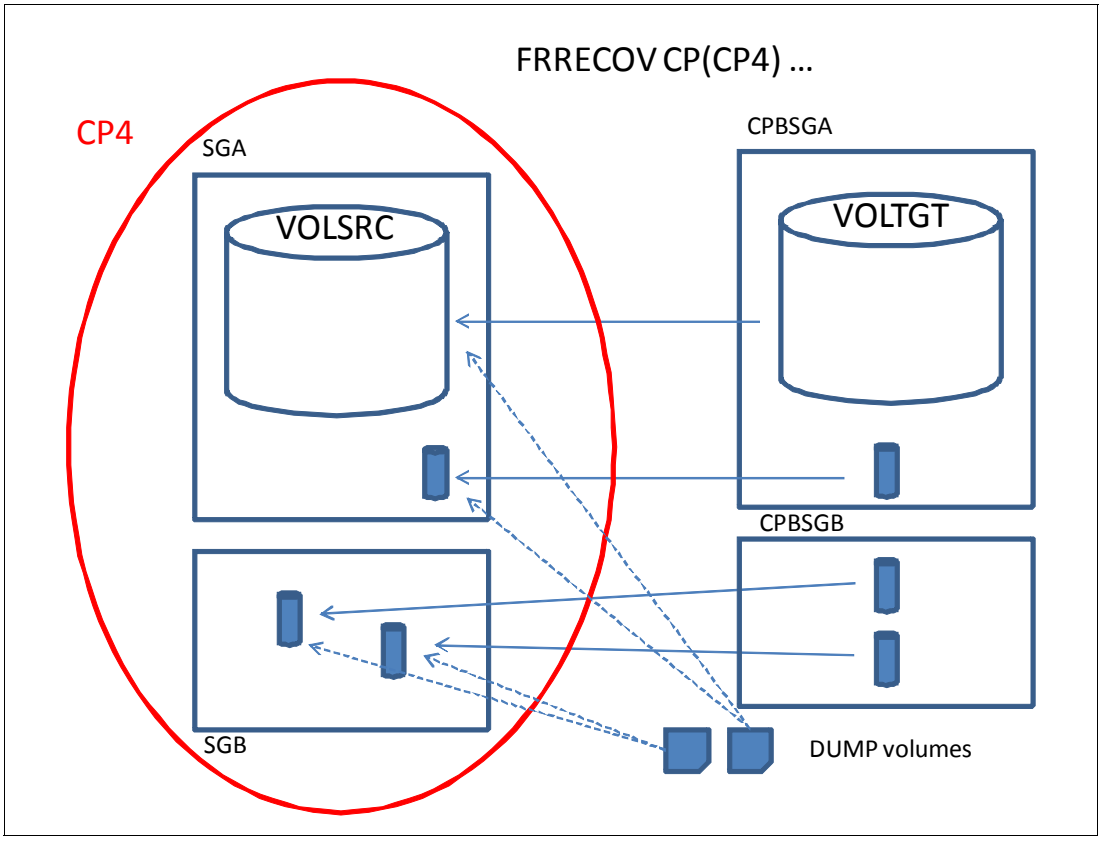

Figure 5-36 Fast replication recovery at the copy pool level

Recovery from a NOCOPY fast replication backup

We start with an example of recovery from a backup version that operates in NOCOPY mode. Support for recovery from fast replication DASD backup versions that operate in NOCOPY mode is new with DFSMShsm V1.12 and is supported for copy pools with the ALLOW FAST REVERSE RESTORE=Y setting only.

Tip: NOCOPY DASD backups cannot be used for recovery at the volume or data set level.

The FRRECOV command that we used is shown in Example 5-27.

Example 5-27 FRRECOV command at the copy pool level

```
HSEND FRRECOV CP(CPSE2) VERIFY(Y)
```

When VERIFY(Y) is used on the FRRECOV command, DFSMShsm checks for conditions that might prevent a successful fast replication recovery. The following conditions are verified before fast replication recovery starts for any volume:

- The copy pool is not defined to allow fast reverse restore, but at least one volume is in an active FlashCopy relationship.
- The copy pool is defined to allow fast reverse restore, but multiple FlashCopy targets are associated with a source volume in the copy pool. The check for multiple FlashCopy targets considers all relationships even if they were not put in place by a former FRBACKUP command.
- The copy pool is defined to allow fast reverse restore, but one or more DASDs are in the process of being dumped to tape.

Parameter VERIFY(Y) is the default if not specified.

Tip: VERIFY(N) cannot be specified for a copy pool to allow fast reverse restore unless a previous FRRECOV operation determined that the copy pool backup version is no longer eligible for fast reverse restore and regular fast replication recovery can be used.

The messages that are generated as a result of the FRRECOV command are shown in Figure 5-37.

```
ARC1850I VOLUME MLDD20 IN COPY POOL CPSE2 HAS MULTIPLE FLASHCOPY
TARGETS, AS
ARC1850I (CONT.) FOLLOWS
ARC1850I (CONT.) SGNAME   FR-PRIMARY FR-BACKUP  FR-TGT
ARC1850I (CONT.) SG0      MLDD20     YYDE5F
ARC1850I (CONT.) SG0      MLDD20     YYDE21
ARC1001I COPY POOL CPSE2 FRRECOV FAILED, RC=0006, REAS=0076
ARC1806E FAST REPLICATION RECOVERY HAS FAILED FOR COPY POOL CPSE2,
RC=0076
```

Figure 5-37 Displayed messages on FRRECOV CP(CPSE2)

VERIFY detected multiple FlashCopy targets of source volume MLDD20. We must withdraw all other existing FlashCopy relationships before we can successfully recover the copy pool.

Therefore, we must identify which other copy pools have active FlashCopy relationships with source volume MLDD20. We can use the LIST PVOL command as shown in Example 5-28 to solve this issue.

Example 5-28 LIST PVOL(...) BCDS command

```
HSEND LI PVOL(MLDD20) BCDS ODS(...)
```

The output of the command (Figure 5-38) shows which other copy pools relate to volume MLDD20.

```
1- DFSMSHSM CONTROL DATASET - PRIMARY VOLUME-BCDS--- LISTING ----- AT 21:25:51 ON 10/10/15 FOR
SYSTEM=SC70

                                LAST BACKED UP
VOLSER SMS                      DATE       TIME    DUMPCLASS   DUMPED      TIME     EXP DATE

MLDD20 YES                     0000/00/00 00:00:00  MHLRES2   2010/10/15  13:39:10  2010/10/22

FAST REPLICATION ASSOCIATED DATA FOR VOLUME MLDD20:
                                 LAST FRBACKUP
COPY POOL                       DATE       TIME    DUMPCLASS   DUMPED      TIME     EXP DATE

CP01                           0000/00/00 00:00:00  DCFR112   2010/10/01  13:00:19  2010/10/31
CPSE1                          2010/10/15 21:12:28  DCFR112   2010/10/15  21:12:28  2010/11/14
CPSE2                          2010/10/13 18:03:50  DCFR112   2010/10/13  18:03:50  2010/11/12
----- END OF - PRIMARY VOLUME - LISTING -----
```

Figure 5-38 Output of LIST PVOL(...) BCDS command

CP01 is not in use (LAST FRBACKUP DATE is 0000/00/00). So, an active FlashCopy relationship that is caused by CPSE1 must be responsible for the failure of the FRRECOV CP(CPSE2) command.

We must withdraw this fast replication DASD backup explicitly by using the command that is shown in Example 5-29.

Example 5-29 FRBACKUP CP(...) WITHDRAW command

```
HSEND FRBACKUP CP(CPSE1) WITHDRAW
```

After this command is issued, messages are written to the DFSMShsm backup log as shown in Figure 5-39.

```
ARC1838I INITIALIZATION ATTEMPT OF COPY POOL BACKUP STORAGE GROUP VOLUME YYDE21 HAS COMPLETED, RC=0000, RSN=0000 b
ARC1833I WITHDRAW COMPLETED FOR COPY POOL CPSE1, BACKUP VERSION NUMBER 2 WAS INVALIDATED a
```

Figure 5-39 Excerpt from the DFSMShsm backup log on the execution of FRBACKUP CP(...) WITHDRAW

Because the fast replication backup relationship of copy pool CPSE1 was executing in NOCOPY mode, the DASD backup version was invalidated. The DASD backup version can no longer be used for fast replication recovery. (See message ARC1833I, a.) Target volumes are in an unpredictable state when NOCOPY FlashCopy relationships are withdrawn. Therefore, DFSMShsm performs an INIT process for these target volumes by calling Device Support Facilities (ICKDSF). (See message ARC1838I, b.)

Related messages from the internally invoked execution of ICKDSF are in the DFSMShsm JESMSGLG output (Figure 5-40).

```
21.47.43 STC20651  ICK061I   DE21 VTOC INDEX CREATION SUCCESSFUL: VOLUME IS IN INDEX FORMAT
21.47.43 STC20651  ICK10705I VOLUME SERIAL NUMBER FOR DEVICE DE21 IS YYDE21.
21.47.43 STC20651            VTOC LOCATION MOVED.
21.47.43 STC20651  ARC1838I INITIALIZATION ATTEMPT OF COPY POOL BACKUP  716
   716             ARC1838I (CONT.) STORAGE GROUP VOLUME YYDE21 HAS COMPLETED, RC=0000,
   716             ARC1838I (CONT.) RSN=0000
21.47.43 STC20651  ARC1833I WITHDRAW COMPLETED FOR COPY POOL CPSE1,  717
   717             ARC1833I (CONT.) BACKUP VERSION NUMBER 2 WAS INVALIDATED
21.47.43 STC20651  ARC1831I BACKUP VERSION NUMBER 2 OF COPY POOL CPSE1  718
   718             ARC1831I (CONT.) WAS DELETED SUCCESSFULLY
```

Figure 5-40 Excerpt from DFSMShsm JESMSGLG on the execution of the FRBACKUP ... WITHDRAW command

Tip: After you withdraw a fast replication backup version that executes in NOCOPY mode, you cannot use this backup version for recovery any more. If you want to keep a copy of this particular backup version, you must dump it to tape before you perform the withdrawal.

Now, try the initial FRRECOV command again (Example 5-27 on page 102). Figure 5-41 shows the messages that appear in the DFSMShsm backup log on the successful execution of the command.

```
ARC1801I FAST REPLICATION RECOVERY IS STARTING FOR COPY POOL CPSE2, AT 21:52:44 ON 2010/10/15
ARC0640I ARCFRTM - PAGE 0001     5695-DF175  DFSMSDSS V1R12.0 DATA SET SERVICES     2010.288 21:52
ARC0640I ARCFRTM - ADR035I (SCH)-PRIME(06), INSTALLATION EXIT ALTERED BYPASS FAC CLASS CHK DEFAULT TO YES
ARC0640I ARCFRTM -  COPY IDY(YYDE5F) ODY(MLDD20) DUMPCOND FR(REQ) PUR ALLX ALLD(*)      -
ARC0640I ARCFRTM -  FCFVR -
ARC0640I ARCFRTM -  FCFRR - a
ARC0640I ARCFRTM -  DEBUG(FRMSG(DTL))
ARC0640I ARCFRTM - ADR101I (R/I)-RI01 (01), TASKID 001 HAS BEEN ASSIGNED TO COMMAND 'COPY '
ARC0640I ARCFRTM - ADR109I (R/I)-RI01 (01), 2010.288 21:52:45 INITIAL SCAN OF USER CONTROL STATEMENTS COMPLETED
ARC0640I ARCFRTM - ADR050I (001)-PRIME(02), DFSMSDSS INVOKED VIA CROSS MEMORY APPLICATION INTERFACE
ARC0640I ARCFRTM - ADR016I (001)-PRIME(01), RACF LOGGING OPTION IN EFFECT FOR THIS TASK
ARC0640I ARCFRTM - ADR006I (001)-STEND(01), 2010.288 21:52:45 EXECUTION BEGINS
ARC0640I ARCFRTM - ADR241I (001)-DDTFP(01), TARGET VTOC BEGINNING AT 000000003:00 AND ENDING AT 000000008:14 IS OVERLAID
ARC0640I ARCFRTM - ADR806I (001)-TOMI (02), VOLUME YYDE5F WAS COPIED USING A FAST REPLICATION FUNCTION
ARC0640I ARCFRTM - ADR006I (001)-STEND(02), 2010.288 21:52:46 EXECUTION ENDS
ARC0640I ARCFRTM - ADR013I (001)-CLTSK(01), 2010.288 21:52:46 TASK COMPLETED WITH RETURN CODE 0000
ARC0640I ARCFRTM - ADR012I (SCH)-DSSU (01), 2010.288 21:52:46 DFSMSDSS PROCESSING COMPLETE. HIGHEST RETURN CODE IS 0000
ARC1838I INITIALIZATION ATTEMPT OF COPY POOL BACKUP STORAGE GROUP VOLUME YYDE5F HAS COMPLETED, RC=0000, RSN=0000
ARC1851I BACKUP VERSION 0001 FOR COPY POOL CPSE2 WAS INVALIDATED, RC=0002 b
ARC1805I THE FOLLOWING 00001 VOLUME(S) WERE SUCCESSFULLY PROCESSED BY FAST REPLICATION RECOVERY OF COPY POOL CPSE2
ARC1805I (CONT.) MLDD20
ARC1802I FAST REPLICATION RECOVERY HAS COMPLETED FOR COPY POOL CPSE2, AT 21:52:46 ON 2010/10/15, FUNCTION RC=0000,
 MAXIMUM VOLUME RC=0000
```

Figure 5-41 Excerpt from the DFSMShsm backup log on the execution of the FRBACKUP CP(...) command

Recovery was performed with fast reverse restore because the keyword FCFASTREVERSERESTORE (FCFRR, a) was used when DFSMSdss was invoked. On the successful recovery of copy pool CPSE2, the fast replication DASD backup version 0001 (which was in use for recovery) was invalidated by DFSMShsm and the target volumes were initialized (b). Do not worry about RC=0002 in message ARC1851I. RC=0002 confirms that fast reverse restore was used during recovery and that the fast replication DASD backup version was invalidated after the successful recovery operation.

An open usercatalog on volume MLDD20 must be closed and unallocated before the recovery of the volume can occur. Issue a MODIFY CATALOG,UNALLOCATE(...) command (Figure 5-42).

```
21.52.44 STC20651  ARC1801I FAST REPLICATION RECOVERY IS STARTING FOR  721
   721             ARC1801I (CONT.) COPY POOL CPSE2, AT 21:52:44 ON 2010/10/15
21.52.45 STC20651  F CATALOG,UNALLOCATE(UCAT.TESTFRR                        )
```

Figure 5-42 DFSMShsm JESMSGLG output after FRRECOV CP(CPSE2) command

DFSMShsm unallocates catalog UCAT.TESTFRR as shown in Figure 5-42. Unallocate is performed for all catalogs that are specified in the copy pool settings. If the unallocate processing is unsuccessful for a catalog in the copy pool, fast replication recovery fails for the volume that holds the catalog. You must perform unallocation manually before you try the FRRECOV command again.

Catalogs:

- All data sets in the copy pool need to be cataloged in usercatalogs that are allocated on volumes that are part of the copy pool. These usercatalogs must not contain any other data sets.
- Other usercatalogs that contain entries of data sets outside of the copy pool must not be allocated on copy pool volumes.

Use the LIST CP command to show fast replication DASD backups (Example 5-30).

Example 5-30 LIST CP(...) command

```
LI CP(CPSE2) ODS(...)
```

The output of the LIST command that is shown in Figure 5-43 shows clearly that no valid fast replication DASD backup version is available. (See **a** in Figure 5-43 for the output of the LIST command.)

```
 -- DFSMShsm CONTROL DATASET --COPY POOL--LISTING --------- AT 21:58:16 ON
10/10/15 FOR SYSTEM=SC70

COPYPOOL=CPSE2
ALLOWPPRCP FRB=NO FRR=NO

VERSION  VTOCENQ     DATE           TIME     FASTREPLICATIONSTATE  DUMPSTATE
  001       Y      2010/10/13      18:03:50   NONE                  ALLCOMPLETE
TOKEN(C)=C''                                  a                      b
TOKEN(H)=X''
TOTAL NUM OF VOLUMES=00001,INCREMENTAL=N,CATINFO=Y,FCFRR=N,RECOVERYINCOMPLETE=N

SGNAME   SOURCE - TARGET  SOURCE - TARGET  SOURCE - TARGET  SOURCE - TARGET
SG0      MLDD20 - ******

----- END OF -- COPY POOL -- LISTING -----
```

Figure 5-43 Output of the LIST CP(CPSE2) command

The only reason we still see this version on the LIST command is because a dump copy of this fast replication backup version still exists (b).

Tip: You can use a fast replication DASD backup version only one time on a recovery that uses fast reverse restore. When you want to keep a copy of this version, you must dump a copy to tape before using it for a fast reverse restore operation.

Recovery from a fast replication backup with background copy

When you want to recover a copy pool from a fast replication DASD backup version whose background copy is still in progress, you must use, at the time of the FRBACKUP execution, copy pool settings that allow for fast reverse restore. If you cannot wait until the background copy completes, the same restrictions apply as with copy pools that operate in NOCOPY mode:

- If multiple FlashCopy targets are associated with a source volume in the copy pool, FRBACKUP does not execute. The check for multiple FlashCopy targets considers all relationships even if they were not put in place by a former FRBACKUP command.
- If one or more target volumes are in the process of being dumped to tape, FRRECOV only executes with FORCE. If FORCE is used, the dump state is incomplete for that fast replication version and the dump copy cannot be used to recover the whole copy pool.
- After a successful recovery by using fast reverse restore, the fast replication DASD backup version is invalidated and it cannot be used for further FRRECOV commands.

Using fast reverse restore

Check the current progress of background copy activities before you decide to use fast reverse restore. A QUERY command, as shown in Example 5-31, checks for active FlashCopy relationships with this copy pool.

Example 5-31 QUERY CP(CPSE1) command

```
HSEND Q CP(CPSE1)
```

Depending on the percent-complete information (PCT-COMP, a) that is shown in messages on the panel (Figure 5-44), you can decide whether to use fast reverse restore immediately or to wait for the background copy to complete to use regular fast replication recovery and to preserve the DASD backup version.

```
ARC1820I THE FOLLOWING VOLUMES IN COPY POOL CPSE1, VERSION 001, HAVE AN ACTIVE
ARC1820I (CONT.) FLASHCOPY BACKGROUND COPY
ARC1820I (CONT.) SGNAME   FR-PRIMARY FR-BACKUP  PCT-COMP
ARC1820I (CONT.) SG0      MLDD20     YYDE21     001  a
***
```

Figure 5-44 Displayed messages on the QUERY CP(CPSE1) command

A similar check for outstanding dump copies is not available. But, you look on the output of a LIST command as shown in Example 5-32.

Example 5-32 LIST CP(...) ALLVOLS command

```
HSEND LI CP(CPNSPANBOX07) ALLVOLS
```

The output (Figure 5-45) shows whether the current dump of the copy pool is still in progress (DUMPSTATE=PARTIAL) and which of the source volumes was dumped successfully so far. By comparing the list of volume pairs of the fast replication DASD backup version (a) with the list of dump copies (b), you can estimate the progress of the dump process.

```
-- DFSMShsm CONTROL DATASET --COPY POOL--LISTING --------- AT 21:21:47 ON
10/10/20 FOR SYSTEM=SC70

COPYPOOL=CPNSPANBOX07
ALLOWPPRCP FRB=NO FRR=NO

VERSION  VTOCENQ     DATE           TIME     FASTREPLICATIONSTATE  DUMPSTATE
  001      Y      2010/10/20      21:16:36   RECOVERABLE           PARTIAL
TOKEN(C)=C''
TOKEN(H)=X''
TOTAL NUM OF VOLUMES=00003,INCREMENTAL=N,CATINFO=Y,FCFRR=Y,RECOVERYINCOMPLETE=N

SGNAME   SOURCE - TARGET  SOURCE - TARGET  SOURCE - TARGET  SOURCE - TARGET
SG1      MHL0A0 - YYDF20                    a
SG2      MHL1A0 - YY8140  MHL1A1 - YY8141

DUMPCLASS   REQUIRED   DUMPSTATE   VOLSSUC     EXPDATE    AVAILABLE
DCFR112        Y       COMPLETE     00003     2010/11/19      Y

            HWCOMP  ENCRYPT  ENCTYPE    RSAKEY/KPWD
            NO      NONE     *********  ************************************

SOURCE   DUMPVOLS                                          DEVICE TYPE
MHL0A0   VT0018          b                                   3590-1
FILE SEQ=00, DSNAME=HSM.DMP.DCFR112.VMHL0A0.D10293.T361621
MHL1A0   VT0019          b                                   3590-1
FILE SEQ=00, DSNAME=HSM.DMP.DCFR112.VMHL1A0.D10293.T361621
```

Figure 5-45 Output of the LIST CP(...) ALLVOLS command

Fast replication copy pool recovery

The next example describes a copy pool recovery by using regular fast replication. The command is shown in Example 5-33.

Example 5-33 FRRECOV CP(CP1) command

```
HSEND FRRECOV CP(CP1)
```

The messages in DFSMShsm JESMSGLG (Figure 5-46) show the events that occur on the execution of this command.

```
17.29.17 STC22372  ARC1801I FAST REPLICATION RECOVERY IS STARTING FOR  696
   696             ARC1801I (CONT.) COPY POOL CP1, AT 17:29:17 ON 2010/10/20
17.29.17 STC22372  F CATALOG,UNALLOCATE(UCAT.TESTFR                              )
17.29.17 STC22372  ARC1805I THE FOLLOWING 00001 VOLUME(S) WERE  702
   702             ARC1805I (CONT.) SUCCESSFULLY PROCESSED BY FAST REPLICATION RECOVERY
   702             ARC1805I (CONT.) OF COPY POOL CP1
17.29.17 STC22372  ARC1805I (CONT.) MHLOA0
17.29.17 STC22372  ARC1802I FAST REPLICATION RECOVERY HAS COMPLETED FOR  704
   704             ARC1802I (CONT.) COPY POOL CP1, AT 17:29:17 ON 2010/10/20, FUNCTION
   704             ARC1802I (CONT.) RC=0000, MAXIMUM VOLUME RC=0000
```

Figure 5-46 Excerpt from DFSMShsm JESMSGLG on the execution of the FRRECOV CP(CP1) command

The messages in the DFSMShsm backup log on the execution of the command are presented in Figure 5-47.

```
ARC1801I FAST REPLICATION RECOVERY IS STARTING FOR COPY POOL CP1, AT 17:29:17 ON 2010/10/20
ARC0640I ARCFRTM - PAGE 0001     5695-DF175  DFSMSDSS V1R12.0 DATA SET SERVICES     2010.293 17:29
ARC0640I ARCFRTM - ADR035I (SCH)-PRIME(06), INSTALLATION EXIT ALTERED BYPASS FAC CLASS CHK DEFAULT TO YES
ARC0640I ARCFRTM -  COPY IDY(YYD006) ODY(MHLOA0) DUMPCOND FR(REQ) PUR ALLX ALLD(*)      -
ARC0640I ARCFRTM -  DEBUG(FRMSG(DTL))
ARC0640I ARCFRTM - ADR101I (R/I)-RI01 (01), TASKID 001 HAS BEEN ASSIGNED TO COMMAND 'COPY ''
ARC0640I ARCFRTM - ADR109I (R/I)-RI01 (01), 2010.293 17:29:17 INITIAL SCAN OF USER CONTROL STATEMENTS COMPLETED
ARC0640I ARCFRTM - ADR050I (001)-PRIME(02), DFSMSDSS INVOKED VIA CROSS MEMORY APPLICATION INTERFACE
ARC0640I ARCFRTM - ADR016I (001)-PRIME(01), RACF LOGGING OPTION IN EFFECT FOR THIS TASK
ARC0640I ARCFRTM - ADR006I (001)-STEND(01), 2010.293 17:29:17 EXECUTION BEGINS
ARC0640I ARCFRTM - ADR241I (001)-DDTFP(01), TARGET VTOC BEGINNING AT 000000003:00 AND ENDING AT 000000008:14 IS OVERLAID
ARC0640I ARCFRTM - ADR806I (001)-TOMI (02), VOLUME YYD006 WAS COPIED USING A FAST REPLICATION FUNCTION
ARC0640I ARCFRTM - ADR006I (001)-STEND(02), 2010.293 17:29:17 EXECUTION ENDS
ARC0640I ARCFRTM - ADR013I (001)-CLTSK(01), 2010.293 17:29:17 TASK COMPLETED WITH RETURN CODE 0000
ARC0640I ARCFRTM - ADR012I (SCH)-DSSU (01), 2010.293 17:29:17 DFSMSDSS PROCESSING COMPLETE. HIGHEST RETURN CODE IS 0000
ARC0400I VOLUME MHLOA0 IS 99% FREE, 0000000029 FREE TRACK(S), 000009995 FREE CYLINDER(S), FRAG .000
ARC0401I LARGEST EXTENTS FOR MHLOA0 ARE CYLINDERS      9995, TRACKS     149939
ARC0402I VTOC FOR MHLOA0 IS 00090 TRACKS(0004500 DSCBS), 0004491 FREE DSCBS(99% OF TOTAL)
ARC1805I THE FOLLOWING 00001 VOLUME(S) WERE SUCCESSFULLY PROCESSED BY FAST REPLICATION RECOVERY OF COPY POOL CP1
ARC1805I (CONT.) MHLOA0
ARC1802I FAST REPLICATION RECOVERY HAS COMPLETED FOR COPY POOL CP1, AT 17:29:17 ON 2010/10/20, FUNCTION RC=0000,
 MAXIMUM VOLUME RC=0000
```

Figure 5-47 Excerpt from DFSMShsm backup log on the execution of the FRRECOV CP(CP1) command

Recovery from an incremental fast replication backup

When you want to recover a copy pool from a fast replication DASD backup version whose background copy is still in progress, the same restrictions apply as described in “Recovery from a fast replication backup with background copy” on page 107.

We used copy pool CP2 to demonstrate a copy pool recovery from an incremental fast replication backup version. The command that we used is shown in Example 5-34.

Example 5-34 FRRECOV CP(CP2) command

```
HSEND FRRECOV CP(CP2)
```

The messages that appear in DFSMShsm JESMSGLG on the execution of the command are shown in Figure 5-48.

```
18.16.22 STC22372  ARC1801I FAST REPLICATION RECOVERY IS STARTING FOR  885
   885             ARC1801I (CONT.) COPY POOL CP2, AT 18:16:22 ON 2010/10/20
18.16.22 STC22372  F CATALOG,UNALLOCATE(UCAT.TESTFR                        )
18.16.22 STC22372  ARC1805I THE FOLLOWING 00001 VOLUME(S) WERE  891
   891             ARC1805I (CONT.) SUCCESSFULLY PROCESSED BY FAST REPLICATION RECOVERY
   891             ARC1805I (CONT.) OF COPY POOL CP2
18.16.22 STC22372  ARC1805I (CONT.) MHLOA0
18.16.22 STC22372  ARC1802I FAST REPLICATION RECOVERY HAS COMPLETED FOR  893
   893             ARC1802I (CONT.) COPY POOL CP2, AT 18:16:22 ON 2010/10/20, FUNCTION
   893             ARC1802I (CONT.) RC=0000, MAXIMUM VOLUME RC=0000
```

Figure 5-48 Excerpt from DFSMShsm JESMSGLG on the execution of the FRRECOV CP(CP2) command

More details about the execution of the FRRECOV CP(CP2) command are in the DFSMShsm backup log (Figure 5-49).

```
ARC1801I FAST REPLICATION RECOVERY IS STARTING FOR COPY POOL CP2, AT 18:16:22 ON 2010/10/20
ARC0640I ARCFRTM - PAGE 0001     5695-DF175  DFSMSDSS V1R12.0 DATA SET SERVICES     2010.293 18:16
ARC0640I ARCFRTM - ADR035I (SCH)-PRIME(06), INSTALLATION EXIT ALTERED BYPASS FAC CLASS CHK DEFAULT TO YES
ARC0640I ARCFRTM -  COPY IDY(MLD361) ODY(MHLOA0) DUMPCOND FR(REQ) PUR FCINCRLAST      a -
ARC0640I ARCFRTM -  DEBUG(FRMSG(DTL))
ARC0640I ARCFRTM - ADR101I (R/I)-RI01 (01), TASKID 001 HAS BEEN ASSIGNED TO COMMAND 'COPY '
ARC0640I ARCFRTM - ADR109I (R/I)-RI01 (01), 2010.293 18:16:22 INITIAL SCAN OF USER CONTROL STATEMENTS COMPLETED
ARC0640I ARCFRTM - ADR050I (001)-PRIME(02), DFSMSDSS INVOKED VIA CROSS MEMORY APPLICATION INTERFACE
ARC0640I ARCFRTM - ADR016I (001)-PRIME(01), RACF LOGGING OPTION IN EFFECT FOR THIS TASK
ARC0640I ARCFRTM - ADR006I (001)-STEND(01), 2010.293 18:16:22 EXECUTION BEGINS
ARC0640I ARCFRTM - ADR241I (001)-DDTFP(01), TARGET VTOC BEGINNING AT 000000003:00 AND ENDING AT 000000008:14 IS OVERLAID
ARC0640I ARCFRTM - ADR806I (001)-TOMI (02), VOLUME MLD361 WAS COPIED USING A FAST REPLICATION FUNCTION
ARC0640I ARCFRTM - ADR006I (001)-STEND(02), 2010.293 18:16:22 EXECUTION ENDS
ARC0640I ARCFRTM - ADR013I (001)-CLTSK(01), 2010.293 18:16:22 TASK COMPLETED WITH RETURN CODE 0000
ARC0640I ARCFRTM - ADR012I (SCH)-DSSU (01), 2010.293 18:16:22 DFSMSDSS PROCESSING COMPLETE. HIGHEST RETURN CODE IS 0000
ARC0400I VOLUME MHLOA0 IS 99% FREE, 0000000029 FREE TRACK(S), 000009995 FREE CYLINDER(S), FRAG .000
ARC0401I LARGEST EXTENTS FOR MHLOA0 ARE CYLINDERS      9995, TRACKS     149939
ARC0402I VTOC FOR MHLOA0 IS 00090 TRACKS(0004500 DSCBS), 0004491 FREE DSCBS(99% OF TOTAL)
ARC1805I THE FOLLOWING 00001 VOLUME(S) WERE SUCCESSFULLY PROCESSED BY FAST REPLICATION RECOVERY OF COPY POOL CP2
ARC1805I (CONT.) MHLOA0
ARC1802I FAST REPLICATION RECOVERY HAS COMPLETED FOR COPY POOL CP2, AT 18:16:22 ON 2010/10/20, FUNCTION RC=0000,
 MAXIMUM VOLUME RC=0000
```

Figure 5-49 Excerpt from the DFSMShsm backup log on the execution of the FRRECOV CP(CP2) command

At the DFSMSdss keyword level, in Figure 5-49, the following situations are apparent:

- No full volume relationship is being used.
- The incremental relationship ends (keyword FCINCRLAST, a).

We execute an FCQUERY command to confirm the situation, as shown in Example 5-35.

Example 5-35 FCQUERY DEV(...) command

```
FCQUERY DEV(D103)
```

The messages that are generated from this command (Figure 5-50) show no active FlashCopy relationships.

```
ANTF0420I FCQUERY Formatted -3
DEVN SSID LSS CCA  CU     SERIAL       ACT    MAX XC PC CC RV SE  SEQNUM
D103 89E1  01  03 2107 0000000BALB1      0  65534  N  N  N  N NN 00000000
ANTF0001I FCQUERY COMMAND COMPLETED FOR DEVICE D103, COMPLETION CODE: 00
***
```

Figure 5-50 Output of FCQUERY command

When you execute the next FRBACKUP command, it reestablishes an incremental FlashCopy relationship automatically because DFSMShsm remembers the original setting from before the execution of the recovery. Figure 5-51 shows the output of an LI CP(CP2) command after the execution of a FRBACKUP CP(CP2) command.

```
-- DFSMShsm CONTROL DATASET --COPY POOL--LISTING --------- AT 18:22:20 ON
10/10/20 FOR SYSTEM=SC70

COPYPOOL=CP2
ALLOWPPRCP FRB=NO FRR=NO

VERSION  VTOCENQ     DATE           TIME     FASTREPLICATIONSTATE  DUMPSTATE
  002      Y      2010/10/20      18:15:36   RECOVERABLE           NONE
TOKEN(C)=C''
TOKEN(H)=X''
TOTAL NUM OF VOLUMES=00001,INCREMENTAL=Y,CATINFO=Y,FCFRR=Y,RECOVERYINCOMPLETE=N

SGNAME   SOURCE - TARGET  SOURCE - TARGET  SOURCE - TARGET  SOURCE - TARGET
SG1      MHL0A0 - MLD361

VERSION  VTOCENQ     DATE           TIME     FASTREPLICATIONSTATE  DUMPSTATE
  001      Y      2010/10/20      18:10:47   NONE                  ALLCOMPLETE
TOKEN(C)=C''
TOKEN(H)=X''
TOTAL NUM OF VOLUMES=00001,INCREMENTAL=N,CATINFO=Y,FCFRR=N,RECOVERYINCOMPLETE=N

SGNAME   SOURCE - TARGET  SOURCE - TARGET  SOURCE - TARGET  SOURCE - TARGET
SG1      MHL0A0 - ******

----- END OF -- COPY POOL -- LISTING -----
```

Figure 5-51 LIST CP(CP2) command output after the execution of the FRBACKUP CP(CP2) command

Recovery from a fast replication dump copy

When you recover a copy pool from a fast replication dump copy, you must use the FRRECOV command. Use of RECOVER * TOVOLUME(...) is not supported for those kinds of dump copies.

Starting with z/OS DFSMS V1.12, several tasks can be used in parallel to recover the copy pool volumes from dump copies. SETSYS MAXDUMPRECOVERTASKS(*nn*) sets up the maximum number of volume recoveries from dump tasks that DFSMShsm can concurrently process. The default setting is 1. The setting applies to the fast replication recovery of copy pool volumes from dump copies and to volume recovery processing that is being requested by RECOVER commands.

The actual number of recover tasks is limited by the following values:

- The number of available tape drives
- The stacking level that was used to create the dump copies

We used the command that is shown in Example 5-36 to demonstrate this function.

Example 5-36 FRRECOV CP(CPNSPANBOX07) FROMDUMP example

```
HSEND FRRECOV CP(CPNSPANBOX07) FROMDUMP
```

The messages in the DFSMShsm backup log are shown in Figure 5-52.

```
 DFSMSHSM BACKUP LOG, TIME 00:39:26,  DATE 10/10/21
ARC1801I FAST REPLICATION RECOVERY FROM DUMP IS STARTING FOR COPY POOL CPNSPANBOX07, AT 14:30:26 ON 2010/10/21
 ARC1805I THE FOLLOWING 00003 VOLUME(S) WERE SUCCESSFULLY PROCESSED BY FAST REPLICATION RECOVERY OF COPY POOL
 CPNSPANBOX07
 ARC1805I (CONT.) MHL0A0
 ARC1805I (CONT.) MHL1A0
 ARC1805I (CONT.) MHL1A1
 ARC1802I FAST REPLICATION RECOVERY FROM DUMP HAS COMPLETED FOR COPY POOL CPNSPANBOX07, AT 14:30:36 ON 2010/10/21,
  FUNCTION RC=0000, MAXIMUM VOLUME RC=0000
```

Figure 5-52 DFSMShsm backup log messages on the execution of FRRECOV CP(CPNSPANBOX07) FROMDUMP

The messages in DFSMShsm JESMSGLG are shown in Figure 5-53 and Figure 5-54 on page 114.

```
14.30.26 STC22760  ARC1801I FAST REPLICATION RECOVERY FROM DUMP IS  149
   149             ARC1801I (CONT.) STARTING FOR COPY POOL CPNSPANBOX07, AT 14:30:26 ON
   149             ARC1801I (CONT.) 2010/10/21
14.30.26 STC22760  F CATALOG,UNALLOCATE(UCAT.ZFSFR                                  )
14.30.26 STC22760  F CATALOG,UNALLOCATE(UCAT.TESTFR                                 )
14.30.26 STC22760  ARC0622I FULL VOLUME RESTORE STARTING ON VOLUME MHL0A0  159
   159             ARC0622I (CONT.) AT 14:30:26 ON 2010/10/21, SYSTEM SC70, TASK
   159             ARC0622I (CONT.) ID=GRVOL01
14.30.26 STC22760  ARC0622I FULL VOLUME RESTORE STARTING ON VOLUME MHL0A0  160
   160             ARC0622I (CONT.) AT 14:30:26 ON 2010/10/21, SYSTEM SC70, TASK
   160             ARC0622I (CONT.) ID=GRVOL01
14.30.26 STC22760  ARC0622I FULL VOLUME RESTORE STARTING ON VOLUME MHL1A0  161
   161             ARC0622I (CONT.) AT 14:30:26 ON 2010/10/21, SYSTEM SC70, TASK
   161             ARC0622I (CONT.) ID=GRVOL02
14.30.26 STC22760  ARC0622I FULL VOLUME RESTORE STARTING ON VOLUME MHL1A0  162
   162             ARC0622I (CONT.) AT 14:30:26 ON 2010/10/21, SYSTEM SC70, TASK
   162             ARC0622I (CONT.) ID=GRVOL02
14.30.26 STC22760  ARC0622I FULL VOLUME RESTORE STARTING ON VOLUME MHL1A1  165
   165             ARC0622I (CONT.) AT 14:30:26 ON 2010/10/21, SYSTEM SC70, TASK
   165             ARC0622I (CONT.) ID=GRVOL03
14.30.26 STC22760  ARC0622I FULL VOLUME RESTORE STARTING ON VOLUME MHL1A1  166
   166             ARC0622I (CONT.) AT 14:30:26 ON 2010/10/21, SYSTEM SC70, TASK
   166             ARC0622I (CONT.) ID=GRVOL03
14.30.26 STC22760 *IEC501A M 0415,VT0018,SL,,DFHSM70,JV,HSM.DMP.DCFR112.VMHL0A0.D10293.T361621
14.30.26 STC22760 *IEC501A M 0401,VT0019,SL,,DFHSM70,JV,HSM.DMP.DCFR112.VMHL1A0.D10293.T361621
14.30.26 STC22760 *IEC501A M 043B,VT0020,SL,,DFHSM70,JV,HSM.DMP.DCFR112.VMHL1A1.D10293.T361621
14.30.27 STC22760  IEC604I VTOC CONVERT ROUTINE ENTERED ON D103,MHL0A0,DOS,DEVMAN
14.30.28 STC22760  IEC604I VTOC CONVERT ROUTINE ENTERED ON 8105,MHL1A0,DOS,DEVMAN
14.30.28 STC22760  IEC604I VTOC CONVERT ROUTINE ENTERED ON 8106,MHL1A1,DOS,DEVMAN
14.30.28 STC22760  ICK502I   BUILDIX FUNCTION STARTED
14.30.28 STC22760  ICK502I   BUILDIX FUNCTION STARTED
14.30.28 STC22760  ICK502I   BUILDIX FUNCTION STARTED
14.30.35 STC22760  ICK503I   D103 REQUEST RECEIVED TO CONVERT VTOC TO IXFORMAT
14.30.35 STC22760  ICK504I   D103 VTOC FORMAT IS CURRENTLY OSFORMAT, REQUEST ACCEPTED
14.30.35 STC22760  ICK503I   8105 REQUEST RECEIVED TO CONVERT VTOC TO IXFORMAT
14.30.35 STC22760  ICK504I   8105 VTOC FORMAT IS CURRENTLY OSFORMAT, REQUEST ACCEPTED
14.30.35 STC22760  ICK503I   8106 REQUEST RECEIVED TO CONVERT VTOC TO IXFORMAT
14.30.35 STC22760  ICK504I   8106 VTOC FORMAT IS CURRENTLY OSFORMAT, REQUEST ACCEPTED
14.30.35 STC22760  ICK513I   D103  BUILDIX PROCESSING COMPLETED:  VTOC IS NOW IN IXFORMAT
14.30.35 STC22760  IEF234E K 0415,VT0018,PVT,DFHSM70,JV
14.30.35 STC22760  ARC0623I FULL VOLUME RESTORE OF VOLUME MHL0A0 ENDING  199
   199             ARC0623I (CONT.) AT 14:30:35, DCLASS=DCFR112, DGEN=000,
   199             ARC0623I (CONT.) DATE=2010/10/20, PROCESSING SUCCESSFUL
14.30.35 STC22760  ARC0623I FULL VOLUME RESTORE OF VOLUME MHL0A0 ENDING  200
   200             ARC0623I (CONT.) AT 14:30:35, DCLASS=DCFR112, DGEN=000,
   200             ARC0623I (CONT.) DATE=2010/10/20, PROCESSING SUCCESSFUL
14.30.35 STC22760  ICK513I   8105  BUILDIX PROCESSING COMPLETED:  VTOC IS NOW IN IXFORMAT
14.30.35 STC22760  ICK513I   8106  BUILDIX PROCESSING COMPLETED:  VTOC IS NOW IN IXFORMAT
14.30.36 STC22760  IEF234E K 0401,VT0019,PVT,DFHSM70,JV
14.30.36 STC22760  IEF234E K 043B,VT0020,PVT,DFHSM70,JV
```

Figure 5-53 DFSMShsm JESMSGLG messages on executing FRRECOV CP(CPNSPANBOX07) FROMDUMP (1 of 2)

```
14.30.36 STC22760  ARC0623I FULL VOLUME RESTORE OF VOLUME MHL1A0 ENDING  209
   209             ARC0623I (CONT.) AT 14:30:36, DCLASS=DCFR112, DGEN=000,
   209             ARC0623I (CONT.) DATE=2010/10/20, PROCESSING SUCCESSFUL
14.30.36 STC22760  ARC0623I FULL VOLUME RESTORE OF VOLUME MHL1A0 ENDING  210
   210             ARC0623I (CONT.) AT 14:30:36, DCLASS=DCFR112, DGEN=000,
   210             ARC0623I (CONT.) DATE=2010/10/20, PROCESSING SUCCESSFUL
14.30.36 STC22760  ARC0623I FULL VOLUME RESTORE OF VOLUME MHL1A1 ENDING  211
   211             ARC0623I (CONT.) AT 14:30:36, DCLASS=DCFR112, DGEN=000,
   211             ARC0623I (CONT.) DATE=2010/10/20, PROCESSING SUCCESSFUL
14.30.36 STC22760  ARC0623I FULL VOLUME RESTORE OF VOLUME MHL1A1 ENDING  212
   212             ARC0623I (CONT.) AT 14:30:36, DCLASS=DCFR112, DGEN=000,
   212             ARC0623I (CONT.) DATE=2010/10/20, PROCESSING SUCCESSFUL
14.30.36 STC22760  ARC1805I THE FOLLOWING 00003 VOLUME(S) WERE  213
   213             ARC1805I (CONT.) SUCCESSFULLY PROCESSED BY FAST REPLICATION RECOVERY
   213             ARC1805I (CONT.) OF COPY POOL CPNSPANBOX07
14.30.36 STC22760  ARC1805I (CONT.) MHL0A0
14.30.36 STC22760  ARC1805I (CONT.) MHL1A0
14.30.36 STC22760  ARC1805I (CONT.) MHL1A1
14.30.36 STC22760  ARC1802I FAST REPLICATION RECOVERY FROM DUMP HAS  217
   217             ARC1802I (CONT.) COMPLETED FOR COPY POOL CPNSPANBOX07, AT 14:30:36 ON
   217             ARC1802I (CONT.) 2010/10/21, FUNCTION RC=0000, MAXIMUM VOLUME RC=0000
```

Figure 5-54 DFSMShsm JESMSGLG messages on executing FRRECOV CP(CPNSPANBOX07) FROMDUMP (2 of 2)

The messages in the DFSMShsm dump log on the execution of the FRRECOV CP(CPNSPANBOX07) FROMDUMP command are shown in Figure 5-55, Figure 5-56 on page 115, and Figure 5-57 on page 116.

```
 DFSMSHSM DUMP LOG, TIME 13:59:57,  DATE 10/10/21
ARC0622I FULL VOLUME RESTORE STARTING ON VOLUME MHL0A0 AT 14:30:26 ON 2010/10/21, SYSTEM SC70, TASK ID=GRVOL01
ARC0622I FULL VOLUME RESTORE STARTING ON VOLUME MHL1A0 AT 14:30:26 ON 2010/10/21, SYSTEM SC70, TASK ID=GRVOL02
ARC0622I FULL VOLUME RESTORE STARTING ON VOLUME MHL1A1 AT 14:30:26 ON 2010/10/21, SYSTEM SC70, TASK ID=GRVOL03
ARC0640I GRVOL01 - PAGE 0001     5695-DF175  DFSMSDSS V1R12.0 DATA SET SERVICES     2010.294 14:30
ARC0640I GRVOL01 - ADR035I (SCH)-PRIME(06), INSTALLATION EXIT ALTERED BYPASS FAC CLASS CHK DEFAULT TO YES
ARC0640I GRVOL01 -  RESTORE FULL INDDNAME(SYS00387) OUTDDNAME(SYS00386) -
ARC0640I GRVOL01 -  PURGE COPYVOLID CANCELERROR
ARC0640I GRVOL01 - ADR101I (R/I)-RI01 (01), TASKID 001 HAS BEEN ASSIGNED TO COMMAND 'RESTORE '
ARC0640I GRVOL01 - ADR109I (R/I)-RI01 (01), 2010.294 14:30:26 INITIAL SCAN OF USER CONTROL STATEMENTS COMPLETED
ARC0640I GRVOL01 - ADR050I (001)-PRIME(01), DFSMSDSS INVOKED VIA APPLICATION INTERFACE
ARC0640I GRVOL01 - ADR016I (001)-PRIME(01), RACF LOGGING OPTION IN EFFECT FOR THIS TASK
ARC0640I GRVOL01 - ADR006I (001)-STEND(01), 2010.294 14:30:26 EXECUTION BEGINS
ARC0640I GRVOL02 - PAGE 0001     5695-DF175  DFSMSDSS V1R12.0 DATA SET SERVICES     2010.294 14:30
ARC0640I GRVOL02 - ADR035I (SCH)-PRIME(06), INSTALLATION EXIT ALTERED BYPASS FAC CLASS CHK DEFAULT TO YES
ARC0640I GRVOL03 - PAGE 0001     5695-DF175  DFSMSDSS V1R12.0 DATA SET SERVICES     2010.294 14:30
ARC0640I GRVOL03 - ADR035I (SCH)-PRIME(06), INSTALLATION EXIT ALTERED BYPASS FAC CLASS CHK DEFAULT TO YES
ARC0640I GRVOL02 -  RESTORE FULL INDDNAME(SYS00390) OUTDDNAME(SYS00388) -
ARC0640I GRVOL02 -  PURGE COPYVOLID CANCELERROR
ARC0640I GRVOL02 - ADR101I (R/I)-RI01 (01), TASKID 001 HAS BEEN ASSIGNED TO COMMAND 'RESTORE '
ARC0640I GRVOL02 - ADR109I (R/I)-RI01 (01), 2010.294 14:30:26 INITIAL SCAN OF USER CONTROL STATEMENTS COMPLETED
ARC0640I GRVOL03 -  RESTORE FULL INDDNAME(SYS00391) OUTDDNAME(SYS00389) -
ARC0640I GRVOL03 -  PURGE COPYVOLID CANCELERROR
ARC0640I GRVOL03 - ADR101I (R/I)-RI01 (01), TASKID 001 HAS BEEN ASSIGNED TO COMMAND 'RESTORE '
ARC0640I GRVOL03 - ADR109I (R/I)-RI01 (01), 2010.294 14:30:26 INITIAL SCAN OF USER CONTROL STATEMENTS COMPLETED
```

Figure 5-55 DFSMShsm dump log messages on executing FRRECOV CP(CPNSPANBOX07) FROMDUMP (Part 1 of 3)

```
ARC0640I GRVOLO2 - ADR050I (001)-PRIME(01), DFSMSDSS INVOKED VIA APPLICATION INTERFACE
ARC0640I GRVOLO2 - ADR016I (001)-PRIME(01), RACF LOGGING OPTION IN EFFECT FOR THIS TASK
ARC0640I GRVOLO3 - ADR050I (001)-PRIME(01), DFSMSDSS INVOKED VIA APPLICATION INTERFACE
ARC0640I GRVOLO3 - ADR016I (001)-PRIME(01), RACF LOGGING OPTION IN EFFECT FOR THIS TASK
ARC0640I GRVOLO2 - ADR006I (001)-STEND(01), 2010.294 14:30:26 EXECUTION BEGINS
ARC0640I GRVOLO3 - ADR006I (001)-STEND(01), 2010.294 14:30:26 EXECUTION BEGINS
ARC0640I GRVOLO1 - ADR780I (001)-TDFP (01),
 THE INPUT DUMP DATA SET BEING PROCESSED IS IN FULL VOLUME FORMAT AND WAS CREATED BY DFSMSDSS VERSION 1
ARC0640I GRVOLO1 -                          RELEASE 12 MODIFICATION LEVEL 0 ON 2010.293 21:18:29
ARC0640I GRVOLO1 - ADR808I (001)-TDFP (01),
 THE INPUT DUMP DATA SET BEING PROCESSED WAS CREATED FROM A CONDITIONED VOLUME
ARC0640I GRVOLO2 - ADR780I (001)-TDFP (01),
 THE INPUT DUMP DATA SET BEING PROCESSED IS IN FULL VOLUME FORMAT AND WAS CREATED BY DFSMSDSS VERSION 1
ARC0640I GRVOLO2 -                          RELEASE 12 MODIFICATION LEVEL 0 ON 2010.293 21:18:29
ARC0640I GRVOLO2 - ADR808I (001)-TDFP (01),
 THE INPUT DUMP DATA SET BEING PROCESSED WAS CREATED FROM A CONDITIONED VOLUME
ARC0640I GRVOLO3 - ADR780I (001)-TDFP (01),
 THE INPUT DUMP DATA SET BEING PROCESSED IS IN FULL VOLUME FORMAT AND WAS CREATED BY DFSMSDSS VERSION 1
ARC0640I GRVOLO3 -                          RELEASE 12 MODIFICATION LEVEL 0 ON 2010.293 21:18:29
ARC0640I GRVOLO3 - ADR808I (001)-TDFP (01),
 THE INPUT DUMP DATA SET BEING PROCESSED WAS CREATED FROM A CONDITIONED VOLUME
ARC0640I GRVOLO1 - ADR460I (001)-UTMSG(01), UTILITY GENERATED MESSAGES FOLLOW FOR VOLUME MHLOA0
ARC0640I GRVOLO1 -  ICKDSF - MVS/ESA    DEVICE SUPPORT FACILITIES 17.0               TIME: 14:30:28        10/21/10
  PAGE   1
ARC0640I GRVOLO1 -
ARC0640I GRVOLO1 -       BUILDIX DDNAME(SYS00386) IXVTOC
ARC0640I GRVOLO1 -  ICK01502I BUILDIX FUNCTION STARTED
ARC0640I GRVOLO1 -  ICK00700I DEVICE INFORMATION FOR D103 IS CURRENTLY AS FOLLOWS:
ARC0640I GRVOLO1 -            PHYSICAL DEVICE = 3390
ARC0640I GRVOLO1 -            STORAGE CONTROLLER = 2107
ARC0640I GRVOLO1 -            STORAGE CONTROL DESCRIPTOR = E8
ARC0640I GRVOLO1 -            DEVICE DESCRIPTOR = 0C
ARC0640I GRVOLO1 -            ADDITIONAL DEVICE INFORMATION = 4A00003C
ARC0640I GRVOLO1 -            TRKS/CYL = 15, # PRIMARY CYLS = 10017
ARC0640I GRVOLO1 -  ICK04000I DEVICE IS IN SIMPLEX STATE
ARC0640I GRVOLO1 -  ICK03091I EXISTING VOLUME SERIAL READ = MHLOA0
ARC0640I GRVOLO1 -  ICK01503I D103 REQUEST RECEIVED TO CONVERT VTOC TO IXFORMAT
ARC0640I GRVOLO1 -  ICK01504I D103 VTOC FORMAT IS CURRENTLY OSFORMAT, REQUEST ACCEPTED
ARC0640I GRVOLO1 -  ICK01513I D103  BUILDIX PROCESSING COMPLETED:  VTOC IS NOW IN IXFORMAT
ARC0640I GRVOLO1 -  ICK01317I VTOC-INDEX IS LOCATED AT CCHH=X'0001 0000' AND IS    30 TRACKS.
ARC0640I GRVOLO1 -            14:30:35    10/21/10
ARC0640I GRVOLO1 -
ARC0640I GRVOLO1 -  ICK00002I ICKDSF PROCESSING COMPLETE. MAXIMUM CONDITION CODE WAS 0
ARC0640I GRVOLO1 - PAGE 0002     5695-DF175  DFSMSDSS V1R12.0 DATA SET SERVICES     2010.294 14:30
ARC0640I GRVOLO1 - ADR006I (001)-STEND(02), 2010.294 14:30:35 EXECUTION ENDS
ARC0640I GRVOLO1 - ADR013I (001)-CLTSK(01), 2010.294 14:30:35 TASK COMPLETED WITH RETURN CODE 0000
ARC0640I GRVOLO1 - ADR012I (SCH)-DSSU (01), 2010.294 14:30:35 DFSMSDSS PROCESSING COMPLETE. HIGHEST RETURN CODE IS
0000
ARC0400I VOLUME MHLOA0 IS 99% FREE, 0000000029 FREE TRACK(S), 000009995 FREE CYLINDER(S), FRAG .000
ARC0401I LARGEST EXTENTS FOR MHLOA0 ARE CYLINDERS      9995, TRACKS     149939
ARC0402I VTOC FOR MHLOA0 IS 00090 TRACKS(0004500 DSCBS), 0004491 FREE DSCBS(99% OF TOTAL)
ARC0623I FULL VOLUME RESTORE OF VOLUME MHLOA0 ENDING AT 14:30:35, DCLASS=DCFR112, DGEN=000, DATE=2010/10/20,
 PROCESSING SUCCESSFUL
ARC0640I GRVOLO2 - ADR460I (001)-UTMSG(01), UTILITY GENERATED MESSAGES FOLLOW FOR VOLUME MHL1A0 ARC0640I GRVOLO2 -
ICKDSF - MVS/ESA    DEVICE SUPPORT FACILITIES 17.0               TIME: 14:30:28        10/21/10
  PAGE   1
ARC0640I GRVOLO2 -
ARC0640I GRVOLO2 -       BUILDIX DDNAME(SYS00388) IXVTOC
ARC0640I GRVOLO2 -  ICK01502I BUILDIX FUNCTION STARTED
```

Figure 5-56 DFSMShsm dump log messages from FRRECOV CP(CPNSPANBOX07) FROMDUMP (Part 2 of 3)

```
ARC0640I GRVOLO2 -  ICKOO700I DEVICE INFORMATION FOR 8105 IS CURRENTLY AS FOLLOWS:
ARC0640I GRVOLO2 -            PHYSICAL DEVICE = 3390
ARC0640I GRVOLO2 -            STORAGE CONTROLLER = 2105
ARC0640I GRVOLO2 -            STORAGE CONTROL DESCRIPTOR = E8
ARC0640I GRVOLO2 -            DEVICE DESCRIPTOR = 0A
ARC0640I GRVOLO2 -            ADDITIONAL DEVICE INFORMATION = 4A000035
ARC0640I GRVOLO2 -            TRKS/CYL = 15, # PRIMARY CYLS = 3339
ARC0640I GRVOLO2 -  ICK04000I DEVICE IS IN SIMPLEX STATE
ARC0640I GRVOLO2 -  ICK03091I EXISTING VOLUME SERIAL READ = MHL1A0
ARC0640I GRVOLO2 -  ICK01503I 8105 REQUEST RECEIVED TO CONVERT VTOC TO IXFORMAT
ARC0640I GRVOLO2 -  ICK01504I 8105 VTOC FORMAT IS CURRENTLY OSFORMAT, REQUEST ACCEPTED
ARC0640I GRVOLO2 -  ICK01513I 8105  BUILDIX PROCESSING COMPLETED:  VTOC IS NOW IN IXFORMAT
ARC0640I GRVOLO2 -  ICK01317I VTOC-INDEX IS LOCATED AT CCHH=X'0001 0000' AND IS    30 TRACKS.
ARC0640I GRVOLO2 -            14:30:35    10/21/10
ARC0640I GRVOLO2 -
ARC0640I GRVOLO2 -  ICK00002I ICKDSF PROCESSING COMPLETE. MAXIMUM CONDITION CODE WAS 0
ARC0640I GRVOLO3 - ADR460I (001)-UTMSG(01), UTILITY GENERATED MESSAGES FOLLOW FOR VOLUME MHL1A1
ARC0640I GRVOLO3 -  ICKDSF - MVS/ESA    DEVICE SUPPORT FACILITIES 17.0                TIME: 14:30:28        10/21/10
  PAGE   1
ARC0640I GRVOLO3 -
ARC0640I GRVOLO3 -       BUILDIX DDNAME(SYS00389) IXVTOC
ARC0640I GRVOLO3 -  ICK01502I BUILDIX FUNCTION STARTED
ARC0640I GRVOLO3 -  ICKOO700I DEVICE INFORMATION FOR 8106 IS CURRENTLY AS FOLLOWS:
ARC0640I GRVOLO3 -            PHYSICAL DEVICE = 3390
ARC0640I GRVOLO3 -            STORAGE CONTROLLER = 2105
ARC0640I GRVOLO3 -            STORAGE CONTROL DESCRIPTOR = E8
ARC0640I GRVOLO3 -            DEVICE DESCRIPTOR = 0A
ARC0640I GRVOLO3 -            ADDITIONAL DEVICE INFORMATION = 4A000035
ARC0640I GRVOLO3 -            TRKS/CYL = 15, # PRIMARY CYLS = 3339
ARC0640I GRVOLO3 -  ICK04000I DEVICE IS IN SIMPLEX STATE
ARC0640I GRVOLO3 -  ICK03091I EXISTING VOLUME SERIAL READ = MHL1A1
ARC0640I GRVOLO3 -  ICK01503I 8106 REQUEST RECEIVED TO CONVERT VTOC TO IXFORMAT
ARC0640I GRVOLO3 -  ICK01504I 8106 VTOC FORMAT IS CURRENTLY OSFORMAT, REQUEST ACCEPTED
ARC0640I GRVOLO3 -  ICK01513I 8106  BUILDIX PROCESSING COMPLETED:  VTOC IS NOW IN IXFORMAT
ARC0640I GRVOLO3 -  ICK01317I VTOC-INDEX IS LOCATED AT CCHH=X'0001 0000' AND IS    30 TRACKS.
ARC0640I GRVOLO3 -            14:30:36    10/21/10
ARC0640I GRVOLO3 -
ARC0640I GRVOLO3 -  ICK00002I ICKDSF PROCESSING COMPLETE. MAXIMUM CONDITION CODE WAS 0
ARC0640I GRVOLO2 - PAGE 0002     5695-DF175  DFSMSDSS V1R12.0 DATA SET SERVICES     2010.294 14:30
ARC0640I GRVOLO2 - ADR006I (001)-STEND(02), 2010.294 14:30:36 EXECUTION ENDS
ARC0640I GRVOLO2 - ADR013I (001)-CLTSK(01), 2010.294 14:30:36 TASK COMPLETED WITH RETURN CODE 0000
ARC0640I GRVOLO2 - ADR012I (SCH)-DSSU (01), 2010.294 14:30:36 DFSMSDSS PROCESSING COMPLETE. HIGHEST RETURN CODE IS
0000
ARC0640I GRVOLO3 - PAGE 0002     5695-DF175  DFSMSDSS V1R12.0 DATA SET SERVICES     2010.294 14:30
ARC0640I GRVOLO3 - ADR006I (001)-STEND(02), 2010.294 14:30:36 EXECUTION ENDS
ARC0640I GRVOLO3 - ADR013I (001)-CLTSK(01), 2010.294 14:30:36 TASK COMPLETED WITH RETURN CODE 0000
ARC0640I GRVOLO3 - ADR012I (SCH)-DSSU (01), 2010.294 14:30:36 DFSMSDSS PROCESSING COMPLETE. HIGHEST RETURN CODE IS
0000
ARC0400I VOLUME MHL1A0 IS 99% FREE, 0000000017 FREE TRACK(S), 000003328 FREE CYLINDER(S), FRAG .000
ARC0401I LARGEST EXTENTS FOR MHL1A0 ARE CYLINDERS      3328, TRACKS      49920
ARC0402I VTOC FOR MHL1A0 IS 00090 TRACKS(0004500 DSCBS), 0004493 FREE DSCBS(99% OF TOTAL)
ARC0623I FULL VOLUME RESTORE OF VOLUME MHL1A0 ENDING AT 14:30:36, DCLASS=DCFR112, DGEN=000, DATE=2010/10/20,
PROCESSING SUCCESSFUL
ARC0400I VOLUME MHL1A1 IS 99% FREE, 0000000009 FREE TRACK(S), 000003327 FREE CYLINDER(S), FRAG .000
ARC0401I LARGEST EXTENTS FOR MHL1A1 ARE CYLINDERS      3327, TRACKS      49905
ARC0402I VTOC FOR MHL1A1 IS 00090 TRACKS(0004500 DSCBS), 0004493 FREE DSCBS(99% OF TOTAL)
ARC0623I FULL VOLUME RESTORE OF VOLUME MHL1A1 ENDING AT 14:30:36, DCLASS=DCFR112, DGEN=000, DATE=2010/10/20,
PROCESSING SUCCESSFUL
 DFSMSHSM DUMP LOG, TIME 14:30:36,  DATE 10/10/21
```

Figure 5-57 DFSMShsm dump log messages from FRRECOV CP(CPNSPANBOX07) FROMDUMP (Part 3 of 3)

After the restore of the volumes, the VTOC indexes were rebuilt by internal calls of ICKDSF.

Recovery at the volume level

Recovery at the volume level from fast replication backups is supported from DASD versions and dump copies (Figure 5-58).

When you use recovery at the volume level, always remember that the catalog entries of data sets on this particular volume might be out of sync after recovery. If the volume that you are recovering contains an integrated catalog facility (ICF) catalog, this catalog probably applies to data sets on other volumes that are contained in the copy pool or in the worst case, to data sets that are somewhere else. This situation can occur if you do not strictly follow the guidelines to keep only data sets, which are also contained in the volume pool, in catalogs on volumes of the copy pool.

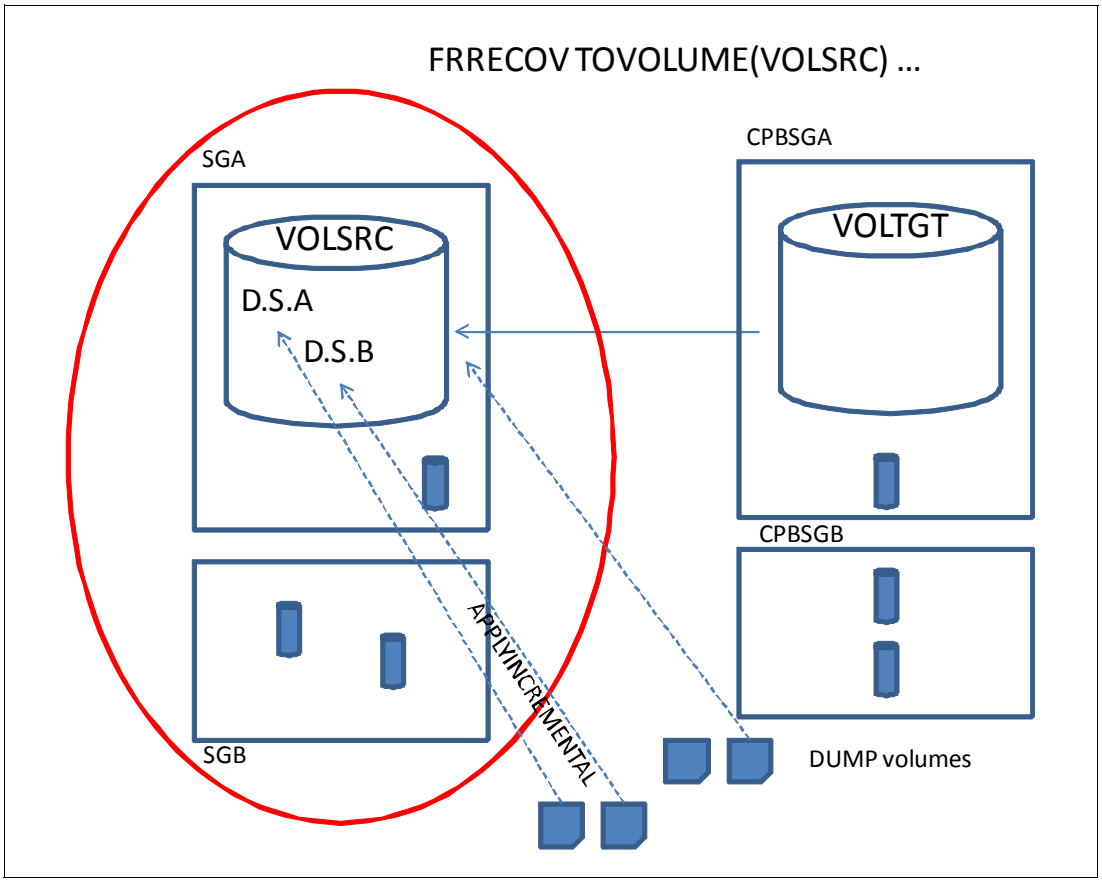

Figure 5-58 Fast replication recovery at the volume level

Recovery from a fast replication DASD backup version

We chose copy pool CP1 to demonstrate the recovery of a single volume from a fast replication DASD backup version. The command is shown in Example 5-37.

Example 5-37 FRRECOV TOVOLUME(MHL0A0) FROMCP(CP1) command

```
HSEND FRRECOV TOVOLUME(MHL0A0) FROMCP(CP1)
```

We were required to specify the FROMCP(CP1) parameter because volume MHL0A0 is covered by more than one copy pool. The FROMDASD parameter is the default.

The messages in DFSMShsm JESMSGLG (Figure 5-59) show that our initial request failed.

```
18.42.51 STC22372  ARC1801I FAST REPLICATION RECOVERY IS STARTING FOR  626
   626             ARC1801I (CONT.) VOLUME MHL0A0, AT 18:42:51 ON 2010/10/20
18.42.51 STC22372  F CATALOG,UNALLOCATE(UCAT.TESTFR                        )
18.42.51 STC22372  ARC1802I FAST REPLICATION RECOVERY HAS COMPLETED FOR  632
   632             ARC1802I (CONT.) VOLUME MHL0A0, AT 18:42:51 ON 2010/10/20, FUNCTION
   632             ARC1802I (CONT.) RC=0008, MAXIMUM VOLUME RC=0008
```

Figure 5-59 Excerpt from DFSMShsm JESMSGLG on executing FRRECOV TOVOLUME(MHL0A0) FROMCP(CP1)

The DFSMShsm backup log (Figure 5-60) shows more details.

```
ARC1801I FAST REPLICATION RECOVERY IS STARTING FOR VOLUME MHL0A0, AT 18:42:51 ON 2010/10/20
ARC0640I ARCFRTM - PAGE 0001     5695-DF175  DFSMSDSS V1R12.0 DATA SET SERVICES     2010.293 18:42
ARC0640I ARCFRTM - ADR035I (SCH)-PRIME(06), INSTALLATION EXIT ALTERED BYPASS FAC CLASS CHK DEFAULT TO YES
ARC0640I ARCFRTM -  COPY IDY(YYD006) ODY(MHL0A0) DUMPCOND FR(REQ) PUR ALLX ALLD(*)      -
ARC0640I ARCFRTM -  DEBUG(FRMSG(DTL))
ARC0640I ARCFRTM - ADR101I (R/I)-RI01 (01), TASKID 001 HAS BEEN ASSIGNED TO COMMAND 'COPY '
ARC0640I ARCFRTM - ADR109I (R/I)-RI01 (01), 2010.293 18:42:51 INITIAL SCAN OF USER CONTROL STATEMENTS COMPLETED
ARC0640I ARCFRTM - ADR050I (001)-PRIME(02), DFSMSDSS INVOKED VIA CROSS MEMORY APPLICATION INTERFACE
ARC0640I ARCFRTM - ADR016I (001)-PRIME(01), RACF LOGGING OPTION IN EFFECT FOR THIS TASK
ARC0640I ARCFRTM - ADR006I (001)-STEND(01), 2010.293 18:42:51 EXECUTION BEGINS
ARC0640I ARCFRTM - ADR918I (001)-DDTFP(03), FAST REPLICATION COULD NOT BE USED FOR VOLUME YYD006, RETURN CODE 9
ARC0640I ARCFRTM -     a            VOLUME MHL0A0 WAS REJECTED FOR QFRVOLS VOLUME REASON CODE C - FULL VOL FC
SOURCE RELATION
ARC0640I ARCFRTM - ADR938E (001)-DDTFP(03),
 FASTREPLICATION(REQUIRED) WAS SPECIFIED BUT FAST REPLICATION COULD NOT BE USED FOR VOLUME YYD006
ARC0640I ARCFRTM - ADR006I (001)-STEND(02), 2010.293 18:42:51 EXECUTION ENDS
ARC0640I ARCFRTM - ADR013I (001)-CLTSK(01), 2010.293 18:42:51 TASK COMPLETED WITH RETURN CODE 0008
ARC0640I ARCFRTM - ADR012I (SCH)-DSSU (01),
 2010.293 18:42:51 DFSMSDSS PROCESSING COMPLETE. HIGHEST RETURN CODE IS 0008 FROM:
ARC0640I ARCFRTM -                          TASK    001
ARC0400I VOLUME MHL0A0 IS 99% FREE, 0000000029 FREE TRACK(S), 000009995 FREE CYLINDER(S), FRAG .000
ARC0401I LARGEST EXTENTS FOR MHL0A0 ARE CYLINDERS      9995, TRACKS     149939
ARC0402I VTOC FOR MHL0A0 IS 00090 TRACKS(0004500 DSCBS), 0004491 FREE DSCBS(99% OF TOTAL)
ARC1802I FAST REPLICATION RECOVERY HAS COMPLETED FOR VOLUME MHL0A0, AT 18:42:51 ON 2010/10/20, FUNCTION RC=0008,
 MAXIMUM VOLUME RC=0008
```

Figure 5-60 Excerpt from the DFSMShsm backup log on executing FRRECOV TOVOLUME(MHL0A0) FROMCP(CP1)

Message ADR918I (a) describes the reason for the failure; another FlashCopy relationship with source volume MHL0A0 exists. You can use a LIST PVOL(MHL0A0) BCDS command to determine other copy pools that might have other relationships. We do not describe this command in detail here because we explained this procedure in Example 5-28 on page 103.

Copy pool CP2 holds an incremental FlashCopy relationship on MHL0A0 in this case. We can withdraw this relationship by using the FRBACKUP CP(CP2) WITHDRAW command, but we decided to execute a FRBACKUP CP(CP2) FCINCREMENTALLAST command (Example 5-38) to create a fast replication DASD backup version of the current contents of copy pool CP2 before an internal withdrawal of the FlashCopy relationship will occur.

Example 5-38 FRBACKUP CP(CP2) FCINCREMENTALLAST command

```
HSEND FRBACKUP CP(CP2) FCINCRLAST
```

The messages in the DFSMShsm backup log on the execution of this command are shown in Figure 5-61 on page 119.

```
ARC1801I FAST REPLICATION BACKUP IS STARTING FOR COPY POOL CP2, AT 18:46:56 ON 2010/10/20
ARC0640I ARCFRTM - PAGE 0001     5695-DF175  DFSMSDSS V1R12.0 DATA SET SERVICES     2010.293 18:46
ARC0640I ARCFRTM - ADR035I (SCH)-PRIME(06), INSTALLATION EXIT ALTERED BYPASS FAC CLASS CHK DEFAULT TO YES
ARC0640I ARCFRTM -  COPY IDY(MHL0A0) ODY(MLD361) DUMPCOND FR(REQ) PUR FCINCRLAST        -
ARC0640I ARCFRTM -  FCFVR -
ARC0640I ARCFRTM -  DEBUG(FRMSG(DTL))
ARC0640I ARCFRTM - ADR101I (R/I)-RI01 (01), TASKID 001 HAS BEEN ASSIGNED TO COMMAND 'COPY '
ARC0640I ARCFRTM - ADR109I (R/I)-RI01 (01), 2010.293 18:46:56 INITIAL SCAN OF USER CONTROL STATEMENTS COMPLETED
ARC0640I ARCFRTM - ADR050I (001)-PRIME(02), DFSMSDSS INVOKED VIA CROSS MEMORY APPLICATION INTERFACE
ARC0640I ARCFRTM - ADR016I (001)-PRIME(01), RACF LOGGING OPTION IN EFFECT FOR THIS TASK
ARC0640I ARCFRTM - ADR006I (001)-STEND(01), 2010.293 18:46:56 EXECUTION BEGINS
ARC0640I ARCFRTM - ADR241I (001)-DDTFP(01), TARGET VTOC BEGINNING AT 000000003:00 AND ENDING AT 000000008:14 IS OVERLAID
ARC0640I ARCFRTM - ADR806I (001)-TOMI (02), VOLUME MHL0A0 WAS COPIED USING A FAST REPLICATION FUNCTION
ARC0640I ARCFRTM - ADR006I (001)-STEND(02), 2010.293 18:46:56 EXECUTION ENDS
ARC0640I ARCFRTM - ADR013I (001)-CLTSK(01), 2010.293 18:46:56 TASK COMPLETED WITH RETURN CODE 0000
ARC0640I ARCFRTM - ADR012I (SCH)-DSSU (01), 2010.293 18:46:56 DFSMSDSS PROCESSING COMPLETE. HIGHEST RETURN CODE IS 0000
ARC1805I THE FOLLOWING 00001 VOLUME(S) WERE SUCCESSFULLY PROCESSED BY FAST REPLICATION BACKUP OF COPY POOL CP2
ARC1805I (CONT.) MHL0A0
ARC1802I FAST REPLICATION BACKUP HAS COMPLETED FOR COPY POOL CP2, AT 18:46:56 ON 2010/10/20, FUNCTION RC=0000,
 MAXIMUM VOLUME RC=0000, CAPTURE CATALOG RC=0000
```

Figure 5-61 Excerpt from the DFSMShsm backup log on executing the FRBACKUP CP(CP2) FCINCRLAST command

Now that the other FlashCopy relationship on the source volumes was withdrawn, we reissued the command as shown in Example 5-37 on page 117 and it worked. Figure 5-62 shows the messages that are written in the DFSMShsm backup log on the successful execution of the command.

```
ARC1801I FAST REPLICATION RECOVERY IS STARTING FOR VOLUME MHL0A0, AT 18:47:27 ON 2010/10/20
ARC0640I ARCFRTM - PAGE 0001     5695-DF175  DFSMSDSS V1R12.0 DATA SET SERVICES     2010.293 18:47
ARC0640I ARCFRTM - ADR035I (SCH)-PRIME(06), INSTALLATION EXIT ALTERED BYPASS FAC CLASS CHK DEFAULT TO YES
ARC0640I ARCFRTM -  COPY IDY(YYD006) ODY(MHL0A0) DUMPCOND FR(REQ) PUR ALLX ALLD(*)      -
ARC0640I ARCFRTM -  DEBUG(FRMSG(DTL))
ARC0640I ARCFRTM - ADR101I (R/I)-RI01 (01), TASKID 001 HAS BEEN ASSIGNED TO COMMAND 'COPY '
ARC0640I ARCFRTM - ADR109I (R/I)-RI01 (01), 2010.293 18:47:27 INITIAL SCAN OF USER CONTROL STATEMENTS COMPLETED
ARC0640I ARCFRTM - ADR050I (001)-PRIME(02), DFSMSDSS INVOKED VIA CROSS MEMORY APPLICATION INTERFACE
ARC0640I ARCFRTM - ADR016I (001)-PRIME(01), RACF LOGGING OPTION IN EFFECT FOR THIS TASK
ARC0640I ARCFRTM - ADR006I (001)-STEND(01), 2010.293 18:47:27 EXECUTION BEGINS
ARC0640I ARCFRTM - ADR241I (001)-DDTFP(01), TARGET VTOC BEGINNING AT 000000003:00 AND ENDING AT 000000008:14 IS OVERLAID
ARC0640I ARCFRTM - ADR806I (001)-TOMI (02), VOLUME YYD006 WAS COPIED USING A FAST REPLICATION FUNCTION
ARC0640I ARCFRTM - ADR006I (001)-STEND(02), 2010.293 18:47:27 EXECUTION ENDS
ARC0640I ARCFRTM - ADR013I (001)-CLTSK(01), 2010.293 18:47:27 TASK COMPLETED WITH RETURN CODE 0000
ARC0640I ARCFRTM - ADR012I (SCH)-DSSU (01), 2010.293 18:47:27 DFSMSDSS PROCESSING COMPLETE. HIGHEST RETURN CODE IS 0000
ARC0400I VOLUME MHL0A0 IS 99% FREE, 0000000029 FREE TRACK(S), 000009995 FREE CYLINDER(S), FRAG .000
ARC0401I LARGEST EXTENTS FOR MHL0A0 ARE CYLINDERS      9995, TRACKS     149939
ARC0402I VTOC FOR MHL0A0 IS 00090 TRACKS(0004500 DSCBS), 0004491 FREE DSCBS(99% OF TOTAL)
```

Figure 5-62 DFSMShsm backup log from the FRRECOV TOVOLUME(MHL0A0) FROMCP(CP1) command

Recovery from a fast replication dump copy

We used the command that is shown in Example 5-39 for the recovery of a single volume of a copy pool from a dump copy.

Example 5-39 FRRECOV TOVOLUME(MHL0A0) FROMDUMP command

```
HSEND FRRECOV VERSION(1) TOVOLUME(MHL0A0) FROMCP(CP2) FROMDUMP
```

Figure 5-63 shows the messages in DFSMShsm JESMSGLG after we issued the command.

```
18.53.31 STC22372  ARC1801I FAST REPLICATION RECOVERY FROM DUMP IS  661
   661             ARC1801I (CONT.) STARTING FOR VOLUME MHL0A0, AT 18:53:31 ON 2010/10/20
18.53.31 STC22372  F CATALOG,UNALLOCATE(UCAT.TESTFR                                  )
18.53.31 STC22372  ARC0622I FULL VOLUME RESTORE STARTING ON VOLUME MHL0A0  666
   666             ARC0622I (CONT.) AT 18:53:31 ON 2010/10/20, SYSTEM SC70, TASK
   666             ARC0622I (CONT.) ID=GRVOL01
18.53.31 STC22372  ARC0622I FULL VOLUME RESTORE STARTING ON VOLUME MHL0A0  667
   667             ARC0622I (CONT.) AT 18:53:31 ON 2010/10/20, SYSTEM SC70, TASK
   667             ARC0622I (CONT.) ID=GRVOL01
18.53.31 STC22372 *IEC501A M 040D,VT0002,SL,,DFHSM70,JV,HSM.DMP.DCFR112.VMHL0A0.D10293.T471018
18.53.32 STC22372  IEC604I VTOC CONVERT ROUTINE ENTERED ON D103,MHL0A0,DOS,DEVMAN
18.53.33 STC22372  ICK502I   BUILDIX FUNCTION STARTED
18.53.40 STC22372  ICK503I   D103 REQUEST RECEIVED TO CONVERT VTOC TO IXFORMAT
18.53.40 STC22372  ICK504I   D103 VTOC FORMAT IS CURRENTLY OSFORMAT, REQUEST ACCEPTED
18.53.40 STC22372  ICK513I   D103  BUILDIX PROCESSING COMPLETED:  VTOC IS NOW IN IXFORMAT
18.53.40 STC22372  IEF234E K 040D,VT0002,PVT,DFHSM70,JV
18.53.40 STC22372  ARC0623I FULL VOLUME RESTORE OF VOLUME MHL0A0 ENDING  682
   682             ARC0623I (CONT.) AT 18:53:40, DCLASS=DCFR112, DGEN=001,
   682             ARC0623I (CONT.) DATE=2010/10/20, PROCESSING SUCCESSFUL
18.53.40 STC22372  ARC0623I FULL VOLUME RESTORE OF VOLUME MHL0A0 ENDING  683
   683             ARC0623I (CONT.) AT 18:53:40, DCLASS=DCFR112, DGEN=001,
   683             ARC0623I (CONT.) DATE=2010/10/20, PROCESSING SUCCESSFUL
```

Figure 5-63 DFSMShsm JESMSGLG from the FRRECOV TOVOLUME(MHL0A0) FROMDUMP command

The message in the DFSMShsm backup log on the execution of the command is shown in Figure 5-64.

```
ARC1801I FAST REPLICATION RECOVERY FROM DUMP IS STARTING FOR VOLUME MHL0A0, AT 18:53:31 ON 2010/10/20
```

Figure 5-64 DFSMShsm backup log from the FRRECOV TOVOLUME(MHL0A0) FROMDUMP command

The messages that appear in the DFSMShsm dump log on the execution of the command are shown in Figure 5-65.

```
DFSMSHSM DUMP LOG, TIME 18:11:52,  DATE 10/10/20
ARC0622I FULL VOLUME RESTORE STARTING ON VOLUME MHL0A0 AT 18:53:31 ON 2010/10/20, SYSTEM SC70, TASK ID=GRVOL01
ARC0640I GRVOL01 - PAGE 0001     5695-DF175  DFSMSDSS V1R12.0 DATA SET SERVICES     2010.293 18:53
ARC0640I GRVOL01 - ADR035I (SCH)-PRIME(06), INSTALLATION EXIT ALTERED BYPASS FAC CLASS CHK DEFAULT TO YES
ARC0640I GRVOL01 -  RESTORE FULL INDDNAME(SYS00345) OUTDDNAME(SYS00344) -
ARC0640I GRVOL01 -  PURGE COPYVOLID CANCELERROR
ARC0640I GRVOL01 - ADR101I (R/I)-RI01 (01), TASKID 001 HAS BEEN ASSIGNED TO COMMAND 'RESTORE '
ARC0640I GRVOL01 - ADR109I (R/I)-RI01 (01), 2010.293 18:53:31 INITIAL SCAN OF USER CONTROL STATEMENTS COMPLETED
ARC0640I GRVOL01 - ADR050I (001)-PRIME(01), DFSMSDSS INVOKED VIA APPLICATION INTERFACE
ARC0640I GRVOL01 - ADR016I (001)-PRIME(01), RACF LOGGING OPTION IN EFFECT FOR THIS TASK
ARC0640I GRVOL01 - ADR006I (001)-STEND(01), 2010.293 18:53:31 EXECUTION BEGINS
ARC0640I GRVOL01 - ADR780I (001)-TDFP (01),
 THE INPUT DUMP DATA SET BEING PROCESSED IS IN FULL VOLUME FORMAT AND WAS CREATED BY DFSMSDSS VERSION 1
ARC0640I GRVOL01 -                          RELEASE 12 MODIFICATION LEVEL 0 ON 2010.293 18:11:51
ARC0640I GRVOL01 - ADR808I (001)-TDFP (01),
 THE INPUT DUMP DATA SET BEING PROCESSED WAS CREATED FROM A CONDITIONED VOLUME
ARC0640I GRVOL01 - ADR460I (001)-UTMSG(01), UTILITY GENERATED MESSAGES FOLLOW FOR VOLUME MHL0A0
ARC0640I GRVOL01 -  ICKDSF - MVS/ESA    DEVICE SUPPORT FACILITIES 17.0               TIME: 18:53:33        10/20/10
  PAGE   1
ARC0640I GRVOL01 -
ARC0640I GRVOL01 -       BUILDIX DDNAME(SYS00344) IXVTOC
ARC0640I GRVOL01 -  ICK01502I BUILDIX FUNCTION STARTED
ARC0640I GRVOL01 -  ICK00700I DEVICE INFORMATION FOR D103 IS CURRENTLY AS FOLLOWS:
ARC0640I GRVOL01 -            PHYSICAL DEVICE = 3390
ARC0640I GRVOL01 -            STORAGE CONTROLLER = 2107
ARC0640I GRVOL01 -            STORAGE CONTROL DESCRIPTOR = E8
ARC0640I GRVOL01 -            DEVICE DESCRIPTOR = 0C
ARC0640I GRVOL01 -            ADDITIONAL DEVICE INFORMATION = 4A00003C
ARC0640I GRVOL01 -            TRKS/CYL = 15, # PRIMARY CYLS = 10017
ARC0640I GRVOL01 -  ICK04000I DEVICE IS IN SIMPLEX STATE
ARC0640I GRVOL01 -  ICK03091I EXISTING VOLUME SERIAL READ = MHL0A0
ARC0640I GRVOL01 -  ICK01503I D103 REQUEST RECEIVED TO CONVERT VTOC TO IXFORMAT
ARC0640I GRVOL01 -  ICK01504I D103 VTOC FORMAT IS CURRENTLY OSFORMAT, REQUEST ACCEPTED
ARC0640I GRVOL01 -  ICK01513I D103  BUILDIX PROCESSING COMPLETED:  VTOC IS NOW IN IXFORMAT
ARC0640I GRVOL01 -  ICK01317I VTOC-INDEX IS LOCATED AT CCHH=X'0001 0000' AND IS    30 TRACKS.
ARC0640I GRVOL01 -            18:53:40    10/20/10
ARC0640I GRVOL01 -
ARC0640I GRVOL01 -  ICK00002I ICKDSF PROCESSING COMPLETE. MAXIMUM CONDITION CODE WAS 0
ARC0640I GRVOL01 - PAGE 0002     5695-DF175  DFSMSDSS V1R12.0 DATA SET SERVICES     2010.293 18:53
ARC0640I GRVOL01 - ADR006I (001)-STEND(02), 2010.293 18:53:40 EXECUTION ENDS
ARC0640I GRVOL01 - ADR013I (001)-CLTSK(01), 2010.293 18:53:40 TASK COMPLETED WITH RETURN CODE 0000
ARC0640I GRVOL01 - ADR012I (SCH)-DSSU (01), 2010.293 18:53:40 DFSMSDSS PROCESSING COMPLETE. HIGHEST RETURN CODE IS 0000
ARC0400I VOLUME MHL0A0 IS 99% FREE, 0000000029 FREE TRACK(S), 000009995 FREE CYLINDER(S), FRAG .000
ARC0401I LARGEST EXTENTS FOR MHL0A0 ARE CYLINDERS      9995, TRACKS     149939
ARC0402I VTOC FOR MHL0A0 IS 00090 TRACKS(0004500 DSCBS), 0004491 FREE DSCBS(99% OF TOTAL)
ARC0623I FULL VOLUME RESTORE OF VOLUME MHL0A0 ENDING AT 18:53:40, DCLASS=DCFR112, DGEN=001, DATE=2010/10/20,
 PROCESSING SUCCESSFUL
ARC1802I FAST REPLICATION RECOVERY FROM DUMP HAS COMPLETED FOR VOLUME MHL0A0, AT 18:53:40 ON 2010/10/20,
 FUNCTION RC=0000, MAXIMUM VOLUME RC=0000
 DFSMSHSM DUMP LOG, TIME 18:53:40,  DATE 10/10/20
```

Figure 5-65 DFSMShsm dump log from the FRRECOV TOVOLUME(MHL0A0) FROMDUMP command

Recovery from a fast replication dump copy with APPLYINCREMENTAL

You can request an APPLYINCREMENTAL process as part of the recovery of a single volume from a fast replication dump copy.

We used the command that is shown in Example 5-40 to test this feature.

Example 5-40 FRRECOV TOVOLUME(MHL1A1) FROMCP(CPNSPANBOX07) FROMDUMP(AINC)

```
HSEND FRRECOV TOVOLUME(MHL1A1) FROMCP(CPNSPANBOX07) FROMDUMP(AINC)
```

The messages in DFSMShsm JESMSGLG on the execution of the command are shown in Figure 5-66.

```
21.33.23 STC22372  ARC1801I FAST REPLICATION RECOVERY FROM DUMP IS  432
   432             ARC1801I (CONT.) STARTING FOR VOLUME MHL1A1, AT 21:33:23 ON 2010/10/20
21.33.23 STC22372  F CATALOG,UNALLOCATE(UCAT.ZFSFR                                  )
21.33.23 STC22372  F CATALOG,UNALLOCATE(UCAT.TESTFR                                 )
21.33.23 STC22372  ARC0622I FULL VOLUME RESTORE STARTING ON VOLUME MHL1A1  443
   443             ARC0622I (CONT.) AT 21:33:23 ON 2010/10/20, SYSTEM SC70, TASK
   443             ARC0622I (CONT.) ID=GRVOL01
21.33.23 STC22372  ARC0622I FULL VOLUME RESTORE STARTING ON VOLUME MHL1A1  444
   444             ARC0622I (CONT.) AT 21:33:23 ON 2010/10/20, SYSTEM SC70, TASK
   444             ARC0622I (CONT.) ID=GRVOL01
21.33.23 STC22372 *IEC501A M 042D,VT0020,SL,,DFHSM70,JV,HSM.DMP.DCFR112.VMHL1A1.D10293.T361621
21.33.25 STC22372  IEC604I VTOC CONVERT ROUTINE ENTERED ON 8106,MHL1A1,DOS,DEVMAN
21.33.25 STC22372  ICK502I   BUILDIX FUNCTION STARTED
21.33.32 STC22372  ICK503I   8106 REQUEST RECEIVED TO CONVERT VTOC TO IXFORMAT
21.33.32 STC22372  ICK504I   8106 VTOC FORMAT IS CURRENTLY OSFORMAT, REQUEST ACCEPTED
21.33.32 STC22372  ICK513I   8106  BUILDIX PROCESSING COMPLETED:  VTOC IS NOW IN IXFORMAT
21.33.33 STC22372  IEF234E K 042D,VT0020,PVT,DFHSM70,JV
21.33.33 STC22372  ARC0734I ACTION=RECOVER FRVOL=   *** TOVOL=MHL1A1  466
   466             ARC0734I (CONT.) TRACKS=       *** RC=  43, REASON=   18, AGE= ***,
   466             ARC0734I (CONT.) DSN=SYS1.VVDS.VMHL1A1
21.33.33 STC22372  ARC0760I TAPE VOLUME VT0104 WILL BE NEEDED FOR RECOVERY
21.33.33 STC22372  ARC0787I 2 DATA SET RECOVER REQUESTS SCHEDULED FOR  468
   468             ARC0787I (CONT.) VOLUME MHL1A1
21.33.33 STC22372  ARC0623I FULL VOLUME RESTORE OF VOLUME MHL1A1 ENDING  469
   469             ARC0623I (CONT.) AT 21:33:33, DCLASS=DCFR112, DGEN=000,
   469             ARC0623I (CONT.) DATE=2010/10/20, PROCESSING SUCCESSFUL
21.33.33 STC22372  ARC0623I FULL VOLUME RESTORE OF VOLUME MHL1A1 ENDING  470
   470             ARC0623I (CONT.) AT 21:33:33, DCLASS=DCFR112, DGEN=000,
   470             ARC0623I (CONT.) DATE=2010/10/20, PROCESSING SUCCESSFUL
21.33.33 STC22372 *IEC501A M 0407,VT0104,SL,,DFHSM70,JV,HSM.BACKTAPE.DATASET
21.33.39 STC22372  IEF234E K 0407,VT0104,PVT,DFHSM70,JV
```

Figure 5-66 DFSMShsm JESMSGLG for FRRECOV TOVOLUME(MHL1A1) FROMDUMP(APPLYINCREMENTAL)

The messages that appear in the DFSMShsm dump log on the execution of the command are shown in Figure 5-67.

```
DFSMSHSM DUMP LOG, TIME 21:18:30,  DATE 10/10/20
ARC0622I FULL VOLUME RESTORE STARTING ON VOLUME MHL1A1 AT 21:33:23 ON 2010/10/20, SYSTEM SC70, TASK ID=GRVOL01
ARC0640I GRVOL01 - PAGE 0001     5695-DF175  DFSMSDSS V1R12.0 DATA SET SERVICES     2010.293 21:33
ARC0640I GRVOL01 - ADR035I (SCH)-PRIME(06), INSTALLATION EXIT ALTERED BYPASS FAC CLASS CHK DEFAULT TO YES
ARC0640I GRVOL01 -  RESTORE FULL INDDNAME(SYS00464) OUTDDNAME(SYS00463) -
ARC0640I GRVOL01 -  PURGE COPYVOLID CANCELERROR
ARC0640I GRVOL01 - ADR101I (R/I)-RI01 (01), TASKID 001 HAS BEEN ASSIGNED TO COMMAND 'RESTORE '
ARC0640I GRVOL01 - ADR109I (R/I)-RI01 (01), 2010.293 21:33:23 INITIAL SCAN OF USER CONTROL STATEMENTS COMPLETED
ARC0640I GRVOL01 - ADR050I (001)-PRIME(01), DFSMSDSS INVOKED VIA APPLICATION INTERFACE
ARC0640I GRVOL01 - ADR016I (001)-PRIME(01), RACF LOGGING OPTION IN EFFECT FOR THIS TASK
ARC0640I GRVOL01 - ADR006I (001)-STEND(01), 2010.293 21:33:23 EXECUTION BEGINS
ARC0640I GRVOL01 - ADR780I (001)-TDFP (01),
 THE INPUT DUMP DATA SET BEING PROCESSED IS IN FULL VOLUME FORMAT AND WAS CREATED BY DFSMSDSS VERSION 1
ARC0640I GRVOL01 -                          RELEASE 12 MODIFICATION LEVEL 0 ON 2010.293 21:18:29
ARC0640I GRVOL01 - ADR808I (001)-TDFP (01),
 THE INPUT DUMP DATA SET BEING PROCESSED WAS CREATED FROM A CONDITIONED VOLUME
ARC0640I GRVOL01 - ADR460I (001)-UTMSG(01), UTILITY GENERATED MESSAGES FOLLOW FOR VOLUME MHL1A1
ARC0640I GRVOL01 -  ICKDSF - MVS/ESA    DEVICE SUPPORT FACILITIES 17.0               TIME: 21:33:25        10/20/10
  PAGE   1
ARC0640I GRVOL01 -
ARC0640I GRVOL01 -       BUILDIX DDNAME(SYS00463) IXVTOC
ARC0640I GRVOL01 -  ICK01502I BUILDIX FUNCTION STARTED
ARC0640I GRVOL01 -  ICK00700I DEVICE INFORMATION FOR 8106 IS CURRENTLY AS FOLLOWS:
ARC0640I GRVOL01 -            PHYSICAL DEVICE = 3390
ARC0640I GRVOL01 -            STORAGE CONTROLLER = 2105
ARC0640I GRVOL01 -            STORAGE CONTROL DESCRIPTOR = E8
ARC0640I GRVOL01 -            DEVICE DESCRIPTOR = 0A
ARC0640I GRVOL01 -            ADDITIONAL DEVICE INFORMATION = 4A000035
ARC0640I GRVOL01 -            TRKS/CYL = 15, # PRIMARY CYLS = 3339
ARC0640I GRVOL01 -  ICK04000I DEVICE IS IN SIMPLEX STATE
ARC0640I GRVOL01 -  ICK03091I EXISTING VOLUME SERIAL READ = MHL1A1
ARC0640I GRVOL01 -  ICK01503I 8106 REQUEST RECEIVED TO CONVERT VTOC TO IXFORMAT
ARC0640I GRVOL01 -  ICK01504I 8106 VTOC FORMAT IS CURRENTLY OSFORMAT, REQUEST ACCEPTED
ARC0640I GRVOL01 -  ICK01513I 8106  BUILDIX PROCESSING COMPLETED:  VTOC IS NOW IN IXFORMAT
ARC0640I GRVOL01 -  ICK01317I VTOC-INDEX IS LOCATED AT CCHH=X'0001 0000' AND IS    30 TRACKS.
ARC0640I GRVOL01 -            21:33:32    10/20/10
ARC0640I GRVOL01 -
ARC0640I GRVOL01 -  ICK00002I ICKDSF PROCESSING COMPLETE. MAXIMUM CONDITION CODE WAS 0
ARC0640I GRVOL01 - PAGE 0002     5695-DF175  DFSMSDSS V1R12.0 DATA SET SERVICES     2010.293 21:33
ARC0640I GRVOL01 - ADR006I (001)-STEND(02), 2010.293 21:33:32 EXECUTION ENDS
ARC0640I GRVOL01 - ADR013I (001)-CLTSK(01), 2010.293 21:33:33 TASK COMPLETED WITH RETURN CODE 0000
ARC0640I GRVOL01 - ADR012I (SCH)-DSSU (01), 2010.293 21:33:33 DFSMSDSS PROCESSING COMPLETE. HIGHEST RETURN CODE IS 0000
ARC0400I VOLUME MHL1A1 IS 99% FREE, 0000000009 FREE TRACK(S), 000003329 FREE CYLINDER(S), FRAG .000
ARC0401I LARGEST EXTENTS FOR MHL1A1 ARE CYLINDERS      3329, TRACKS      49940
ARC0402I VTOC FOR MHL1A1 IS 00090 TRACKS(0004500 DSCBS), 0004495 FREE DSCBS(99% OF TOTAL)
ARC0623I FULL VOLUME RESTORE OF VOLUME MHL1A1 ENDING AT 21:33:33, DCLASS=DCFR112, DGEN=000, DATE=2010/10/20,
 PROCESSING SUCCESSFUL
ARC1802I FAST REPLICATION RECOVERY FROM DUMP HAS COMPLETED FOR VOLUME MHL1A1, AT 21:33:33 ON 2010/10/20,
 FUNCTION RC=0000, MAXIMUM VOLUME RC=0000
 DFSMSHSM DUMP LOG, TIME 21:33:33,  DATE 10/10/20
```

Figure 5-67 DFSMShsm dump log for FRRECOV TOVOLUME(MHL1A1) FROMDUMP(APPLYINCREMENTAL)

The messages in the DFSMShsm backup log on the execution of the command (Figure 5-68) show the data sets that were recovered during the APPLYINCREMENTAL phase.

```
DFSMSHSM BACKUP LOG, TIME 21:31:02,  DATE 10/10/20
ARC1801I FAST REPLICATION RECOVERY FROM DUMP IS STARTING FOR VOLUME MHL1A1, AT 21:33:23 ON 2010/10/20
ARC0734I ACTION=RECOVER FRVOL=   *** TOVOL=MHL1A1 TRACKS=       *** RC=  43, REASON=   18, AGE= ***,
 DSN=SYS1.VVDS.VMHL1A1
ARC0734I ACTION=RCVSCHD FRVOL=   *** TOVOL=MHL1A1 TRACKS=       *** RC=   0, REASON=    0, AGE= ***, DSN=ZFSFR.CMD.CLIST
ARC0734I ACTION=RCVSCHD FRVOL=   *** TOVOL=MHL1A1 TRACKS=       *** RC=   0, REASON=    0, AGE= ***,
 DSN=ZFSFR.CMD.CLIST.NEW
 DFSMSHSM BACKUP LOG, TIME 21:33:33,  DATE 10/10/20
```

Figure 5-68 DFSMShsm backup log for FRRECOV TOVOLUME(MHL1A1) FROMDUMP(APPLYINCREMENTAL)

Recovery at the data set level

Support for recovery from fast replication backups at the data set level is available since z/OS DFSMS V1.8. Recent enhancements with z/OS DFSMS V1.12 further improve this facility by capturing the catalog information during fast replication backup. Captured catalog information is used to support the recovery of data sets that were moved or deleted since the fast replication backup occurred.

Captured catalog information is kept in catalog information data sets (CIDS) on ML1 volumes (Figure 5-69).

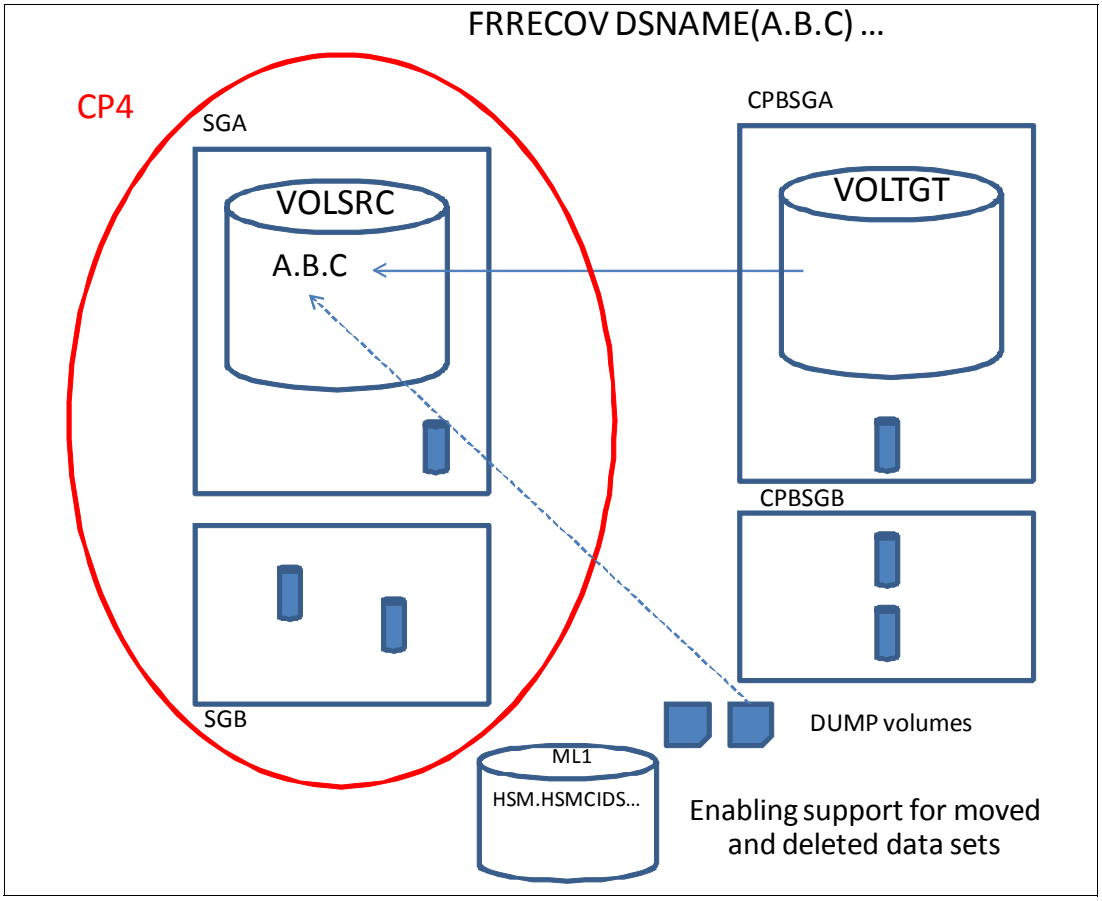

Figure 5-69 Fast replication recovery at the data set level

Important: Capturing catalog information must be requested on copy pool settings by specifying up to 10 catalogs that reside in the storage groups that are covered by the copy pool. To avoid failures during the capturing process, catalog only data sets in those catalogs that are available on one of the volumes that is covered by the copy pool. Also, the catalogs must not contain any entries that are in error.

Recovery of existing data sets from a fast replication DASD backup

You can request the recovery of one or more data sets by using the FRRECOV DSNAME command. If the data sets still exist, you must use the REPLACE parameter on the execution of FRBACKUP. Support for using wildcards is available but wildcards were not used in our example. For the use of wildcards, see Example 5-44 on page 131.

We used the command that is shown in Example 5-41 to demonstrate how it works. The data sets that we used for our example were not moved or deleted.

Example 5-41 FRRECOV DSNAME(...) command

```
HSEND FRRECOV DSNAME(TESTFR.CNTL.JCL,ZFSFR.CMD.CLIST) REPLACE FROMCP(CPNSPANBOX07)
```

During the recovery of fully qualified existing data sets, DFSMShsm uses the current catalog information for each data set. DFSMShsm compares the current catalog information with the captured catalog information (if available) to determine whether the data set was moved. Moved data sets are reallocated and re-cataloged to the state at which they existed at backup time. On the execution of the command that is shown in Example 5-41, the following messages appeared in the DFSMShsm backup log as shown in Figure 5-70.

```
 DFSMSHSM BACKUP LOG, TIME 14:58:50,  DATE 10/10/21
ARC1801I FAST REPLICATION DATA SET RECOVERY IS STARTING FOR DATA SET TESTFR.CNTL.JCL, ***, AT 15:36:49 ON 2010/10/21
ARC1861I THE FOLLOWING 0002 DATA SET(S) WERE SUCCESSFULLY PROCESSED DURING FAST REPLICATION DATA SET RECOVERY:
ARC1861I (CONT.) TESTFR.CNTL.JCL, COPYPOOL=CPNSPANBOX07, DEVTYPE=DASD
ARC1861I (CONT.) ZFSFR.CMD.CLIST, COPYPOOL=CPNSPANBOX07, DEVTYPE=DASD
ARC1802I FAST REPLICATION DATA SET RECOVERY HAS COMPLETED FOR DATA SET TESTFR.CNTL.JCL, ***, AT 15:36:50 ON
2010/10/21,
 FUNCTION RC=0000, MAXIMUM DATA SET RC=0000
```

Figure 5-70 Messages in DFSMShsm backup log on the execution of the FRRECOV DSNAME(...) command

Detailed messages of the data set recovery are always contained in the DFSMShsm dump log, whether the recovery occurred from a fast replication DASD backup or from a fast replication dump copy. The messages appeared on the execution of our command (Example 5-41 on page 125) as shown in Figure 5-71.

```
 DFSMSHSM DUMP LOG, TIME 14:58:50,  DATE 10/10/21
ARC0640I GDSN01 - PAGE 0001     5695-DF175  DFSMSDSS V1R12.0 DATA SET SERVICES     2010.294 15:36
ARC0640I GDSN01 - ADR035I (SCH)-PRIME(06), INSTALLATION EXIT ALTERED BYPASS FAC CLASS CHK DEFAULT TO YES
ARC0640I GDSN02 - PAGE 0001     5695-DF175  DFSMSDSS V1R12.0 DATA SET SERVICES     2010.294 15:36
ARC0640I GDSN02 - ADR035I (SCH)-PRIME(06), INSTALLATION EXIT ALTERED BYPASS FAC CLASS CHK DEFAULT TO YES
ARC0640I GDSN01 -  COPY DS(INC(TESTFR.CNTL.JCL                            )) -
ARC0640I GDSN02 -  COPY DS(INC(ZFSFR.CMD.CLIST                            )) -
ARC0640I GDSN01 -  PHYSINDY(YYDF20) OUTDYNAM(MHL0A0) -
ARC0640I GDSN02 -  PHYSINDY(YY8141) OUTDYNAM(MHL1A1) -
ARC0640I GDSN01 -  BYPASSACS(TESTFR.CNTL.JCL                           ) -
ARC0640I GDSN02 -  BYPASSACS(ZFSFR.CMD.CLIST                           ) -
ARC0640I GDSN01 -  ALLDATA(*) ALLEXCP REPLACEU CANCELERROR -
ARC0640I GDSN02 -  ALLDATA(*) ALLEXCP REPLACEU CANCELERROR -
ARC0640I GDSN01 -  TGTGDS( DEFERRED) -
ARC0640I GDSN02 -  TGTGDS( DEFERRED) -
ARC0640I GDSN01 -  FORCECP(0) PROCESS(SYS1) -
ARC0640I GDSN02 -  FORCECP(0) PROCESS(SYS1) -
ARC0640I GDSN01 -  STORCLAS(HSMFR                        ) -
ARC0640I GDSN02 -  STORCLAS(ZFSFR                        ) -
ARC0640I GDSN01 -  MGMTCLAS(HFS                          ) -
ARC0640I GDSN02 -  MGMTCLAS(MCDB22                       ) -
ARC0640I GDSN01 -  DEBUG(FRMSG(DTL)) -
ARC0640I GDSN02 -  DEBUG(FRMSG(DTL)) -
ARC0640I GDSN01 -  FASTREPLICATION(PREFERRED)
ARC0640I GDSN02 -  FASTREPLICATION(PREFERRED)
ARC0640I GDSN01 - ADR101I (R/I)-RI01 (01), TASKID 001 HAS BEEN ASSIGNED TO COMMAND 'COPY '
ARC0640I GDSN02 - ADR101I (R/I)-RI01 (01), TASKID 001 HAS BEEN ASSIGNED TO COMMAND 'COPY '
ARC0640I GDSN01 - ADR109I (R/I)-RI01 (01), 2010.294 15:36:49 INITIAL SCAN OF USER CONTROL STATEMENTS COMPLETED
ARC0640I GDSN02 - ADR109I (R/I)-RI01 (01), 2010.294 15:36:49 INITIAL SCAN OF USER CONTROL STATEMENTS COMPLETED
ARC0640I GDSN01 - ADR050I (001)-PRIME(02), DFSMSDSS INVOKED VIA CROSS MEMORY APPLICATION INTERFACE
ARC0640I GDSN02 - ADR050I (001)-PRIME(02), DFSMSDSS INVOKED VIA CROSS MEMORY APPLICATION INTERFACE
ARC0640I GDSN01 - ADR016I (001)-PRIME(01), RACF LOGGING OPTION IN EFFECT FOR THIS TASK
ARC0640I GDSN02 - ADR016I (001)-PRIME(01), RACF LOGGING OPTION IN EFFECT FOR THIS TASK
ARC0640I GDSN01 - ADR006I (001)-STEND(01), 2010.294 15:36:49 EXECUTION BEGINS
ARC0640I GDSN02 - ADR006I (001)-STEND(01), 2010.294 15:36:49 EXECUTION BEGINS
ARC0640I GDSN01 - ADR442I (001)-PPRNV(01), DATA SET TESTFR.CNTL.JCL PREALLOCATED, ON VOLUME(S): MHL0A0
ARC0640I GDSN01 - ADR806I (001)-TOMI (01), DATA SET TESTFR.CNTL.JCL COPIED USING A FAST REPLICATION FUNCTION
ARC0640I GDSN01 - ADR454I (001)-DDDS (02), THE FOLLOWING DATA SETS WERE SUCCESSFULLY PROCESSED
ARC0640I GDSN01 -                           TESTFR.CNTL.JCL
ARC0640I GDSN01 - ADR006I (001)-STEND(02), 2010.294 15:36:50 EXECUTION ENDS
ARC0640I GDSN01 - ADR013I (001)-CLTSK(01), 2010.294 15:36:50 TASK COMPLETED WITH RETURN CODE 0000
ARC0640I GDSN01 - ADR012I (SCH)-DSSU (01), 2010.294 15:36:50 DFSMSDSS PROCESSING COMPLETE. HIGHEST RETURN CODE IS 0000
ARC0640I GDSN02 - ADR442I (001)-PPRNV(01), DATA SET ZFSFR.CMD.CLIST PREALLOCATED, ON VOLUME(S): MHL1A1
ARC0640I GDSN02 - ADR806I (001)-TOMI (01), DATA SET ZFSFR.CMD.CLIST COPIED USING A FAST REPLICATION FUNCTION
ARC0640I GDSN02 - ADR454I (001)-DDDS (02), THE FOLLOWING DATA SETS WERE SUCCESSFULLY PROCESSED
ARC0640I GDSN02 -                           ZFSFR.CMD.CLIST
ARC0640I GDSN02 - ADR006I (001)-STEND(02), 2010.294 15:36:50 EXECUTION ENDS
ARC0640I GDSN02 - ADR013I (001)-CLTSK(01), 2010.294 15:36:50 TASK COMPLETED WITH RETURN CODE 0000
ARC0640I GDSN02 - ADR012I (SCH)-DSSU (01), 2010.294 15:36:50 DFSMSDSS PROCESSING COMPLETE. HIGHEST RETURN CODE IS 0000
```

Figure 5-71 Messages in DFSMShsm dump log on the execution of the FRRECOV DSNAME(...) command

The messages that appear in DFSMShsm JESMSGLG on the execution of the command are shown in Figure 5-72.

```
15.36.49 STC23065  ARC1801I FAST REPLICATION DATA SET RECOVERY IS  610
   610             ARC1801I (CONT.) STARTING FOR DATA SET TESTFR.CNTL.JCL, ***, AT
   610             ARC1801I (CONT.) 15:36:49 ON 2010/10/21
15.36.50 STC23065  ARC1861I THE FOLLOWING 0002 DATA SET(S) WERE  614
   614             ARC1861I (CONT.) SUCCESSFULLY PROCESSED DURING FAST REPLICATION DATA
   614             ARC1861I (CONT.) SET RECOVERY:
15.36.50 STC23065  ARC1861I (CONT.) TESTFR.CNTL.JCL, COPYPOOL=CPNSPANBOX07, DEVTYPE=DASD
15.36.50 STC23065  ARC1861I (CONT.) ZFSFR.CMD.CLIST, COPYPOOL=CPNSPANBOX07, DEVTYPE=DASD
15.36.50 STC23065  ARC1802I FAST REPLICATION DATA SET RECOVERY HAS  617
   617             ARC1802I (CONT.) COMPLETED FOR DATA SET TESTFR.CNTL.JCL, ***, AT
   617             ARC1802I (CONT.) 15:36:50 ON 2010/10/21, FUNCTION RC=0000, MAXIMUM
   617             ARC1802I (CONT.) DATA SET RC=0000
```

Figure 5-72 Messages in DFSMShsm JESMSGLG on the execution of the FRRECOV DSNAME(...) command

Note: In all appearances of messages ARC1801I and ARC1802I, only the first data set name, as requested on the FRBACKUP command, is referenced.

Recovery of moved and deleted data sets from fast replication DASD backup

For the next test, we moved one data set and deleted another data set before we started the recovery:

- ZFSFR.JOBS.JCL was moved from volume MHL1A0 to volume MHL0A0.
- ZFSFR.CMD.CLIST was deleted.

The command that we used for our example is shown in Example 5-42. We used no wildcards because no support exists for deleted data sets that use wildcards.

Example 5-42 FRRECOV DSNAME(...) command

```
HSEND FRRECOV DSNAME(ZFSFR.JOBS.JCL,ZFSFR.CMD.CLIST) REPLACE FROMCP(CPNSPANBOX07)
```

On the recovery of the fully qualified existing data sets, DFSMShsm uses the current catalog information for each data set and compares it with the captured catalog information (if available) to determine whether the data set was moved. Deleted or moved data sets are reallocated and re-cataloged to the state at which they existed at backup time.

Important: Support for deleted data sets is available only if catalog information was captured at backup time. When it was set up, the copy pool must specify to capture catalog information at the time of FRBACKUP. If one of the catalogs contains errors, capturing catalog information during FRBACKUP might fail for certain entries. In this case, a deleted data set might not be supported for recovery. To recover this type of a data set, you must recatalog the data set to exactly the volume where it resided during FRBACKUP in advance of the execution of FRRECOV.

Figure 5-73 on page 128 shows the messages in the DFSMShsm backup log on the execution of the command.

```
 DFSMSHSM BACKUP LOG, TIME 14:58:50,  DATE 10/10/21
ARC1801I FAST REPLICATION DATA SET RECOVERY IS STARTING FOR DATA SET ZFSFR.JOBS.JCL, ***, AT 16:15:32 ON 2010/10/21
ARC1861I THE FOLLOWING 0002 DATA SET(S) WERE SUCCESSFULLY PROCESSED DURING FAST REPLICATION DATA SET RECOVERY:
ARC1861I (CONT.) ZFSFR.JOBS.JCL, COPYPOOL=CPNSPANBOX07, DEVTYPE=DASD
ARC1861I (CONT.) ZFSFR.CMD.CLIST, COPYPOOL=CPNSPANBOX07, DEVTYPE=DASD
ARC1802I FAST REPLICATION DATA SET RECOVERY HAS COMPLETED FOR DATA SET ZFSFR.JOBS.JCL, ***, AT 16:15:32 ON 2010/10/21,
 FUNCTION RC=0000, MAXIMUM DATA SET RC=0000
```

Figure 5-73 Messages in the DFSMShsm backup log on the execution of the FRRECOV DSNAME(...) command

The detailed messages on the execution of the FRRECOV command are in the DFSMShsm dump log, which is shown in Figure 5-74.

```
ARC0640I GDSN01 - PAGE 0001     5695-DF175  DFSMSDSS V1R12.0 DATA SET SERVICES     2010.294 16:15
ARC0640I GDSN01 - ADR035I (SCH)-PRIME(06), INSTALLATION EXIT ALTERED BYPASS FAC CLASS CHK DEFAULT TO YES
ARC0640I GDSN01 -  COPY DS(INC(ZFSFR.JOBS.JCL                                 )) -
ARC0640I GDSN01 -  PHYSINDY(YY8140) OUTDYNAM(MHL1A0) -
ARC0640I GDSN01 -  BYPASSACS(ZFSFR.JOBS.JCL                                ) -
ARC0640I GDSN01 -  ALLDATA(*) ALLEXCP REPLACEU CANCELERROR -
ARC0640I GDSN01 -  TGTGDS( DEFERRED) -
ARC0640I GDSN01 -  FORCECP(0) PROCESS(SYS1) -
ARC0640I GDSN01 -  STORCLAS(ZFSFR                          ) -
ARC0640I GDSN01 -  MGMTCLAS(MCDB22                         ) -
ARC0640I GDSN01 -  DEBUG(FRMSG(DTL)) -
ARC0640I GDSN01 -  FASTREPLICATION(PREFERRED)
ARC0640I GDSN01 - ADR101I (R/I)-RI01 (01), TASKID 001 HAS BEEN ASSIGNED TO COMMAND 'COPY '
ARC0640I GDSN01 - ADR109I (R/I)-RI01 (01), 2010.294 16:15:32 INITIAL SCAN OF USER CONTROL STATEMENTS COMPLETED
ARC0640I GDSN01 - ADR050I (001)-PRIME(02), DFSMSDSS INVOKED VIA CROSS MEMORY APPLICATION INTERFACE
ARC0640I GDSN01 - ADR016I (001)-PRIME(01), RACF LOGGING OPTION IN EFFECT FOR THIS TASK
ARC0640I GDSN01 - ADR006I (001)-STEND(01), 2010.294 16:15:32 EXECUTION BEGINS
ARC0640I GDSN02 - PAGE 0001     5695-DF175  DFSMSDSS V1R12.0 DATA SET SERVICES     2010.294 16:15
ARC0640I GDSN02 - ADR035I (SCH)-PRIME(06), INSTALLATION EXIT ALTERED BYPASS FAC CLASS CHK DEFAULT TO YES
ARC0640I GDSN02 -  COPY DS(INC(ZFSFR.CMD.CLIST                                 )) -
ARC0640I GDSN02 -  PHYSINDY(YY8141) OUTDYNAM(MHL1A1) -
ARC0640I GDSN02 -  BYPASSACS(ZFSFR.CMD.CLIST                               ) -
ARC0640I GDSN02 -  ALLDATA(*) ALLEXCP REPLACEU CANCELERROR -
ARC0640I GDSN02 -  TGTGDS( DEFERRED) -
ARC0640I GDSN02 -  FORCECP(0) PROCESS(SYS1) -
ARC0640I GDSN02 -  STORCLAS(ZFSFR                          ) -
ARC0640I GDSN02 -  MGMTCLAS(MCDB22                         ) -
ARC0640I GDSN02 -  DEBUG(FRMSG(DTL)) -
ARC0640I GDSN02 -  FASTREPLICATION(PREFERRED)
ARC0640I GDSN02 - ADR101I (R/I)-RI01 (01), TASKID 001 HAS BEEN ASSIGNED TO COMMAND 'COPY '
ARC0640I GDSN02 - ADR109I (R/I)-RI01 (01), 2010.294 16:15:32 INITIAL SCAN OF USER CONTROL STATEMENTS COMPLETED
ARC0640I GDSN02 - ADR050I (001)-PRIME(02), DFSMSDSS INVOKED VIA CROSS MEMORY APPLICATION INTERFACE
ARC0640I GDSN02 - ADR016I (001)-PRIME(01), RACF LOGGING OPTION IN EFFECT FOR THIS TASK
ARC0640I GDSN02 - ADR006I (001)-STEND(01), 2010.294 16:15:32 EXECUTION BEGINS
ARC0640I GDSN02 - ADR396I (001)-PCNVS(01), DATA SET ZFSFR.CMD.CLIST ALLOCATED, ON VOLUME(S): MHL1A1
ARC0640I GDSN02 - ADR806I (001)-TOMI (01), DATA SET ZFSFR.CMD.CLIST COPIED USING A FAST REPLICATION FUNCTION
ARC0640I GDSN02 - ADR454I (001)-DDDS (02), THE FOLLOWING DATA SETS WERE SUCCESSFULLY PROCESSED
ARC0640I GDSN02 -                           ZFSFR.CMD.CLIST
ARC0640I GDSN02 - ADR006I (001)-STEND(02), 2010.294 16:15:32 EXECUTION ENDS
ARC0640I GDSN02 - ADR013I (001)-CLTSK(01), 2010.294 16:15:32 TASK COMPLETED WITH RETURN CODE 0000
ARC0640I GDSN02 - ADR012I (SCH)-DSSU (01), 2010.294 16:15:32 DFSMSDSS PROCESSING COMPLETE. HIGHEST RETURN CODE IS 0000
ARC0640I GDSN01 - ADR396I (001)-PCNVS(01), DATA SET ZFSFR.JOBS.JCL ALLOCATED, ON VOLUME(S): MHL1A0
ARC0640I GDSN01 - ADR806I (001)-TOMI (01), DATA SET ZFSFR.JOBS.JCL COPIED USING A FAST REPLICATION FUNCTION
ARC0640I GDSN01 - ADR454I (001)-DDDS (02), THE FOLLOWING DATA SETS WERE SUCCESSFULLY PROCESSED
ARC0640I GDSN01 -                           ZFSFR.JOBS.JCL
ARC0640I GDSN01 - ADR006I (001)-STEND(02), 2010.294 16:15:32 EXECUTION ENDS
ARC0640I GDSN01 - ADR013I (001)-CLTSK(01), 2010.294 16:15:32 TASK COMPLETED WITH RETURN CODE 0000
ARC0640I GDSN01 - ADR012I (SCH)-DSSU (01), 2010.294 16:15:32 DFSMSDSS PROCESSING COMPLETE. HIGHEST RETURN CODE IS 0000
```

Figure 5-74 Messages in the DFSMShsm dump log on the execution of the FRRECOV DSNAME(...) command

The messages as written in DFSMShsm JESMSGLG on the execution of the command (Example 5-42 on page 127) are shown in Figure 5-75.

```
16.15.32 STC23065  ARC1801I FAST REPLICATION DATA SET RECOVERY IS  648
   648             ARC1801I (CONT.) STARTING FOR DATA SET ZFSFR.JOBS.JCL, ***, AT
   648             ARC1801I (CONT.) 16:15:32 ON 2010/10/21
16.15.32 STC23065  ARC1861I THE FOLLOWING 0002 DATA SET(S) WERE  649
   649             ARC1861I (CONT.) SUCCESSFULLY PROCESSED DURING FAST REPLICATION DATA
   649             ARC1861I (CONT.) SET RECOVERY:
16.15.32 STC23065  ARC1861I (CONT.) ZFSFR.JOBS.JCL, COPYPOOL=CPNSPANBOX07, DEVTYPE=DASD
16.15.32 STC23065  ARC1861I (CONT.) ZFSFR.CMD.CLIST, COPYPOOL=CPNSPANBOX07, DEVTYPE=DASD
16.15.32 STC23065  ARC1802I FAST REPLICATION DATA SET RECOVERY HAS  652
   652             ARC1802I (CONT.) COMPLETED FOR DATA SET ZFSFR.JOBS.JCL, ***, AT
   652             ARC1802I (CONT.) 16:15:32 ON 2010/10/21, FUNCTION RC=0000, MAXIMUM
   652             ARC1802I (CONT.) DATA SET RC=0000
```

Figure 5-75 Messages in DFSMShsm JESMSGLG on the execution of the FRRECOV DSNAME(...) command

Using data set filtering on FRRECOV DSNAME(...) commands

If you specify a partially qualified data set name on the FRRECOV DSNAME command, DFSMShsm processes every cataloged data set in the standard search order that matches your filtering criteria.

Table 5-3 shows the wildcard support on the FRRECOV command.

Table 5-3 Wildcard support on the FRRECOV command

Type of data sets that are specified with the FRRECOV command	Moved data sets	Deleted data sets	Original allocation
Single fully qualified data set	Process	Process	Process
Multiple fully qualified data sets	Process	Process	Process
Wildcard specified on a single or multiple data sets	Process	Not processed	Process

Tip: You cannot use wildcards for deleted data sets.

We deleted data set TESTFR.CNTL.JCL (Figure 5-76). Data sets ZFSFR.CMD.CLIST and ZFSFR.JOBS.JCL were renamed vice versa, respectively, so that it appears to FRRECOV processing as though both data sets were moved (Figure 5-77).

```
DSLIST - Data Sets Matching ZFSFR                          Data set deleted
Command ===>                                               Scroll ===> CSR

Command - Enter "/" to select action              Message          Volume
------------------------------------------------------------------------------
         TESTFR                                                    *ALIAS
         TESTFR.CMD.CLIST                                          MHL0A0
         TESTFR.CMD.CLIST.NEW                                      MHL0A0
         TESTFR.CNTL.JCL                          Deleted
         TESTFR.CX                                                 MHL000
         ZFSFR                                                     *ALIAS
         ZFSFR.CMD.CLIST                                           MHL1A1
         ZFSFR.CMD.CLIST.NEW                                       MHL1A1
         ZFSFR.JOBS.JCL                                            MHL1A0
         ZFSFR.MV.DATA                            Info - I         MHL1A0+
****************************** End of Data Set list ****************************
```

Figure 5-76 Data sets in copy pool CPNSPANBOX07

```
DSLIST - Data Sets Matching ZFSFR                          Data set deleted
Command ===>                                               Scroll ===> CSR

Command - Enter "/" to select action              Message          Volume
------------------------------------------------------------------------------
         TESTFR                                                    *ALIAS
         TESTFR.CMD.CLIST                                          MHL0A0
         TESTFR.CMD.CLIST.NEW                                      MHL0A0
         TESTFR.CNTL.JCL                          Deleted
         TESTFR.CX                                                 MHL000
         ZFSFR                                                     *ALIAS
         ZFSFR.CMD.CLIST                                           MHL1A0
         ZFSFR.CMD.CLIST.NEW                                       MHL1A1
         ZFSFR.JOBS.JCL                                            MHL1A1
         ZFSFR.MV.DATA                            Info - I         MHL1A0+
****************************** End of Data Set list ****************************
```

Figure 5-77 Data sets in copy pool CPNSPANBOX07 after RENAME

You can use a LIST CP(...) DATASETS ODS(...) command as shown in Example 5-43 to display the data sets that are contained in the fast replication backup version and whose catalog information was captured during the creation of the fast replication backup version.

Example 5-43 LIST CP(...) DATASETS command

```
LIST CP(CPNSPANBOX07) DATASETS ODS(MHLRES1.C7)
```

The list of data sets created by the command is shown in Figure 5-78.

```
-- DFSMShsm CONTROL DATA SET -- COPY POOL -- LISTING -- AT 15:23:48 ON 10/10/21
FOR SYSTEM=SC70

COPYPOOL=CPNSPANBOX07                  ,VER=002,GEN=000,CATINFO=Y
CATALOG INFORMATION DATA SET NAME=HSM.HSMCIDS.D10294.T185519.C001            ,
TKN(C)=C''
TKN(H)=X''

CATALOG NAME = UCAT.ZFSFR

DATA SET NAME
ZFSFR.CMD.CLIST
ZFSFR.CMD.CLIST.NEW
ZFSFR.JOBS.JCL
ZFSFR.MV.DATA

CATALOG NAME = UCAT.TESTFR

DATA SET NAME
TESTFR.CMD.CLIST
TESTFR.CMD.CLIST.NEW
TESTFR.CNTL.JCL
TESTFR.CX

TOTAL NUMBER OF DATA SETS =          8
```

Figure 5-78 Output of LIST CP(CPNSPANBOX07) DATASETS command

For the recovery, we used wildcards as shown in Example 5-44.

Example 5-44 FRRECOV DSNAME(...) command using wildcards

```
HSEND FRRECOV DSNAME(TESTFR.**,ZFSFR.*.CLIST,ZFSFR.JOBS.*) FROMCP(CPNSPANBOX07)
REPLACE
```

When you use wildcards on FRRECOV DSNAME commands, DFSMShsm uses current catalog entries to determine matching data sets. TESTFR.CNTL.JCL was not found on the catalog search, which is why we see messages ARC1001I and ARC1193I on the TSO panel (Figure 5-79 on page 132). Data set TESTFR.CNTL.JCL was not recovered even though a backup of this data set exists in the referred fast replication backup version (Figure 5-78).

```
ARC1001I TESTFR.CX RECOVER FAILED, RC=0093, REAS=0066-0024
ARC1193I FAST REPLICATION RECOVERY FAILED

ARC1000I ZFSFR.CMD.CLIST RECOVER PROCESSING ENDED
ARC1000I TESTFR.CMD.CLIST RECOVER PROCESSING ENDED
ARC1000I ZFSFR.JOBS.JCL RECOVER PROCESSING ENDED
ARC1001I TESTFR.**, *** FRRECOV FAILED, RC=0008, REAS=0000
ARC1808E ONE OR MORE FAILURES OCCURRED DURING FAST REPLICATION RECOVERY OF
ARC1808E (CONT.) DATA SET TESTFR.**, ***
ARC1000I TESTFR.CMD.CLIST.NEW RECOVER PROCESSING ENDED
***
```

Figure 5-79 Messages on the execution of the FRRECOV DSNAME(...) command

The messages in DFSMShsm JESMSGLG on the execution of the command are shown in Figure 5-80.

```
21.22.40 STC23065  ARC1801I FAST REPLICATION DATA SET RECOVERY IS  168
   168             ARC1801I (CONT.) STARTING FOR DATA SET TESTFR.**, ***, AT 21:22:40 ON
   168             ARC1801I (CONT.) 2010/10/21
21.22.40 STC23065  ARC1861I THE FOLLOWING 0004 DATA SET(S) WERE  169
   169             ARC1861I (CONT.) SUCCESSFULLY PROCESSED DURING FAST REPLICATION DATA
   169             ARC1861I (CONT.) SET RECOVERY:
21.22.40 STC23065  ARC1861I (CONT.) TESTFR.CMD.CLIST, COPYPOOL=CPNSPANBOX07, DEVTYPE=DASD
21.22.40 STC23065  ARC1861I (CONT.) TESTFR.CMD.CLIST.NEW, COPYPOOL=CPNSPANBOX07, DEVTYPE=DASD
21.22.40 STC23065  ARC1861I (CONT.) ZFSFR.CMD.CLIST, COPYPOOL=CPNSPANBOX07, DEVTYPE=DASD
21.22.40 STC23065  ARC1861I (CONT.) ZFSFR.JOBS.JCL, COPYPOOL=CPNSPANBOX07, DEVTYPE=DASD
21.22.40 STC23065  ARC1862I THE FOLLOWING 0001 DATA SET(S) WERE NOT  174
   174             ARC1862I (CONT.) SELECTED FOR FAST REPLICATION DATA SET RECOVERY
   174             ARC1862I (CONT.) PROCESSING:
21.22.40 STC23065  ARC1862I (CONT.) TESTFR.CX
21.22.40 STC23065  ARC1802I FAST REPLICATION DATA SET RECOVERY HAS  176
   176             ARC1802I (CONT.) COMPLETED FOR DATA SET TESTFR.**, ***, AT 21:22:40 ON
   176             ARC1802I (CONT.) 2010/10/21, FUNCTION RC=0008, MAXIMUM DATA SET RC=0066
```

Figure 5-80 DFSMShsm JESMSGLG on the execution of the FRRECOV DSN(...) command

The DFSMShsm backup log contains messages as shown in Figure 5-81 on the execution of the command. (See Example 5-44 on page 131.)

```
ARC1801I FAST REPLICATION DATA SET RECOVERY IS STARTING FOR DATA SET TESTFR.**, ***, AT 21:22:40 ON 2010/10/21
ARC1861I THE FOLLOWING 0004 DATA SET(S) WERE SUCCESSFULLY PROCESSED DURING FAST REPLICATION DATA SET RECOVERY:
ARC1861I (CONT.) TESTFR.CMD.CLIST, COPYPOOL=CPNSPANBOX07, DEVTYPE=DASD
ARC1861I (CONT.) TESTFR.CMD.CLIST.NEW, COPYPOOL=CPNSPANBOX07, DEVTYPE=DASD
ARC1861I (CONT.) ZFSFR.CMD.CLIST, COPYPOOL=CPNSPANBOX07, DEVTYPE=DASD
ARC1861I (CONT.) ZFSFR.JOBS.JCL, COPYPOOL=CPNSPANBOX07, DEVTYPE=DASD
ARC1862I THE FOLLOWING 0001 DATA SET(S) WERE NOT SELECTED FOR FAST REPLICATION DATA SET RECOVERY PROCESSING:
ARC1862I (CONT.) TESTFR.CX
ARC1802I FAST REPLICATION DATA SET RECOVERY HAS COMPLETED FOR DATA SET TESTFR.**, ***, AT 21:22:40 ON 2010/10/21,
 FUNCTION RC=0008, MAXIMUM DATA SET RC=0066
```

Figure 5-81 DFSMShsm backup log on the execution of the FRRECOV DSN(...) command

Detailed messages on the execution of the FRBACKUP DSNAME command are in the DFSMShsm dump log as shown in Figure 5-82 and Figure 5-83 on page 134.

```
ARC0640I GDSN01 - PAGE 0001     5695-DF175  DFSMSDSS V1R12.0 DATA SET SERVICES     2010.294 21:22
ARC0640I GDSN01 - ADR035I (SCH)-PRIME(06), INSTALLATION EXIT ALTERED BYPASS FAC CLASS CHK DEFAULT TO YES
ARC0640I GDSN01 -  COPY DS(INC(TESTFR.CMD.CLIST                              )) -
ARC0640I GDSN01 -  PHYSINDY(YYDF20) OUTDYNAM(MHL0A0) -
ARC0640I GDSN01 -  BYPASSACS(TESTFR.CMD.CLIST                              ) -
ARC0640I GDSN01 -  ALLDATA(*) ALLEXCP REPLACEU CANCELERROR -
ARC0640I GDSN01 -  TGTGDS( DEFERRED) -
ARC0640I GDSN01 -  FORCECP(0) PROCESS(SYS1) -
ARC0640I GDSN01 -  STORCLAS(HSMFR                          ) -
ARC0640I GDSN01 -  MGMTCLAS(MCDB22                         ) -
ARC0640I GDSN01 -  DEBUG(FRMSG(DTL)) -
ARC0640I GDSN01 -  FASTREPLICATION(PREFERRED)
ARC0640I GDSN01 - ADR101I (R/I)-RI01 (01), TASKID 001 HAS BEEN ASSIGNED TO COMMAND 'COPY '
ARC0640I GDSN01 - ADR109I (R/I)-RI01 (01), 2010.294 21:22:40 INITIAL SCAN OF USER CONTROL STATEMENTS COMPLETED
ARC0640I GDSN01 - ADR050I (001)-PRIME(02), DFSMSDSS INVOKED VIA CROSS MEMORY APPLICATION INTERFACE
ARC0640I GDSN01 - ADR016I (001)-PRIME(01), RACF LOGGING OPTION IN EFFECT FOR THIS TASK
ARC0640I GDSN02 - PAGE 0001     5695-DF175  DFSMSDSS V1R12.0 DATA SET SERVICES     2010.294 21:22
ARC0640I GDSN02 - ADR035I (SCH)-PRIME(06), INSTALLATION EXIT ALTERED BYPASS FAC CLASS CHK DEFAULT TO YES
ARC0640I GDSN02 -  COPY DS(INC(TESTFR.CMD.CLIST.NEW                          )) -
ARC0640I GDSN02 -  PHYSINDY(YYDF20) OUTDYNAM(MHL0A0) -
ARC0640I GDSN02 -  BYPASSACS(TESTFR.CMD.CLIST.NEW                          ) -
ARC0640I GDSN02 -  ALLDATA(*) ALLEXCP REPLACEU CANCELERROR -
ARC0640I GDSN02 -  TGTGDS( DEFERRED) -
ARC0640I GDSN02 -  FORCECP(0) PROCESS(SYS1) -
ARC0640I GDSN02 -  STORCLAS(HSMFR                          ) -
ARC0640I GDSN02 -  MGMTCLAS(MCDB22                         ) -
ARC0640I GDSN02 -  DEBUG(FRMSG(DTL)) -
ARC0640I GDSN02 -  FASTREPLICATION(PREFERRED)
ARC0640I GDSN02 - ADR101I (R/I)-RI01 (01), TASKID 001 HAS BEEN ASSIGNED TO COMMAND 'COPY '
ARC0640I GDSN02 - ADR109I (R/I)-RI01 (01), 2010.294 21:22:40 INITIAL SCAN OF USER CONTROL STATEMENTS COMPLETED
ARC0640I GDSN01 - ADR006I (001)-STEND(01), 2010.294 21:22:40 EXECUTION BEGINS
ARC0640I GDSN02 - ADR050I (001)-PRIME(02), DFSMSDSS INVOKED VIA CROSS MEMORY APPLICATION INTERFACE
ARC0640I GDSN02 - ADR016I (001)-PRIME(01), RACF LOGGING OPTION IN EFFECT FOR THIS TASK
ARC0640I GDSN02 - ADR006I (001)-STEND(01), 2010.294 21:22:40 EXECUTION BEGINS
ARC0640I GDSN03 - PAGE 0001     5695-DF175  DFSMSDSS V1R12.0 DATA SET SERVICES     2010.294 21:22
ARC0640I GDSN03 - ADR035I (SCH)-PRIME(06), INSTALLATION EXIT ALTERED BYPASS FAC CLASS CHK DEFAULT TO YES
ARC0640I GDSN03 -  COPY DS(INC(ZFSFR.CMD.CLIST                               )) -
ARC0640I GDSN03 -  PHYSINDY(YY8141) OUTDYNAM(MHL1A1) -
ARC0640I GDSN03 -  BYPASSACS(ZFSFR.CMD.CLIST                               ) -
ARC0640I GDSN03 -  ALLDATA(*) ALLEXCP REPLACEU CANCELERROR -
ARC0640I GDSN03 -  TGTGDS( DEFERRED) -
ARC0640I GDSN03 -  FORCECP(0) PROCESS(SYS1) -
ARC0640I GDSN03 -  STORCLAS(ZFSFR                          ) -
ARC0640I GDSN03 -  MGMTCLAS(MCDB22                         ) -
ARC0640I GDSN03 -  DEBUG(FRMSG(DTL)) -
ARC0640I GDSN03 -  FASTREPLICATION(PREFERRED)
ARC0640I GDSN03 - ADR101I (R/I)-RI01 (01), TASKID 001 HAS BEEN ASSIGNED TO COMMAND 'COPY '
ARC0640I GDSN03 - ADR109I (R/I)-RI01 (01), 2010.294 21:22:40 INITIAL SCAN OF USER CONTROL STATEMENTS COMPLETED
ARC0640I GDSN03 - ADR050I (001)-PRIME(02), DFSMSDSS INVOKED VIA CROSS MEMORY APPLICATION INTERFACE
ARC0640I GDSN03 - ADR016I (001)-PRIME(01), RACF LOGGING OPTION IN EFFECT FOR THIS TASK
ARC0640I GDSN03 - ADR006I (001)-STEND(01), 2010.294 21:22:40 EXECUTION BEGINS
```

Figure 5-82 DFSMShsm dump log on the execution of the FRRECOV DSN(...) command (Part 1 of 2)

```
ARC0640I GDSN04 - PAGE 0001     5695-DF175  DFSMSDSS V1R12.0 DATA SET SERVICES     2010.294 21:22
ARC0640I GDSN04 - ADR035I (SCH)-PRIME(06), INSTALLATION EXIT ALTERED BYPASS FAC CLASS CHK DEFAULT TO YES
 ARC0640I GDSN04 -  COPY DS(INC(ZFSFR.JOBS.JCL                                  )) -
 ARC0640I GDSN04 -  PHYSINDY(YY8140) OUTDYNAM(MHL1A0) -
 ARC0640I GDSN04 -  BYPASSACS(ZFSFR.JOBS.JCL                                ) -
 ARC0640I GDSN04 -  ALLDATA(*) ALLEXCP REPLACEU CANCELERROR -
 ARC0640I GDSN04 -  TGTGDS( DEFERRED) -
 ARC0640I GDSN04 -  FORCECP(0) PROCESS(SYS1) -
 ARC0640I GDSN04 -  STORCLAS(ZFSFR                          ) -
 ARC0640I GDSN04 -  MGMTCLAS(MCDB22                         ) -
 ARC0640I GDSN04 -  DEBUG(FRMSG(DTL)) -
 ARC0640I GDSN04 -  FASTREPLICATION(PREFERRED)
ARC0640I GDSN04 - ADR101I (R/I)-RI01 (01), TASKID 001 HAS BEEN ASSIGNED TO COMMAND 'COPY '
 ARC0640I GDSN04 - ADR109I (R/I)-RI01 (01), 2010.294 21:22:40 INITIAL SCAN OF USER CONTROL STATEMENTS COMPLETED
 ARC0640I GDSN04 - ADR050I (001)-PRIME(02), DFSMSDSS INVOKED VIA CROSS MEMORY APPLICATION INTERFACE
 ARC0640I GDSN04 - ADR016I (001)-PRIME(01), RACF LOGGING OPTION IN EFFECT FOR THIS TASK
 ARC0640I GDSN04 - ADR006I (001)-STEND(01), 2010.294 21:22:40 EXECUTION BEGINS
 ARC0640I GDSN03 - ADR396I (001)-PCNVS(01), DATA SET ZFSFR.CMD.CLIST ALLOCATED, ON VOLUME(S): MHL1A1
 ARC0640I GDSN03 - ADR806I (001)-TOMI (01), DATA SET ZFSFR.CMD.CLIST COPIED USING A FAST REPLICATION FUNCTION
 ARC0640I GDSN03 - ADR454I (001)-DDDS (02), THE FOLLOWING DATA SETS WERE SUCCESSFULLY PROCESSED
 ARC0640I GDSN03 -                           ZFSFR.CMD.CLIST
 ARC0640I GDSN03 - ADR006I (001)-STEND(02), 2010.294 21:22:40 EXECUTION ENDS
 ARC0640I GDSN03 - ADR013I (001)-CLTSK(01), 2010.294 21:22:40 TASK COMPLETED WITH RETURN CODE 0000
 ARC0640I GDSN03 - ADR012I (SCH)-DSSU (01), 2010.294 21:22:40 DFSMSDSS PROCESSING COMPLETE. HIGHEST RETURN CODE IS 0000
ARC0640I GDSN01 - ADR442I (001)-PPRNV(01), DATA SET TESTFR.CMD.CLIST PREALLOCATED, ON VOLUME(S): MHL0A0
 ARC0640I GDSN02 - ADR442I (001)-PPRNV(01), DATA SET TESTFR.CMD.CLIST.NEW PREALLOCATED, ON VOLUME(S): MHL0A0
 ARC0640I GDSN04 - ADR396I (001)-PCNVS(01), DATA SET ZFSFR.JOBS.JCL ALLOCATED, ON VOLUME(S): MHL1A0
 ARC0640I GDSN04 - ADR806I (001)-TOMI (01), DATA SET ZFSFR.JOBS.JCL COPIED USING A FAST REPLICATION FUNCTION
 ARC0640I GDSN01 - ADR806I (001)-TOMI (01), DATA SET TESTFR.CMD.CLIST COPIED USING A FAST REPLICATION FUNCTION
 ARC0640I GDSN04 - ADR454I (001)-DDDS (02), THE FOLLOWING DATA SETS WERE SUCCESSFULLY PROCESSED
 ARC0640I GDSN04 -                           ZFSFR.JOBS.JCL
 ARC0640I GDSN04 - ADR006I (001)-STEND(02), 2010.294 21:22:40 EXECUTION ENDS
 ARC0640I GDSN04 - ADR013I (001)-CLTSK(01), 2010.294 21:22:40 TASK COMPLETED WITH RETURN CODE 0000
 ARC0640I GDSN04 - ADR012I (SCH)-DSSU (01), 2010.294 21:22:40 DFSMSDSS PROCESSING COMPLETE. HIGHEST RETURN CODE IS 0000
 ARC0640I GDSN02 - ADR806I (001)-TOMI (01), DATA SET TESTFR.CMD.CLIST.NEW COPIED USING A FAST REPLICATION FUNCTION
 ARC0640I GDSN01 - ADR454I (001)-DDDS (02), THE FOLLOWING DATA SETS WERE SUCCESSFULLY PROCESSED
 ARC0640I GDSN01 -                           TESTFR.CMD.CLIST
 ARC0640I GDSN01 - ADR006I (001)-STEND(02), 2010.294 21:22:40 EXECUTION ENDS
 ARC0640I GDSN01 - ADR013I (001)-CLTSK(01), 2010.294 21:22:40 TASK COMPLETED WITH RETURN CODE 0000
 ARC0640I GDSN01 - ADR012I (SCH)-DSSU (01), 2010.294 21:22:40 DFSMSDSS PROCESSING COMPLETE. HIGHEST RETURN CODE IS 0000
 ARC0640I GDSN02 - ADR454I (001)-DDDS (02), THE FOLLOWING DATA SETS WERE SUCCESSFULLY PROCESSED
 ARC0640I GDSN02 -                           TESTFR.CMD.CLIST.NEW
 ARC0640I GDSN02 - ADR006I (001)-STEND(02), 2010.294 21:22:40 EXECUTION ENDS
 ARC0640I GDSN02 - ADR013I (001)-CLTSK(01), 2010.294 21:22:40 TASK COMPLETED WITH RETURN CODE 0000
 ARC0640I GDSN02 - ADR012I (SCH)-DSSU (01), 2010.294 21:22:40 DFSMSDSS PROCESSING COMPLETE. HIGHEST RETURN CODE IS 0000
```

Figure 5-83 DFSMShsm dump log on the execution of the FRRECOV DSN(...) command (Part 2 of 2)

Recovery of a data set from a fast replication dump copy

We tested the recovery of an existing data set from a dump copy only, but moved and deleted data sets are supported, as well. The command that we used for this test is shown in Example 5-45.

Example 5-45 FRRECOV DSNAME(...) FROMDUMP command

```
HSEND FRRECOV DSNAME(TESTFR.CNTL.JCL) FROMCP(CPNSPANBOX07) REPLACE FROMDUMP GEN(1)
```

The messages from DFSMShsm JESMSGLG are shown in Figure 5-84.

```
 13.29.43 STC23065  ARC1801I FAST REPLICATION DATA SET RECOVERY IS  203
    203             ARC1801I (CONT.) STARTING FOR DATA SET TESTFR.CNTL.JCL, AT 13:29:43 ON
    203             ARC1801I (CONT.) 2010/10/22
13.29.43 STC23065 *IEC501A M 040D,VT0018,SL,,DFHSM70,JV,HSM.DMP.DCFR112.VMHL0A0.D10293.T361621
 13.29.44 STC23065  ARC1861I THE FOLLOWING 0001 DATA SET(S) WERE  211
    211             ARC1861I (CONT.) SUCCESSFULLY PROCESSED DURING FAST REPLICATION DATA
    211             ARC1861I (CONT.) SET RECOVERY:
 13.29.44 STC23065  ARC1861I (CONT.) TESTFR.CNTL.JCL, COPYPOOL=CPNSPANBOX07, DEVTYPE=TAPE
 13.29.44 STC23065  ARC1802I FAST REPLICATION DATA SET RECOVERY HAS  213
    213             ARC1802I (CONT.) COMPLETED FOR DATA SET TESTFR.CNTL.JCL, AT 13:29:44
    213             ARC1802I (CONT.) ON 2010/10/22, FUNCTION RC=0000, MAXIMUM DATA SET
    213             ARC1802I (CONT.) RC=0000
 13.29.49 STC23065  IEF234E K 040D,VT0018,PVT,DFHSM70,JV
```

Figure 5-84 DFSMShsm JESMSGLG from the FRRECOV DSNAME(...) FROMDUMP command

The messages from the DFSMShsm backup log are shown in Figure 5-85.

```
ARC1801I FAST REPLICATION DATA SET RECOVERY IS STARTING FOR DATA SET TESTFR.CNTL.JCL, AT 13:29:43 ON 2010/10/22
ARC1861I THE FOLLOWING 0001 DATA SET(S) WERE SUCCESSFULLY PROCESSED DURING FAST REPLICATION DATA SET RECOVERY:
ARC1861I (CONT.) TESTFR.CNTL.JCL, COPYPOOL=CPNSPANBOX07, DEVTYPE=TAPE
ARC1802I FAST REPLICATION DATA SET RECOVERY HAS COMPLETED FOR DATA SET TESTFR.CNTL.JCL, AT 13:29:44 ON 2010/10/22,
 FUNCTION RC=0000, MAXIMUM DATA SET RC=0000
```

Figure 5-85 DFSMShsm backup log from the FRRECOV DSNAME(...) FROMDUMP command

The messages from the DFSMShsm dump log are shown in Figure 5-86.

```
ARC0640I GDSN01 - PAGE 0001     5695-DF175  DFSMSDSS V1R12.0 DATA SET SERVICES     2010.295 13:29
ARC0640I GDSN01 - ADR035I (SCH)-PRIME(06), INSTALLATION EXIT ALTERED BYPASS FAC CLASS CHK DEFAULT TO YES
ARC0640I GDSN01 - ADR035I (SCH)-PRIME(03), INSTALLATION EXIT ALTERED WORKUNIT DEFAULT TO
ARC0640I GDSN01 -  RESTORE DS(INCLUDE(TESTFR.CNTL.JCL                              )) -
ARC0640I GDSN01 -  INDDNAME(SYS00337) OUTDYNAM(MHL0A0,3390    ) REPLACE CANCELERROR -
ARC0640I GDSN01 -  BYPASSACS(TESTFR.CNTL.JCL                                    ) -
ARC0640I GDSN01 -  STORCLAS(HSMFR                         ) CATALOG FORCECP(0) -
ARC0640I GDSN01 -  MGMTCLAS(HFS                           )
ARC0640I GDSN01 - ADR101I (R/I)-RI01 (01), TASKID 001 HAS BEEN ASSIGNED TO COMMAND 'RESTORE '
ARC0640I GDSN01 - ADR109I (R/I)-RI01 (01), 2010.295 13:29:43 INITIAL SCAN OF USER CONTROL STATEMENTS COMPLETED
ARC0640I GDSN01 - ADR050I (001)-PRIME(01), DFSMSDSS INVOKED VIA APPLICATION INTERFACE
ARC0640I GDSN01 - ADR016I (001)-PRIME(01), RACF LOGGING OPTION IN EFFECT FOR THIS TASK
ARC0640I GDSN01 - ADR006I (001)-STEND(01), 2010.295 13:29:43 EXECUTION BEGINS
ARC0640I GDSN01 - ADR780I (001)-TDDS (01),
 THE INPUT DUMP DATA SET BEING PROCESSED IS IN FULL VOLUME FORMAT AND WAS CREATED BY DFSMSDSS VERSION 1
ARC0640I GDSN01 -                          RELEASE 12 MODIFICATION LEVEL 0 ON 2010.293 21:18:29
ARC0640I GDSN01 - ADR396I (001)-TDPNV(03), DATA SET TESTFR.CNTL.JCL ALLOCATED, ON VOLUME(S): MHL0A0
ARC0640I GDSN01 - ADR378I (001)-TDDS (01), THE FOLLOWING DATA SETS WERE SUCCESSFULLY PROCESSED FROM VOLUME MHL0A0
ARC0640I GDSN01 -                           TESTFR.CNTL.JCL                              RESTORED ON MHL0A0
ARC0640I GDSN01 - ADR006I (001)-STEND(02), 2010.295 13:29:44 EXECUTION ENDS
ARC0640I GDSN01 - ADR013I (001)-CLTSK(01), 2010.295 13:29:44 TASK COMPLETED WITH RETURN CODE 0000
ARC0640I GDSN01 - ADR012I (SCH)-DSSU (01), 2010.295 13:29:44 DFSMSDSS PROCESSING COMPLETE. HIGHEST RETURN CODE IS 0000
```

Figure 5-86 DFSMShsm dump log from the FRRECOV DSNAME(...) FROMDUMP command

Recovery of multivolume data sets from fast replication DASD backups

Multi-volume data sets are supported by fast replication data set recovery.

Important: Be careful when you recover a multi-volume data set if the catalog information was not captured during FRBACKUP. Always verify a correct catalog capture by using the LIST CP(...) DATASETS command.

We allocated a multi-volume data set in storage group SG2. See the output of LISTC in Figure 5-87.

```
 NONVSAM ------- ZFSFR.MV.DATA
      IN-CAT --- UCAT.ZFSFR
      HISTORY
        DATASET-OWNER-----(NULL)     CREATION--------2010.294
        RELEASE----------------2     EXPIRATION------0000.000
        ACCOUNT-INFO-----------------------------------(NULL)
      SMSDATA
        STORAGECLASS ------ZFSFR     MANAGEMENTCLASS---MCDB22
        DATACLASS --------(NULL)     LBACKUP ---0000.000.0000
      VOLUMES
        VOLSER------------MHL1A0     DEVTYPE------X'3010200F'
FSEQN---------
---------0
        VOLSER------------MHL1A1     DEVTYPE------X'3010200F'
FSEQN---------
---------0
      ASSOCIATIONS--------(NULL)
      ATTRIBUTES
 ***
```

Figure 5-87 Output of LISTC ENT('ZFSFR.MV.DATA') ALL command

After we backed up copy pool CPNSPANBOX07 by using fast replication, we deleted ZFSFR.MV.DATA as a single volume data set on volume MHL1A1. Then, we used the command that is shown in Example 5-46 to recover the data set from the fast replication DASD backup.

Example 5-46 Command to recover the data set from the fast replication DASD backup

```
HSEND FRRECOV DSNAME(ZFSFR.MV.DATA) REPLACE FROMCP(CPNSPANBOX07)
```

DFSMShsm JESMSGLG contains messages as shown in Figure 5-88.

```
19.22.58 STC23065  ARC1801I FAST REPLICATION DATA SET RECOVERY IS  972
   972             ARC1801I (CONT.) STARTING FOR DATA SET ZFSFR.MV.DATA, AT 19:22:58 ON
   972             ARC1801I (CONT.) 2010/10/21
19.22.58 STC23065  ARC1861I THE FOLLOWING 0001 DATA SET(S) WERE  973
   973             ARC1861I (CONT.) SUCCESSFULLY PROCESSED DURING FAST REPLICATION DATA
   973             ARC1861I (CONT.) SET RECOVERY:
19.22.58 STC23065  ARC1861I (CONT.) ZFSFR.MV.DATA, COPYPOOL=CPNSPANBOX07, DEVTYPE=DASD
19.22.58 STC23065  ARC1802I FAST REPLICATION DATA SET RECOVERY HAS  975
   975             ARC1802I (CONT.) COMPLETED FOR DATA SET ZFSFR.MV.DATA, AT 19:22:58 ON
   975             ARC1802I (CONT.) 2010/10/21, FUNCTION RC=0000, MAXIMUM DATA SET RC=0000
```

Figure 5-88 Excerpt from DFSMShsm JESMSGLG on the execution of the FRRECOV DSNAME(...) command

The messages in the DFSMShsm backup log are shown in Figure 5-89.

```
ARC1801I FAST REPLICATION DATA SET RECOVERY IS STARTING FOR DATA SET ZFSFR.MV.DATA, AT 19:22:58 ON 2010/10/21
ARC1861I THE FOLLOWING 0001 DATA SET(S) WERE SUCCESSFULLY PROCESSED DURING FAST REPLICATION DATA SET RECOVERY:
ARC1861I (CONT.) ZFSFR.MV.DATA, COPYPOOL=CPNSPANBOX07, DEVTYPE=DASD
ARC1802I FAST REPLICATION DATA SET RECOVERY HAS COMPLETED FOR DATA SET ZFSFR.MV.DATA, AT 19:22:58 ON 2010/10/21,
 FUNCTION RC=0000, MAXIMUM DATA SET RC=0000
```

Figure 5-89 Excerpt from the DFSMShsm backup log on the execution of the FRRECOV DSNAME(...) command

The messages in the DFSMShsm dump log are shown in Figure 5-90.

```
ARC0640I GDSN01 - PAGE 0001     5695-DF175  DFSMSDSS V1R12.0 DATA SET SERVICES     2010.294 19:22
ARC0640I GDSN01 - ADR035I (SCH)-PRIME(06), INSTALLATION EXIT ALTERED BYPASS FAC CLASS CHK DEFAULT TO YES
ARC0640I GDSN02 - PAGE 0001     5695-DF175  DFSMSDSS V1R12.0 DATA SET SERVICES     2010.294 19:22
ARC0640I GDSN02 - ADR035I (SCH)-PRIME(06), INSTALLATION EXIT ALTERED BYPASS FAC CLASS CHK DEFAULT TO YES
ARC0640I GDSN01 -  COPY DS(INC(ZFSFR.MV.DATA                              )) -
ARC0640I GDSN02 -  COPY DS(INC(ZFSFR.MV.DATA                              )) -
ARC0640I GDSN01 -  PHYSINDY(YY8140) OUTDYNAM(MHL1A0) -
ARC0640I GDSN02 -  PHYSINDY(YY8141) OUTDYNAM(MHL1A1) -
ARC0640I GDSN01 -  BYPASSACS(ZFSFR.MV.DATA                             ) -
ARC0640I GDSN02 -  BYPASSACS(ZFSFR.MV.DATA                             ) -
ARC0640I GDSN01 -  ALLDATA(*) ALLEXCP REPLACEU CANCELERROR -
ARC0640I GDSN02 -  ALLDATA(*) ALLEXCP REPLACEU CANCELERROR -
ARC0640I GDSN01 -  TGTGDS( DEFERRED) -
ARC0640I GDSN02 -  TGTGDS( DEFERRED) -
ARC0640I GDSN01 -  FORCECP(0) PROCESS(SYS1) -
ARC0640I GDSN02 -  FORCECP(0) PROCESS(SYS1) -
ARC0640I GDSN01 -  STORCLAS(ZFSFR                        ) -
ARC0640I GDSN02 -  STORCLAS(ZFSFR                        ) -
ARC0640I GDSN01 -  MGMTCLAS(MCDB22                       ) -
ARC0640I GDSN02 -  MGMTCLAS(MCDB22                       ) -
ARC0640I GDSN01 -  DEBUG(FRMSG(DTL)) -
ARC0640I GDSN02 -  DEBUG(FRMSG(DTL)) -
ARC0640I GDSN01 -  FASTREPLICATION(PREFERRED)
ARC0640I GDSN02 -  FASTREPLICATION(PREFERRED)
ARC0640I GDSN01 - ADR101I (R/I)-RI01 (01), TASKID 001 HAS BEEN ASSIGNED TO COMMAND 'COPY '
ARC0640I GDSN02 - ADR101I (R/I)-RI01 (01), TASKID 001 HAS BEEN ASSIGNED TO COMMAND 'COPY '
ARC0640I GDSN01 - ADR109I (R/I)-RI01 (01), 2010.294 19:22:58 INITIAL SCAN OF USER CONTROL STATEMENTS COMPLETED
ARC0640I GDSN02 - ADR109I (R/I)-RI01 (01), 2010.294 19:22:58 INITIAL SCAN OF USER CONTROL STATEMENTS COMPLETED
ARC0640I GDSN01 - ADR050I (001)-PRIME(02), DFSMSDSS INVOKED VIA CROSS MEMORY APPLICATION INTERFACE
ARC0640I GDSN02 - ADR050I (001)-PRIME(02), DFSMSDSS INVOKED VIA CROSS MEMORY APPLICATION INTERFACE
ARC0640I GDSN01 - ADR016I (001)-PRIME(01), RACF LOGGING OPTION IN EFFECT FOR THIS TASK
ARC0640I GDSN02 - ADR016I (001)-PRIME(01), RACF LOGGING OPTION IN EFFECT FOR THIS TASK
ARC0640I GDSN01 - ADR006I (001)-STEND(01), 2010.294 19:22:58 EXECUTION BEGINS
ARC0640I GDSN02 - ADR006I (001)-STEND(01), 2010.294 19:22:58 EXECUTION BEGINS
ARC0640I GDSN01 - ADR396I (001)-PCNVS(01), DATA SET ZFSFR.MV.DATA ALLOCATED, ON VOLUME(S): MHL1A0
ARC0640I GDSN02 - ADR396I (001)-PCNVS(01), DATA SET ZFSFR.MV.DATA ALLOCATED, ON VOLUME(S): MHL1A1
ARC0640I GDSN02 - ADR806I (001)-TOMI (01), DATA SET ZFSFR.MV.DATA COPIED USING A FAST REPLICATION FUNCTION
ARC0640I GDSN01 - ADR806I (001)-TOMI (01), DATA SET ZFSFR.MV.DATA COPIED USING A FAST REPLICATION FUNCTION
ARC0640I GDSN02 - ADR454I (001)-DDDS (02), THE FOLLOWING DATA SETS WERE SUCCESSFULLY PROCESSED
ARC0640I GDSN02 -                           ZFSFR.MV.DATA
ARC0640I GDSN02 - ADR006I (001)-STEND(02), 2010.294 19:22:58 EXECUTION ENDS
ARC0640I GDSN02 - ADR013I (001)-CLTSK(01), 2010.294 19:22:58 TASK COMPLETED WITH RETURN CODE 0000
ARC0640I GDSN02 - ADR012I (SCH)-DSSU (01), 2010.294 19:22:58 DFSMSDSS PROCESSING COMPLETE. HIGHEST RETURN CODE IS 0000
ARC0640I GDSN01 - ADR454I (001)-DDDS (02), THE FOLLOWING DATA SETS WERE SUCCESSFULLY PROCESSED
ARC0640I GDSN01 -                           ZFSFR.MV.DATA
ARC0640I GDSN01 - ADR006I (001)-STEND(02), 2010.294 19:22:58 EXECUTION ENDS
ARC0640I GDSN01 - ADR013I (001)-CLTSK(01), 2010.294 19:22:58 TASK COMPLETED WITH RETURN CODE 0000
ARC0640I GDSN01 - ADR012I (SCH)-DSSU (01), 2010.294 19:22:58 DFSMSDSS PROCESSING COMPLETE. HIGHEST RETURN CODE IS 0000
```

Figure 5-90 Excerpt from the DFSMShsm dump log on the execution of the FRRECOV DSNAME(...) command

On the completion of the recovery process, the data set was allocated on volumes MHL1A0 and MHL1A1 as it was allocated at the time of the backup.

5.3.7 Changing the number of backup copies setting on copy pools

Important: The “number of backup copies” setting on copy pools must not be changed without special consideration.

Incrementing the number of DASD backup versions on a copy pool means increasing the number of target volumes, as well. The same rule applies to decrementing the number of DASD backup versions. Changing the number setting will not cause additional hardware costs but it affects the current operations in your data center.

Next, certain issues that might occur with these changes are described.

Source Control Data Set (SCDS) changes

Changing the number of fast replication DASD backup versions means that you must change the copy pool setting in an SCDS. After validation, you must activate the new configuration. Because DFSMShsm does not look at a changing SMS configuration when the change actually occurs but rather when a DFSMShsm function or a command is executed, it might take time until you notice any changes, for example, in the output of a LIST command.

DFSMShsm notices any changes in copy pool and storage group settings only while executing a FR... command.

Increasing the number of DASD backup versions on a copy pool

When you increase the number of DASD backup versions on a copy pool, first you must add additional volumes to the CPBSGs, as necessary. Next, as advised, execute a FRBACKUP ... PREPARE command.

The example that is shown in Figure 5-91 describes an environment of a copy pool where you might need to use the FORCE parameter on the execution of a FRBACKUP ... PREPARE command.

Tip: When you must issue PREPARE FORCE on a copy pool that currently holds an incremental backup version, the FlashCopy relationship will be withdrawn during execution of the command.

You can avoid the withdrawal of the FlashCopy relationship by skipping the FRBACKUP ... PREPARE FORCE command and instead going directly to the FRBACKUP ... EXECUTE FORCE command. This approach preserves the incremental FlashCopy relationships.

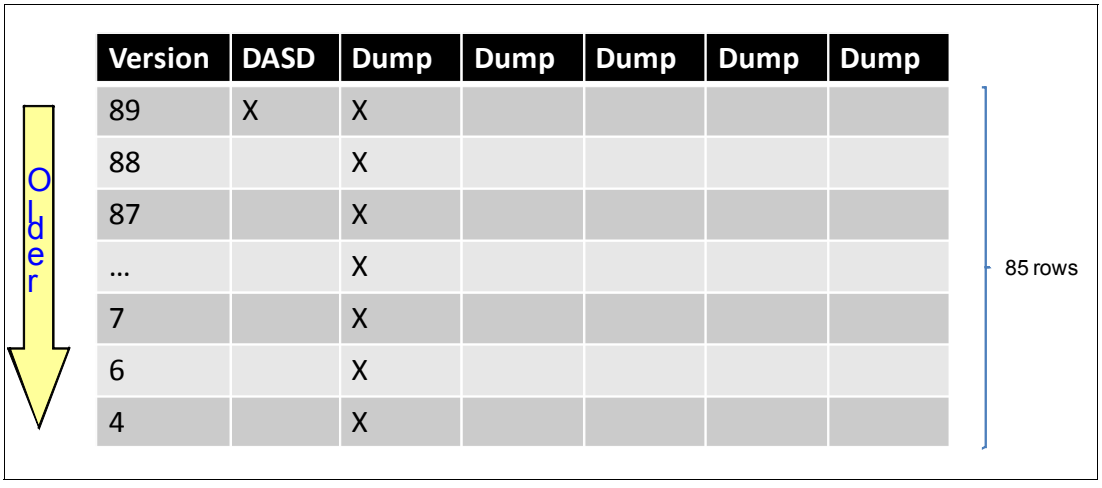

Figure 5-91 DFSMShsm internal table of backup versions of a copy pool

The copy pool is configured to hold one fast replication DASD backup version. As many dump copies of older fast replication versions exist as the table can hold at a time. Now, assume that you need to change the copy pool settings to hold two fast replication DASD backup versions instead of one. According to the general guidelines, you need to execute a FRBACKUP ... PREPARE command to verify the copy pool environment. Even when you correctly prepare the environment to match the new copy pool setting, you will end up with messages as shown in Figure 5-92.

```
ARC1001I COPY POOL CP2 FRBACKUP FAILED, RC=0006, REAS=0050
ARC1806E FAST REPLICATION BACKUP HAS FAILED FOR COPY POOL CP2, RC=0050
```

Figure 5-92 Messages on FRBACKUP ... PREPARE command

Message ARC1806E states "`The dump copies are incomplete for the DASD version to be replaced.`"

This message does not help because you merely wanted to verify your environment and did not intend to replace any DASD version, and no dump copy is pending.

The reason for this message is that prepare processing attempts to use an empty row in the table (Figure 5-91 on page 139), which currently is unavailable. So, to allow prepare processing to complete successfully, you can delete one fast replication backup version manually to free space in the table, or you can use the command as shown in Example 5-47.

Example 5-47 FRBACKUP ... PREPARE FORCE

```
HSEND FRBACKUP PREPARE CP(CP2) FORCE
```

By using the FORCE parameter on the PREPARE command, the oldest dump copy is rolled off during prepare processing, therefore allowing the processing to reuse the empty row for preparing the next fast replication DASD backup version.

Figure 5-93 on page 141 shows part of the output that resulted from the LIST CP(CP2) command just before prepare processing. Versions 0006 and 0004 are the oldest versions at that time.

```
-- DFSMShsm CONTROL DATASET --COPY POOL--LISTING --------- AT 23:33:19 ON
10/10/18 FOR SYSTEM=SC70

 COPYPOOL=CP2
 ALLOWPPRCP FRB=NO FRR=NO

 VERSION  VTOCENQ     DATE           TIME     FASTREPLICATIONSTATE  DUMPSTATE
   089      Y      2010/10/18      22:35:03   RECOVERABLE           ALLCOMPLETE
 TOKEN(C)=C''
 TOKEN(H)=X''
 TOTAL NUM OF
VOLUMES=00001,INCREMENTAL=Y,CATINFO=Y,FCFRR=Y,RECOVERYINCOMPLETE=N

 SGNAME   SOURCE - TARGET  SOURCE - TARGET  SOURCE - TARGET  SOURCE - TARGET
 SG1      MHLOA0 - YYDF20
...
 VERSION  VTOCENQ     DATE           TIME     FASTREPLICATIONSTATE  DUMPSTATE
   006      Y      2010/10/18      21:58:41   NONE                  ALLCOMPLETE
 ...

 SOURCE   DUMPVOLS                                              DEVICE TYPE
 MHLOA0   VT0017                                                3590-1
 FILE SEQ=00, DSNAME=HSM.DMP.DCFR112.VMHLOA0.D10291.T415821

 VERSION  VTOCENQ     DATE           TIME     FASTREPLICATIONSTATE  DUMPSTATE
   004      Y      2010/10/13      18:11:40   NONE                  ALLCOMPLETE
...
 SOURCE   DUMPVOLS                                              DEVICE TYPE
 MHLOA0   VT0004                                                3590-1
 FILE SEQ=00, DSNAME=HSM.DMP.DCFR112.VMHLOA0.D10286.T401118

0----- END OF -- COPY POOL -- LISTING -----
```

Figure 5-93 Excerpt from the LIST COPYPOOL CP(CP2) command before PREPARE FORCE

Figure 5-94 shows part of the output that resulted from the LIST CP(CP2) command after the PREPARE processing. Version 0006 is still in place, but version 0004 disappeared. Instead of version 0004, a new fast replication DASD backup version was prepared.

```
 VERSION  VTOCENQ     DATE           TIME     FASTREPLICATIONSTATE  DUMPSTATE
   006      Y      2010/10/18      21:58:41   NONE                  ALLCOMPLETE
...
 SOURCE   DUMPVOLS                                              DEVICE TYPE
 MHLOA0   VT0017                                                3590-1
 FILE SEQ=00, DSNAME=HSM.DMP.DCFR112.VMHLOA0.D10291.T415821

 VERSION  VTOCENQ     DATE           TIME     FASTREPLICATIONSTATE  DUMPSTATE

 SGNAME   SOURCE - TARGET  SOURCE - TARGET  SOURCE - TARGET  SOURCE - TARGET
 SG1      MHLOA0 - MLD361

0----- END OF -- COPY POOL -- LISTING -----
```

Figure 5-94 Excerpt from the LIST COPYPOOL CP(CP2) command after PREPARE FORCE

Even when you successfully prepared the copy pool, you must continue with a FRBACKUP ... EXECUTE FORCE command if the current fast replication DASD backup version is an incremental backup version.

Decreasing the number of DASD backup versions on a copy pool

We tested a copy pool that was decremented from two versions to one. To add more complexity, one of the backups was incremental. We started from this copy pool setting (Figure 5-95).

```
 COPY POOL DISPLAY                 Page 1 of 5
Command ===>

CDS Name  . . : SYS1.SMS.SCDS
Copy Pool Name: CP2

Description : COPY POOL FOR INCREMENTAL BACKUP

Auto Dump  . . . : N
Dump Class . . . :
Dump Class . . . :
Dump Class . . . :
Dump Class . . . :
Dump Class . . . :
Dump Sys/Sys Group Name :
Number of DASD Fast Replication Backup Versions with Background Copy : 2
FRBACKUP to PPRC Primary Volumes allowed :
FRRECOV to PPRC Primary Volumes allowed :
```

Figure 5-95 Display of copy pool CP2

There were two fast replication DASD backup versions at the beginning of our test (Figure 5-96). Version 104 was incremental and version 103 was non-incremental.

```
 -- DFSMShsm CONTROL DATASET --COPY POOL--LISTING --------- AT 15:15:18 ON
10/10/20 FOR SYSTEM=SC70

 COPYPOOL=CP2
 ALLOWPPRCP FRB=NO FRR=NO

 VERSION  VTOCENQ     DATE           TIME     FASTREPLICATIONSTATE  DUMPSTATE
   104      Y      2010/10/19      22:00:27   RECOVERABLE           ALLCOMPLETE
 TOKEN(C)=C''
 TOKEN(H)=X''
 TOTAL NUM OF
VOLUMES=00001,INCREMENTAL=Y,CATINFO=Y,FCFRR=Y,RECOVERYINCOMPLETE=N

 SGNAME   SOURCE - TARGET  SOURCE - TARGET  SOURCE - TARGET  SOURCE - TARGET
 SG1      MHLOA0 - YYDF20

 VERSION  VTOCENQ     DATE           TIME     FASTREPLICATIONSTATE  DUMPSTATE
   103      Y      2010/10/19      21:58:27   RECOVERABLE           ALLCOMPLETE
 TOKEN(C)=C''
 TOKEN(H)=X''
 TOTAL NUM OF
VOLUMES=00001,INCREMENTAL=N,CATINFO=Y,FCFRR=Y,RECOVERYINCOMPLETE=N

 SGNAME   SOURCE - TARGET  SOURCE - TARGET  SOURCE - TARGET  SOURCE - TARGET
 SG1      MHLOA0 - MLD361

0----- END OF -- COPY POOL -- LISTING -----
```

Figure 5-96 Output of the LIST CP(CP2) command

Next, we changed the number of fast replication DASD backup versions with background copy setting (“Number of DASD Fast Replication Backup Versions with Background Copy”) to 1 (Figure 5-97) and activated the new SMS configuration.

```
 COPY POOL DISPLAY                 Page 1 of 5
Command ===>

CDS Name  . . : SYS1.SMS.SCDS
Copy Pool Name: CP2

Description : COPY POOL FOR INCREMENTAL BACKUP

Auto Dump  . . . : N
Dump Class . . . :
Dump Class . . . :
Dump Class . . . :
Dump Class . . . :
Dump Class . . . :
Dump Sys/Sys Group Name :
Number of DASD Fast Replication Backup Versions with Background Copy : 1
FRBACKUP to PPRC Primary Volumes allowed :
FRRECOV to PPRC Primary Volumes allowed :
```

Figure 5-97 Changed the setting of copy pool CP2

Now, we attempted to create a new fast replication DASD backup version by using the command as shown in Example 5-48.

Example 5-48 FRBACKUP CP(CP2) command

```
HSEND FRBACKUP CP(CP2)
```

The following messages appeared in the DFSMShsm backup log (Figure 5-98).

```
ARC1801I FAST REPLICATION BACKUP IS STARTING FOR COPY POOL CP2, AT 14:29:16 ON 2010/10/20
ARC1806E FAST REPLICATION BACKUP HAS FAILED FOR COPY POOL CP2, RC=0066
ARC1802I FAST REPLICATION BACKUP HAS COMPLETED FOR COPY POOL CP2, AT 14:29:16 ON 2010/10/20, FUNCTION RC=0006,
 MAXIMUM VOLUME RC=0000, CAPTURE CATALOG RC=0000
```

Figure 5-98 Excerpt from the DFSMShsm backup log

Message ARC1806E states "The number of versions in the copy pool definition was reduced such that an FRBACKUP command will cause the automatic deletion of an incremental backup version."

The application programmer response offers these guidelines:

"Do one of the following:

- If an incremental version is required in the copy pool and the number of versions is greater than zero, change the number of versions in the copy pool definition when the incremental version is the oldest disk generation possible. Issue the FRBACKUP command again.
- Issue LIST CP(cpname) to determine which version is the incremental version and delete the incremental version by using the FRDELETE command. Issue the FRBACKUP command again with the FCINCREMENTAL keyword."

Because we were not interested in losing the incremental backup version, we did not follow the last guideline. The first guideline did not help because we did not understand it. So, we solved the problem by using the command that is shown in Example 5-49 to delete the fast replication DASD backup version. We checked the version number of the non-incremental backup version by reviewing Figure 5-96 on page 143.

Example 5-49 FRDELETE CP(CP2) VERSIONS(...) command

```
HSEND FRDELETE CP(CP2) VERSIONS(103)
```

The messages in DFSMShsm JESMSGLG (Figure 5-99) confirm the deletion of the fast replication DASD backup version that was non-incremental.

```
14.32.15 STC22372  ARC1831I BACKUP VERSION NUMBER 103 OF COPY POOL CP2  289
   289             ARC1831I (CONT.) WAS DELETED SUCCESSFULLY
```

Figure 5-99 Excerpt from DFSMShsm JESMSGLG

We tried the command again as shown in Example 5-48 on page 144, and it worked. Our method allowed for the preservation of the incremental backup version. The backup versions are now available (Figure 5-100 on page 146).

```
 -- DFSMShsm CONTROL DATASET --COPY POOL--LISTING --------- AT 15:15:18 ON
10/10/20 FOR SYSTEM=SC70

 COPYPOOL=CP2
 ALLOWPPRCP FRB=NO FRR=NO

 VERSION  VTOCENQ     DATE           TIME     FASTREPLICATIONSTATE  DUMPSTATE
   105      Y      2010/10/20      14:33:10   RECOVERABLE           NONE
 TOKEN(C)=C''
 TOKEN(H)=X''
 TOTAL NUM OF
VOLUMES=00001,INCREMENTAL=Y,CATINFO=Y,FCFRR=Y,RECOVERYINCOMPLETE=N

 SGNAME   SOURCE - TARGET  SOURCE - TARGET  SOURCE - TARGET  SOURCE - TARGET
 SG1      MHLOA0 - YYDF20

 VERSION  VTOCENQ     DATE           TIME     FASTREPLICATIONSTATE  DUMPSTATE
   104      Y      2010/10/19      22:00:27   NONE                  ALLCOMPLETE
 TOKEN(C)=C''
 TOKEN(H)=X''
 TOTAL NUM OF
VOLUMES=00001,INCREMENTAL=Y,CATINFO=Y,FCFRR=Y,RECOVERYINCOMPLETE=N

 SGNAME   SOURCE - TARGET  SOURCE - TARGET  SOURCE - TARGET  SOURCE - TARGET
 SG1      MHLOA0 - YYDF20

0----- END OF -- COPY POOL -- LISTING -----
```

Figure 5-100 Output of the LIST CP(...) command

5.4 Correcting mismatched preassigned volume pairs

How do you correct mismatching preassigned volume pairs? No “unprepare” keyword is available. But, you can remove preassigned volume pairs by using the FRDELETE command.

5.4.1 FRDELETE command

By using FRDELETE, you can delete the following members of a copy pool:

- One or more backup versions that are identified by their version numbers
- All backup versions
- Preassigned volume pairs

If you want to delete the preassigned volume pairs of a particular prepared version, you must use the VERSIONS parameter to identify this particular version. You can use the LIST CP(...) GEN(...) command to verify your selection. GEN(0) is always the latest backup version, GEN(1) is the predecessor, and so on.

5.4.2 LIST command

Before the actual deletion, we use the LIST command as shown in Example 5-50 on page 147 to verify the preassigned volume pairs that we want to remove.

Example 5-50 LIST command that includes ALLVOL(GEN(...))

```
HSEND LIST CP(CP1) ALLVOL(GEN(1)) TERM
```

The output of the LIST command confirms our selection. Because no backup version is available so far, GEN(1) must be version 2. (For whatever reason, this information is wrong. It is version 1 that must be deleted.)

```
 COPYPOOL=CP1                          ,ALLOWPPRCP FRB=NO FRR=NO
 VER=***,VTOCENQ=*,MADE ON ********** AT ********,FRS=***************,DPS******
*****
 TKN(C)=C''
 TKN(H)=X''
 TOTAL NUM OF VOLUMES=00001,INCREMENTAL=N,CATINFO=N,FCFRR=Y,RECOVERYINCOMPLETE=N
 SGNAME=SG1       SOURCE=MHLOA0  TARGET=YYDF20
 ARC0140I LIST COMPLETED,        8 LINE(S) OF DATA OUTPUT
```

Figure 5-101 Output of the LIST command that includes ALLVOL(GEN(...))

5.4.3 Deleting preassigned pairs

Now, you can delete all preassigned volume pairs of prepared backup version 1 by using the command that is shown in Example 5-51.

Example 5-51 FRDELETE command to delete the preassigned volume pairs

```
HSEND FRDELETE CP(CP1) VERSION(1)
```

The captured messages are shown in Figure 5-102.

```
ARC1831I BACKUP VERSION NUMBER 1 OF COPY POOL CP1 WAS DELETED SUCCESSFULLY
ARC1832I 1 VERSION(S) DELETED FOR COPYPOOL CP1
```

Figure 5-102 FRDELETE panel messages

By executing the same LIST command again as shown in Example 5-9 on page 74, we can see that we were successful. (You can see the output in Figure 5-103.)

```
 COPYPOOL=CP1                          ,ALLOWPPRCP FRB=NO FRR=NO
 VER=***,VTOCENQ=*,MADE ON ********** AT ********,FRS=***************,DPS******
*****
 TKN(C)=C''
 TKN(H)=X''
 TOTAL NUM OF VOLUMES=00001,INCREMENTAL=N,CATINFO=N,FCFRR=Y,RECOVERYINCOMPLETE=N
 SGNAME=SG1       SOURCE=MHLOA0  TARGET=YYD006
 ARC0140I LIST COMPLETED,        8 LINE(S) OF DATA OUTPUT
```

Figure 5-103 LIST command for copy pool

Now, we are ready to start over again with a new FRBACKUP CP(CP1) PREPARE command.

6

DFSMShsm fast replication security

RACF FACILITY class profiles are used to protect the DFSMShsm fast replication environment. This chapter describes the security considerations for DFSMShsm fast replication and explains how to use RACF to control access to the environment.

6.1 Security for DFSMShsm fast replication

This section describes the RACF support for DFSMShsm and the RACF FACILITY class profiles that are used to protect the DFSMShsm fast replication function. The requirements are described for defining DFSMShsm as a started task to RACF for the use of the cross-memory mode address spaces. With the RACF support for DFSMShsm, a client can control access to DFSMShsm commands by using RACF FACILITY class profiles.

DFSMShsm provides two levels of commands to be protected by RACF FACILITY class profiles:

- Storage administrator commands
- User commands

User commands can be issued by any TSO user if the user has appropriate RACF authority to the data sets to be processed.

Storage administrator commands can be issued by a DFSMShsm authorized user only. No RACF checking is performed to confirm your authority to access the data sets to be processed. In many installations, the storage administrator is different from the security administrator. The security administrator needs to control and monitor the activities against all sensitive data.

A storage administrator who needs to issue only DFSMShsm configuration type commands, such as ADDVOL, can also issue other commands, such as RECOVER *datasetname* NEWNAME. This user might not be allowed by RACF to access this data set, but the user can copy or rename it to a new data set name to which they have READ or ALTER authority. And, the user can use DFSMShsm storage administrator commands to access or delete data that is restricted to them.

As with storage administrator commands, users have access to all user commands and parameters. No granularity exists at the command level.

6.2 The RACF FACILITY class

Table 6-1 shows the base set of FACILITY class profiles for DFSMShsm command protection.

Table 6-1 Base STGADMIN profiles

Profile	Protects
STGADMIN.*	All Data Facility Storage Management Subsystem (DFSMS) commands, including all DFSMShsm commands
STGADMIN.ARC.*	All DFSMShsm commands
STGADMIN.ARC.cmd	Specific storage administrator command
STGADMIN.ARC.cmd.prm	Specific storage administrator command with specific parameter
STGADMIN.ARC.ENDUSER.*	All user commands
STGADMIN.ARC.ENDUSER.h_cmd	Specific user command
STGADMIN.ARC.ENDUSER.h_cmd.prm	Specific user command with specific parameter

Note: The STGADMIN.* profile in this table is a general profile that can be used by other applications, so deleting it can affect other applications.

Table 6-2 shows the RACF profiles that are required to protect the DFSMShsm fast replication commands FRBACKUP, FRRECOV, and FRDELETE.

Table 6-2 STGADMIN profiles for fast replication

Profile	Protects
STGADMIN.ARC.FB.* or STGADMIN.ARC.FB.*cpname*	Any FRBACKUP command Any FRBACKUP CP(only for *cpname*)
STGADMIN.ARC.FR.* or STGADMIN.ARC.FR.*cpname* STGADMIN.ARC.FR.NEWNAME	Any FRRECOV command Any FRRECOV CP(only for *cpname*) Any FRRECOV NEWNAME command
STGADMIN.ARC.FD.* or STGADMIN.ARC.FD.*cpname*	Any FRDELETE command Any FRDELETE CP(only for *cpname*)

For a complete listing of DFSMShsm commands that can be protected, see the *DFSMShsm Implementation and Customization Guide*, SC35-0418.

6.2.1 RACF considerations

If the RACF FACILITY class is not already in use, certain commands are required to prepare the system to protect DFSMShsm commands through RACF.

Tip: To enable the security environment, you must activate the FACILITY class before DFSMShsm is started. When DFSMShsm is started, it checks to determine whether the FACILITY class is active and will fail if the new profiles are not defined.

Creation of the profiles, authorization of users, and activation of the FACILITY class are usually performed by the security administrator.

Table 6-3 shows the RACF commands that are used to activate the FACILITY class protection and to authorize users at different levels to issue DFSMShsm commands.

Table 6-3 RACF commands

RACF command	Purpose
SETROPTS CLASSACT(FACILITY)	Defines the FACILITY class as active
SETROPTS RACLIST(FACILITY)	Activates the sharing or in-storage profiles (improves performance)
RDEFINE FACILITY STGADMIN.ARC.* UACC(NONE)	Defines a default profile, denying all users access to storage administrator commands
PERMIT STGADMIN.ARC.* CLASS(FACILITY) ACCESS(READ) ID(STADM1)	Allows user STDAM1 to issue all storage administrator commands
PERMIT STGADMIN.ARC.FRRECOV CLASS(FACILITY) ACCESS(READ) USER(OPER1)	Allows user OPER1 to issue the FRRECOV command only

6.2.2 User access

FACILITY class profiles are defined in this class so that resource managers (typically licensed programs or components of MVS) can check a user's access to the profiles when the user acts, such as issuing a DFSMShsm command.

A *discrete profile* protects a single resource that has unique security requirements (for example, a specific command). A *generic profile* is a resource profile that can provide RACF protection for zero or more resources. The resources that are protected by a generic profile have similar names and identical security requirements.

To permit a specific user to access a RACF FACILITY class profile, you specify the user ID (ID(*user ID*)) and the universal access (UACC) that the user is allowed to the resources that are protected by the profile.

If a FACILITY class profile that protects a DFSMShsm command is defined with UACC(READ), all users can issue the DFSMShsm user command. The exception is that a discrete profile for that command exists that denies a specific user access.

If a profile for a DFSMShsm command is defined with UACC(NONE), no user can issue the DFSMShsm user command unless that user is granted access by a discrete profile that is defined for that command or if a PERMIT for that user is issued with ACCESS(READ).

Tip: The SETROPTS command with REFRESH can be used to activate new or changed profiles. From the RACF main panel, Services Options Menu, select the option.

The SETROPTS command with the REFRESH option can be used to activate new or changed profiles. From the RACF main panel, Services Options Menu, select option **5 System Options** and select option **6 REFRESH**. Enter `Yes`, as appropriate, as shown in Figure 6-1.

```
 RACF - REFRESH IN-STORAGE INFORMATION
COMMAND ===>

To refresh in-storage PROGRAM CONTROL TABLES,
   enter YES      YES


To refresh in-storage PROFILES FOR ALL CLASSES, enter the following.

   GLOBAL         YES <---- specify YES or leave blank
   GENERIC        YES <---- specify YES or leave blank


To refresh in-storage PROFILES FOR SPECIFIC CLASSES,
   enter YES      YES
```

Figure 6-1 RACF refresh panel

Next, select resources that are to be refreshed as listed in Figure 6-2.

```
 RACF - REFRESH TABLES
COMMAND ===>

Enter class names in the CLASS column.
To specify GLOBAL, GENERIC, or RACLIST, enter YES.
You may specify any combination of GLOBAL, GENERIC, and RACLIST.


 CLASS      GLOBAL  GENERIC  RACLIST       CLASS      GLOBAL  GENERIC RACLIST
 ----------------------------------       ----------------------------------
 FACILITY   ___     YES      YES           ________   ___     ___     ___
 ________   ___     ___      ___           ________   ___     ___     ___
```

Figure 6-2 Select classes to refresh

After you press Enter, the refresh occurs and returns the message `ICH14063I "SETROPTS command complete`." This refresh causes all in-storage profiles within the specified resource class to be replaced with new copies from the RACF database.

For more information about RACF profiles and commands, see these documents:

- *z/OS Security Server RACF Command Language Reference*, SA22-7687
- *z/OS Security Server RACF Security Administrator's Guide*, SA22-7683

6.2.3 DFSMShsm QUERY SECURITY command

The existing QUERY command has a new optional parameter that is called SECURITY.

The QUERY SECURITY command displays the type of command security that is in effect. An ARC1700I message is written that shows the type of security.

When storage administrator and user commands are protected by FACILITY class profiles, the ARC1700I message in Example 6-1 is written.

Example 6-1 QUERY SECURITY that uses RACF

```
ARC0101I QUERY SECURITY COMMAND STARTING ON HOST=5
ARC1700I DFSMSHSM COMMANDS ARE RACF PROTECTED
ARC0101I QUERY SECURITY COMMAND COMPLETED ON HOST=5
```

When storage administrator and user commands are protected by the DFSMShsm AUTH command, the ARC1700I message that is shown in Example 6-2 is written.

Example 6-2 QUERY SECURITY that uses the AUTH command

```
ARC0101I QUERY SECURITY COMMAND STARTING ON HOST=5
ARC1700I DFSMSHSM COMMANDS ARE AUTH PROTECTED
ARC0101I QUERY SECURITY COMMAND COMPLETED ON HOST=5
```

6.3 Identifying the DFSMShsm started task to RACF

With z/OS DFSMS V1.12, you can use DFSMShsm to specify the functions to invoke DFSMSdss in cross-memory mode to alleviate “below the line” storage constraints.

A RACF user ID must be created for DFSMShsm. RACF associates the DFSMShsm user ID with a RACF profile for DFSMShsm. The profile allows DFSMShsm to bypass RACF protection during the migration and backup of user data sets. After you create the DFSMShsm RACF user ID, you must ensure that the DFSMShsm started procedure is defined to the RACF started procedures table.

6.3.1 Configuring DFSMShsm to invoke DFSMSdss as a started task

When DFSMShsm invokes DFSMSdss by using the DFSMSdss cross-memory application programming interface (API), DFSMShsm requests that DFSMSdss use a unique address space identifier for each unique DFSMShsm function and host ID. Table 6-4 on page 155 is a list of the DFSMSdss address space identifiers.

Preparation

If you plan to configure DFSMShsm to start DFSMSdss in its own address space by using the DFSMSdss cross-memory API, you need to configure your security system, in our case RACF, to permit these tasks.

You can associate a RACF user ID to a started task in two ways. These tasks can be defined explicitly in the RACF started procedures table (ICHRIN03), or they can be defined generically in the RACF STARTED class. For specific information about defining the DFSMShsm task to RACF, see the *z/OS DFSMShsm Implementation and Customization Guide*, SC35-0418.

RACF STARTED class example

Example 6-3 shows sample commands that you can use to associate a user ID with a started task by using the RACF STARTED class. The user ID in our example is DFHSM.

Example 6-3 RACF STARTED class example for DFHSM

```
SETR GENERIC(STARTED)
RDEFINE STARTED ARC*.* STDATA(USER(DFHSM))
SETR RACLIST(STARTED) REFRESH
```

6.3.2 DFSMSdss address spaces started by DFSMShsm

To maximize throughput, DFSMSdss address spaces are started by DFSMShsm for certain functions.

Preparation

Table 6-4 lists the DFSMSdss address space identifiers for address spaces that are started by DFSMShsm.

Table 6-4 DFSMSdss address space identifiers for address spaces that are started by DFSMShsm

Function address space identifier	Address space identifier
Backup	ARC*n*BKUP
Control data set (CDS) backup	ARC*n*CDSB
Dump	ARC*n*DUMP
Fast replication backup	DSSFRB*xx*
Fast replication recovery (copy pool and volume)	DSSFRR*xx*
Fast replication recovery (data set)	DSSFRDSR
Migration	ARC*n*MIGR
Recovery from backup (data set and full-volume)	ARC*n*RCVR
Recovery from a dump tape (data set)	ARC*n*REST
Recovery from a dump tape (full-volume)	ARC*n*RST*y*

The following variables are used in the address space identifiers in Table 6-4:

n This variable is the unique DFSMShsm host ID.

xx This variable is the instance of the DFSMSdss started task for fast replication backup and fast replication recovery. The value is a two-digit number 01 - 64.

y This variable is the instance of the DFSMSdss started task for full-volume recovery from a dump tape. The value is a number 1 - 4.

For example, the migration for DFSMShsm host ID 1 results in a generated address space identifier of ARC1MIGR.

Considerations for DFSMSdss address spaces started by DFSMShsm

The FRBACKUP and FRRECOV commands always use DFSMSdss cross-memory support. Use of the DFSMSdss cross-memory API for these functions might result in an increase in CPU time.

After DFSMShsm starts one or more of these address spaces, the address spaces remain active until DFSMShsm is terminated. When DFSMShsm terminates, all of the started DFSMSdss address spaces automatically terminate.

Normally, the starting process for DFSMSdss is IEESYSAS. When IEESYSAS views active jobs in System Display and Search Facility (SDSF), IEESYSAS appears as the job name and the DFSMShsm passed address space identifier appears as the step name.

The DFSMSdss address space identifiers that are started for the dump, data set recovery from dump, data set recovery from backup, migration, backup, and CDS backup functions are optional. The DFSMSdss address space identifiers are controlled by using the SETSYS DSSXMMODE command in the ARCCMDxx member of SYS1.PARMLIB. For more information about using the SETSYS DSSXMMODE command, see *z/OS DFSMShsm Storage Administration,* SC35-0421.

7

Using DFSMSdss to back up copy pools

This chapter shows you how to dump a copy pool to tape by using DFSMSdss and how to restore the tape dump.

7.1 The requirement to back up copy pools

One benefit of using the fast replication function is that it enables a fast replication of a set of volumes to be followed by a dump of each target volume that produces a dump tape that can be restored directly back to the source volume. This capability enables the dump function to be performed without a significant outage.

DFSMShsm does not support the DUMP function for target volumes. Attempts to create a dump copy of a target volume by using either AUTODUMP or the BACKVOL DUMP command fail. You must use DFSMSdss or an equivalent product to create a dump copy of a target volume as shown in Figure 7-1.

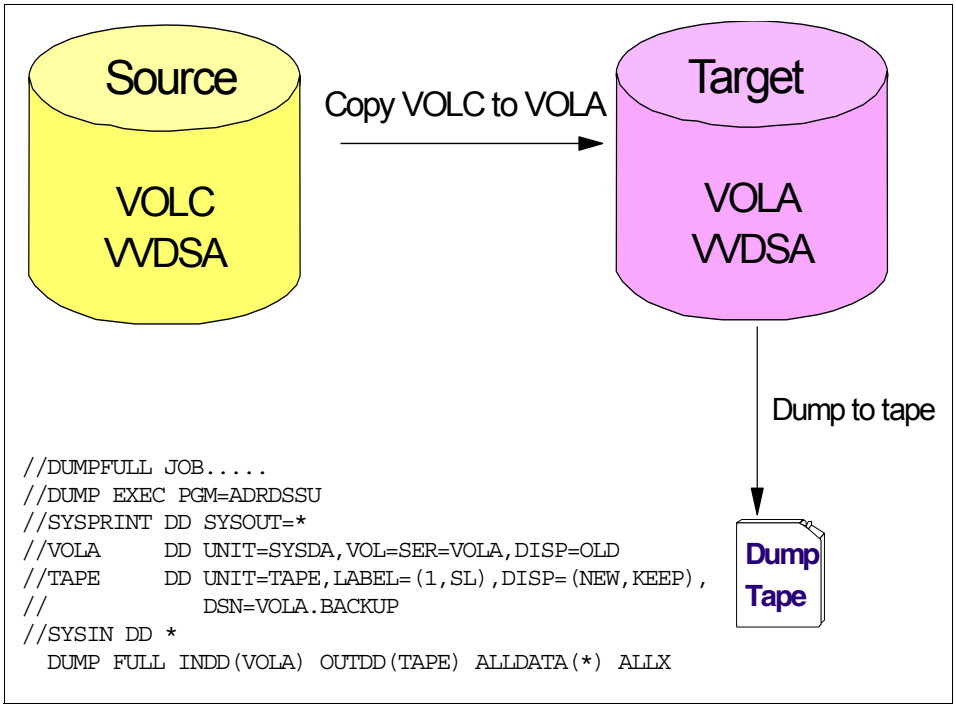

Figure 7-1 DFSMSdss dump procedure

7.2 Dump and restore procedures by using DFSMSdss

The DFSMSdss COPY options and DUMPCONDITIONING Phase 1 to Phase 3 were described in Chapter 4, “DFSMSdss interface considerations” on page 49.

A dump-and-restore procedure is described that is based on using DFSMSdss with the DUMPCONDITIONING Phase 2 support installed. This support is provided in authorized program analysis report (APAR) OW48234.

This support improves the usability of DUMPCONDITIONING by eliminating the requirement to clip the VOLSER following a full volume restore of a dump conditioned volume. The support also allows physical data set restore operations by using a full volume dump of a dump conditioned volume as input.

With this support installed, a full volume copy of a source volume to a target volume with DUMPCONDITIONING specified, followed by a full volume dump of the target volume, results in a dump data set that looks as though it were created by dumping the source volume.

When DFSMShsm calls DFSMSdss during the FRBACKUP process, the DUMPCONDITIONING keyword is used.

Restriction: The target volume of a full volume copy operation with DUMPCONDITIONING specified is referred to as a *conditioned volume*. A full volume dump of a conditioned volume looks as though it were dumped from the original source volume of the copy operation. For example, if you perform a full volume copy with DUMPCONDITIONING of a volume that is called VOL001 to a volume that is called VOL002 and then you perform a full volume dump of VOL002, the dump data set looks as though it were created by a full volume dump of VOL001. This result assumes that the source volume VOL001 has an indexed volume table of contents (VTOC).

If the source volume does not have an indexed VTOC, a full volume dump of the conditioned volume VOL002 does not look as though it were dumped from the original source volume VOL001. Rather, it is an exact image of the conditioned volume. A subsequent full volume restore with the COPYVOLID keyword specified results in the source volume with the same serial number as the conditioned volume.

7.2.1 DFSMSdss DUMP procedure

Example 7-1 is an example of JCL statements to dump a target volume to tape. This example is created by using the Interactive Storage Management Facility (ISMF) Volume Selection Panel and the DUMP command.

Example 7-1 DFSMSdss full volume dump JCL

```
//STEP1  EXEC  PGM=ADRDSSU,REGION=4M
//SYSPRINT DD  SYSOUT=*
//INVOL1   DD  VOL=SER=MHLOAC,UNIT=3390,DISP=SHR
//OUTDD1   DD  DSN=MHLRES3.MHLOAC.DUMP,
//             LABEL=(1,SL),DCB=(TRTCH=COMP),VOL=(,,,3),UNIT=3490,
//             DISP=(NEW,CATLG,DELETE)
//SYSIN    DD    *
      DUMP -
      INDDNAME(INVOL1) -
      OUTDDNAME(OUTDD1) -
      ALLDATA(*) -
      ALLEXCP -
      CANCELERROR -
      OPTIMIZE(4) -
      FULL
/*
```

For a complete set of dumps of all target volumes in a copy pool backup storage group (CPBSG), run DFSMSdss batch jobs to dump each volume in the pool to tape. ISMF is a useful tool to create dump jobs for all volumes. By specifying the CPBSG name in the Storage Group name field in the volume panel, all volumes in the pool can be filtered easily and listed in the ISMF panel.

7.2.2 DFSMSdss RESTORE procedure

Example 7-2 shows sample JCL statements to restore a tape dump of a target volume.

Example 7-2 DFSMSdss full volume restore JCL

```
//STEP1  EXEC  PGM=ADRDSSU,REGION=4M
//SYSPRINT  DD  SYSOUT=*
//OUTDD1  DD    VOL=SER=MHLOAC,UNIT=3390,DISP=OLD
//INDD1   DD DSN=MHLRES3.MHLOAC.DUMP,
//           LABEL=(1,SL),DISP=(OLD,KEEP,KEEP)
//SYSIN   DD    *
 RESTORE FULL -
         INDDNAME(INDD1) -
         OUTDDNAME(OUTDD1) -
         CANCELERROR -
         PURGE -
         WAIT(2,2)
/*
```

The restore JCL must be modified based on the restore's target volume. The PURGE keyword must be used in the restore job because, when the FRBACKUP is performed, the DUMPCONDITIONING keyword is used in DFSMShsm.

7.3 Restoring the DFSMSdss dump

When you restore the full volume dump, certain considerations apply, depending on the target volume that is used for the restore.

Important: If the restore is made to a target volume on a separate isolated system, the following considerations do not apply.

Before you restore a full volume dump to a target volume in the same system, you must verify when the full volume dump is taken and match it with the DFSMShsm copy pool backup versions.

Use the DFSMShsm command LIST COPYPOOL(*copypoolname*) to identify the current copy pool backup versions, with version number, date, and time for the backups. In Example 7-3, the output is written to a data set.

Example 7-3 LIST COPYPOOL command

```
LIST COPYPOOL(CP1) ODS(MHLRES3.BACKUP.VERSIONS)
```

Figure 7-2 is an example of the LIST COPYPOOL command output. Version number, date, and time are important to match with the full volume dump.

```
-- DFSMShsm CONTROL DATASET --COPY POOL--LISTING --------- AT 20:12:35 ON
03/11/03 FOR SYSTEM=SC65

COPYPOOL = CP1

VERSION  VALID VTOCENQ      DATE           TIME
  009      Y      Y      2003/11/03      20:12:11
TOKEN(C)=C''
TOKEN(H)=X''

SGNAME   SOURCE - TARGET  SOURCE - TARGET  SOURCE - TARGET  SOURCE - TARGET
SG1      MHLOAO - MHLOAC  MHLOA1 - MHLOAD

VERSION  VALID VTOCENQ      DATE           TIME
  008      Y      Y      2003/10/31      18:51:33
TOKEN(C)=C''
TOKEN(H)=X''

SGNAME   SOURCE - TARGET  SOURCE - TARGET  SOURCE - TARGET  SOURCE - TARGET
SG1      MHLOAO - MHLOAE  MHLOA1 - MHLOAF

----- END OF -- COPY POOL -- LISTING -----
```

Figure 7-2 LIST COPYPOOL output

7.3.1 Restoring to the FRBACKUP source volume

Restoring a volume from the FRBACKUP source, as shown in Figure 7-3, is described.

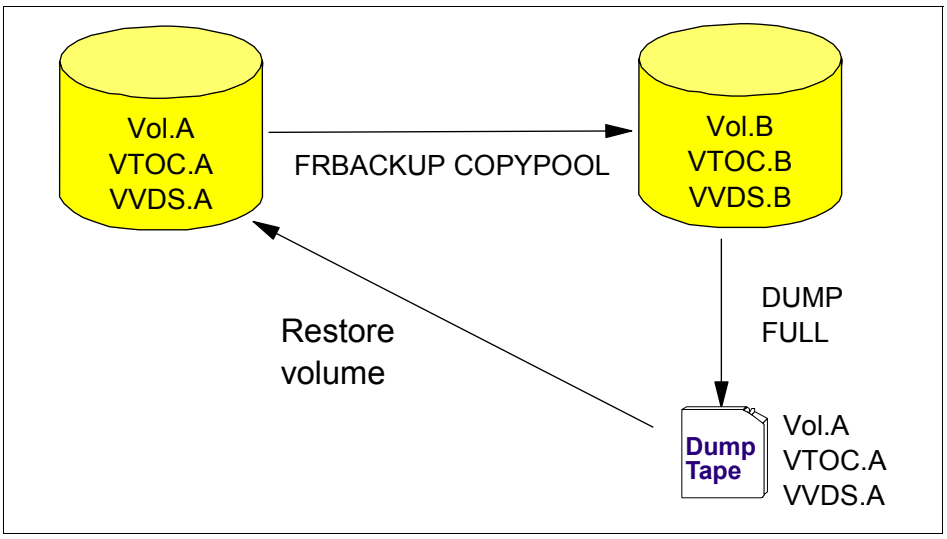

Figure 7-3 Restore to FRBACKUP source volume

You are not required to CLIP the volume label when you restore to the source volume when DUMPCONDITIONING is used and APAR OW48234 is installed. Therefore, you do not need to use COPYVOLID when the source volume has an indexed VTOC. See the restriction in 7.2, “Dump and restore procedures by using DFSMSdss” on page 158.

When a volume must be restored, consider dependencies to other volumes, such as multi-volume data sets and catalogs. You might be required to restore more than one volume for data consistency reasons.

If any active FlashCopy relationships for volumes are to be restored, the FlashCopy relationships must be withdrawn before the restore is done. Use the FRBACKUP COPYPOOL(*cpname*) WITHDRAW command as shown in Example 7-4 to withdraw any active relationships.

Example 7-4 FRBACKUP command with WITHDRAW

```
FRBACKUP COPYPOOL(CP1) WITHDRAW
```

When the restore is complete, any DFSMShsm copy pool backup versions that are created later than the restored full volume dump must be deleted. These versions are invalid because volumes in the copy pool were restored to an earlier time.

Use the DFSMShsm FRDELETE command to delete any invalid versions. Example 7-5 shows the deletion of Version 9.

Example 7-5 FRDELETE of Version 9

```
FRDELETE COPYPOOL(CP1) VERSIONS(9)
```

7.3.2 Restoring to volumes in another system

When you restore to target volumes in a separate system, you can use the COPYVOLID parameter in the restore job if you want to use the serial numbers from the full volume dumps in the separate system (Figure 7-4).

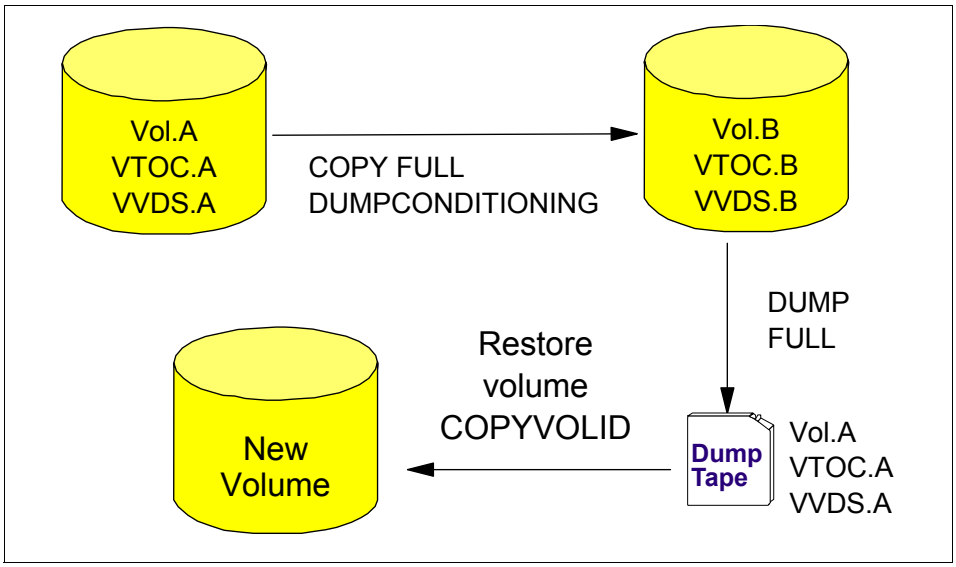

Figure 7-4 Restoring to volumes in a separate system

After you restore volumes in a system that is separate from the system where the volumes originally resided, additional work must always be performed so that the data sets are accessible in the new system. For example, the VTOC, VTOCIX, and Virtual Storage Access Method (VSAM) volume data set (VVDS) reflect the source volume, and the data sets are cataloged in the source system.

To correct these problems, a software product from Rocket Mainstar Software Corporation, which is called *Mirroring Solutions/Volume Conflict Rename (MS/VCR),* can be used to solve post-restoration data access problems. IBM is a reseller of Rocket Mainstar software solutions. The Redbooks publication, *Mainstar MS/VCR The Tool for Efficient Device Cloning*, SG24-6860, provides an overview of MS/VCR and its use.

8

Using DFSMShsm fast replication

This chapter provides an overview of DB2 and its implementation of the DFSMShsm fast replication function. For detailed information about DB2 BACKUP SYSTEM and RESTORE SYSTEM utilities, see *DB2 Version 9 for z/OS: Using the Utility Suite*, SG24-6289.

8.1 DB2 uses DFSMShsm fast replication

DFSMShsm manages full volume fast replication backup versions to support the following functions:

- Support an enhanced backup and recovery of a DB2 data environment for SAP® solutions that run on z/OS system configurations
- Use DS8000 FlashCopy functions and make full volume fast replication available and useful in z/OS environments for fast point-in-time volume backup and recovery operations

8.1.1 Backup and recovery solution

DB2 provides the BACKUP SYSTEM and RESTORE SYSTEM utilities. This backup and restore function of a DB2 environment is based on volume-level backups that use the DS8000 FlashCopy function, including incremental FlashCopy and full volume FlashCopy with background copy or no background copy.

This backup and recovery solution is designed at the DB2 system level in contrast to the DB2 object level. At the system level, data is backed up in the range of terabytes and data consistency is provided across an entire DB2 system, including active logs, bootstrap data sets, catalogs, directories, user tables, and index spaces that are all backed up in a few seconds and logically complete. Application availability is not affected; at least, the availability is unnoticeable to the applications and users.

The DB2 system-level utility in the first version of BACKUP SYSTEM used the *-set log suspend* and *-set log resume* process. This option applies DB2 logging records to the DB2 volumes before exercising the volume-level FlashCopies to create point-in-time volume copies. In addition to the traditional DB2 image copy process, this second and new approach creates backups by using Data Facility Storage Management Subsystem (DFSMS) components and FlashCopy but this method is still controlled by DB2.

All DB2 database and log volumes must be system managed when you use the BACKUP SYSTEM and RESTORE SYSTEM utilities. DFSMShsm manages the actual backup and recovery of the volumes for DB2.

DFSMShsm fast replication was designed to support DB2 system-level BACKUP SYSTEM and RESTORE SYSTEM functions. However, DFSMShsm fast replication functions can be used outside of DB2. For additional information, see Chapter 9, “Using DFSMShsm fast replication in an environment outside of DB2” on page 185.

8.1.2 DFSMShsm commands to support fast replication

The primary DFSMShsm commands in support of fast replication as invoked by DB2 are described. For additional details about the fast replication commands, see Chapter 5, “DFSMShsm fast replication commands” on page 65.

- FRBACKUP

  This command creates a fast replication backup version for each volume in a specified storage management subsystem (SMS) copy pool.

- FRRECOV

  This command starts fast replication to recover a single volume or an entire pool of volumes from the managed backup versions.

  FRRECOV is enhanced in z/OS V1.R12 to selectively recover individual DB2 table spaces also or other z/OS data sets from the involved copy pool backup storage group (CPBSG).

- FRDELETE

  This command is used to delete one or more fast replication volume sets that are not needed any longer.

- LIST and QUERY

  These commands are modified to help to manage and monitor the fast replication backup versions and volumes.

8.2 DB2 uses FlashCopy through DFSMShsm

DB2 V8 provided additional backup and recovery capabilities at the DB2 subsystem or data sharing group level. DB2 can trigger the creation of fast volume backups of an entire DB2 subsystem or data sharing group. With DB2, you can recover a volume, DB2 subsystem, or data sharing group to any point in time. The user of fast replication is responsible to ensure that the set of volumes processed is consistent and correctly serialized. SAP solutions, for example, provide and take advantage of these new backup and recovery functions.

With DB2 V8, a fast, easy, minimally disruptive way to create volume-level backups and a fast, reliable way to recover to a specific point in time are provided by using the new BACKUP SYSTEM and RESTORE SYSTEM utilities:

- The BACKUP SYSTEM utility provides fast volume-level copies of DB2 databases and logs.
- The RESTORE SYSTEM utility recovers a DB2 system to a designated point in time. RESTORE SYSTEM automatically handles any creates, drops, and LOG NO events that might occur between the backup and the recovery.

DB2 uses DFSMShsm function to simplify and improve the performance and reliability of the backup and recovery process. The BACKUP SYSTEM and RESTORE SYSTEM utilities include all tasks that previously were required to perform each function into a single statement.

This enhancement enables DFSMShsm to know which volumes, target and source, must be processed for fast replication functions, and how to manage the fast replication functions. DFSMShsm manages the fast replication backups, and the recovery can be performed at the volume or copy pool level but not at the data set level. The following requirements must be met to take advantage of this function:

- SMS-managed DB2 data sets
- Copy pools for data and logs
- CPBSG type for each source pool storage group in a copy pool

Data set-level recovery is introduced with DB2 V9 and z/OS V1.11. During FRBACKUP, DFSMShsm interfaces with the catalog through the catalog search interface to retrieve all of the related catalog information of all data sets and creates a copy of the catalog information on DFSMShsm ML1 volumes.

Currently, this function requires that the user catalogs (UCATs) reside within the copy pool that is processed by the fast replication process. When the UCAT does not reside within the copy pool, DFSMShsm is unable to query the catalog information because DFSMShsm does not rely on the usual catalog search logic for performance reasons.

DB2 V9 uses the DFSMShsm captured catalog information feature so that deleted and moved data sets can now be recovered (Figure 8-1).

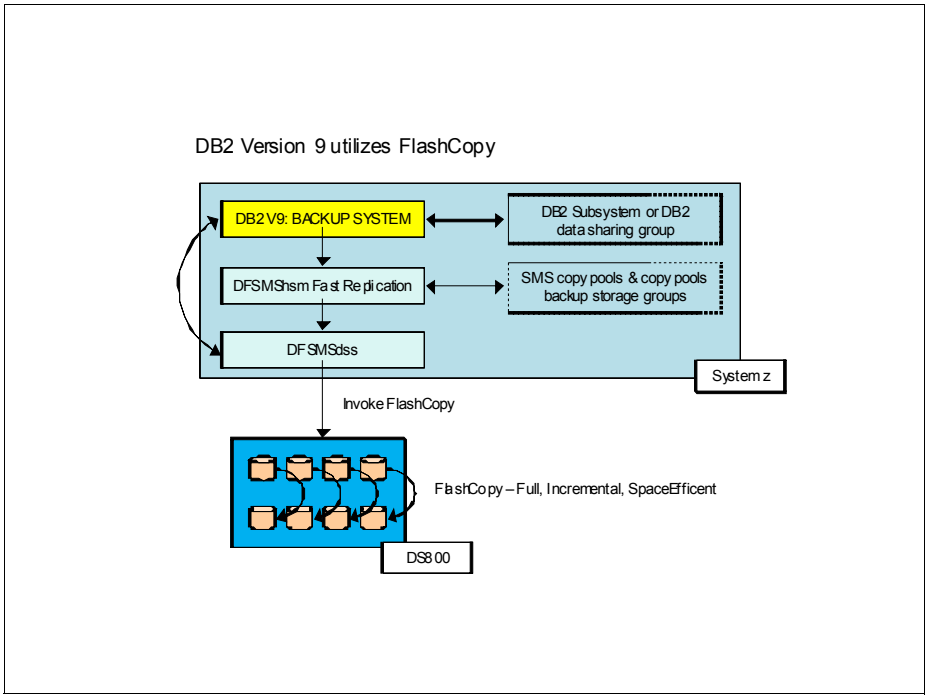

Figure 8-1 DB2 Version 9 uses fast replication

Figure 8-1 indicates the 1-to-1 relationship between the FlashCopy source and target volumes, which affects a data set (table space) level recovery. Currently, a table space is recovered only when the original FlashCopy source volume is available and has sufficient space. This process is managed and controlled through DFSMShsm and does not involve standard SMS allocation processes (automatic class selection (ACS) routines).

With DB2 Version 10, the granularity is now possible on a data set level. Logical copy, backup, or recovery actions require more computer resources and management overhead than FlashCopy actions on the volume level. An entire large DB2 subsystem or data sharing group can be backed up or recovered in a timely fashion only through volume-level FlashCopy at any point in time. SAP software takes advantage of these new backup and recovery functions.

DB2 Version 10 now directly calls the interface with DFSMSdss outside of the fast replication that is managed through DFSMShsm. DFSMSdss uses FlashCopy when the managed data sets reside within the same DS8000 storage subsystem through the DB2 COPY utility function. As Figure 8-2 on page 169 shows, data set-level FlashCopy does not require a strict 1-to-1 volume relationship.

Figure 8-2 also shows how data set-level FlashCopy happens outside of DFSMShsm control through fast replication and is solely controlled through the DB2 direct interaction through its COPY process to DFSMSdss.

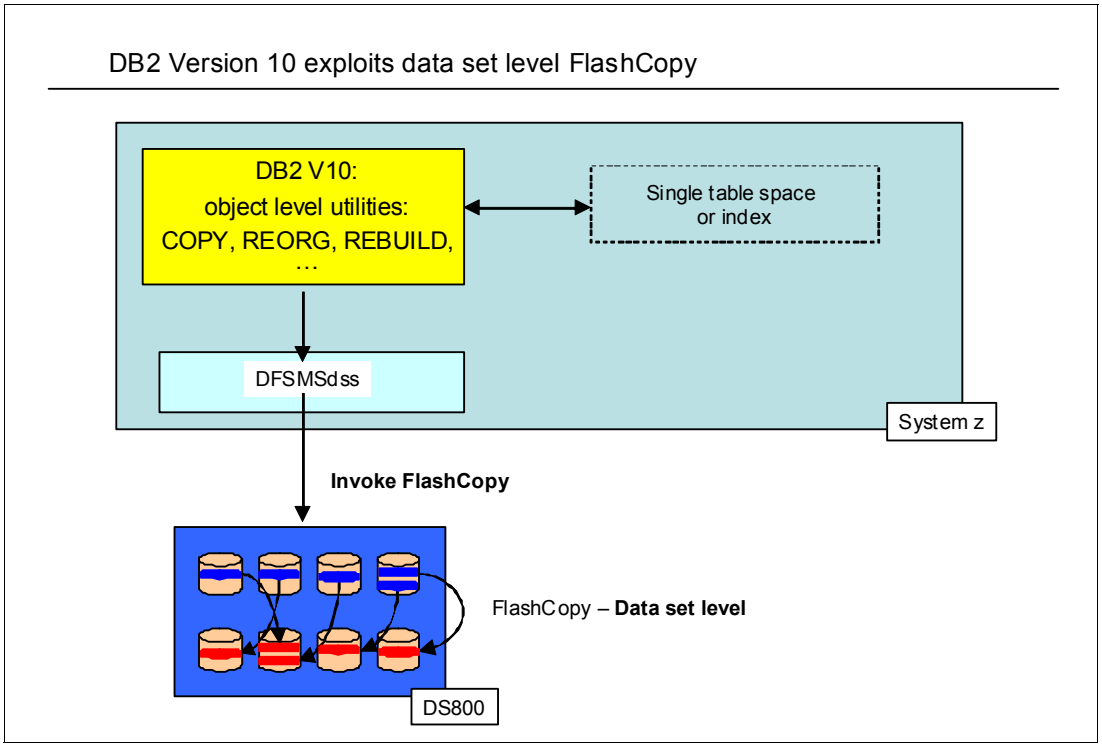

Figure 8-2 DB2 Version 10 expanded FlashCopy to the data set level

z/OS V1.12 and DFSMShsm enhance the granularity from volume level and pool level to data set-level management, especially when you recover data from the copy pool backup storage group (CPBSG). In addition to the pool and volume level, you can now also recover a single data set. Recovering a single data set requires the capture of catalog information of all data sets that reside within the backup copy pool during FRBACKUP processing.

8.2.1 Preparing for DFSMShsm fast replication

Your DB2 administrator and storage administrator must work together to define database and log copy pools by using the required DB2 naming convention to name the copy pools, and associated source and backup storage groups, to use fast replication operations. The database copy pool must contain all volumes that contain the DB2 catalog and directory, and all user data. The log copy pool must contain active logs and the bootstrap data set (BSDS).

After the storage administrator establishes the copy pools, the storage administrator must issue a FRBACKUP PREPARE command against each copy pool. Likewise, the storage administrator must also issue a FRBACKUP PREPARE command any time that a change occurs to the copy pool environment. This command validates the fast replication environment. DFSMShsm pairs a target volume with each source volume for each version that is specified in the copy pool definition.

The DB2 administrator uses the DB2 utility to create fast replication backups of the database.

8.2.2 Serialization

DB2 provides the necessary serialization to prevent data set updates and volume-level updates from occurring when DB2 invokes DFSMShsm with the FRBACKUP COPYPOOL command. The normal DB2 update workload can continue until it updates the integrated catalog facility (ICF) catalogs (delete, define, and extend functions).

8.2.3 Copy pool construct for DB2

The copy pool construct that relates to DB2 must point to SMS storage groups that will be processed for fast replication operations.

The BACKUP SYSTEM utility requires that at least a database copy pool that contains all database objects (DB2 catalog and directory and all user data) exists to take a data-only backup. If you plan to take full system backups, a log copy pool that consists of the active logs and BSDS sets is required. The DB2 RESTORE SYSTEM utility uses the database copy pool only. A copy pool can contain up to 256 SMS storage groups that are to be processed for fast replication operations.

The copy pool naming convention must be of the following form:

`DSN$`*`locn-name`*`$`*`cp-type`*

The following explanations refer to the copy pool naming convention:

- `DSN` is the unique DB2 product identifier.
- `$` is a required delimiter.
- *`locn-name`* is the DB2 location name.
- `$` is a required delimiter.
- *`cp-type`* is the copy pool type:
  - `DB` for database
  - `LG` for logs

For example, DB2 DB9B uses copy pools with the following names:

- DSN$DB9A$DB for the DATA COPYPOOL
- DSN$DB9A$LG for the LOG COPYPOOL

8.2.4 Copy pool backup storage group

The SMS copy pool backup storage group (CPBSG) is used to contain target volumes for DFSMShsm fast replication operations. These storage groups cannot be accessed by ACS routines because SMS prevents new data set allocations to this type of storage group.

The target CPBSG must have a sufficient number of volumes to satisfy the number of backup versions that are specified for a source storage group. For example, if the DB2 database storage group has three source volumes and the VERSIONS attribute was specified as 4, the CPBSG must have at least 12 volumes to satisfy four backup versions of three volumes each, as shown in Figure 8-3 on page 171.

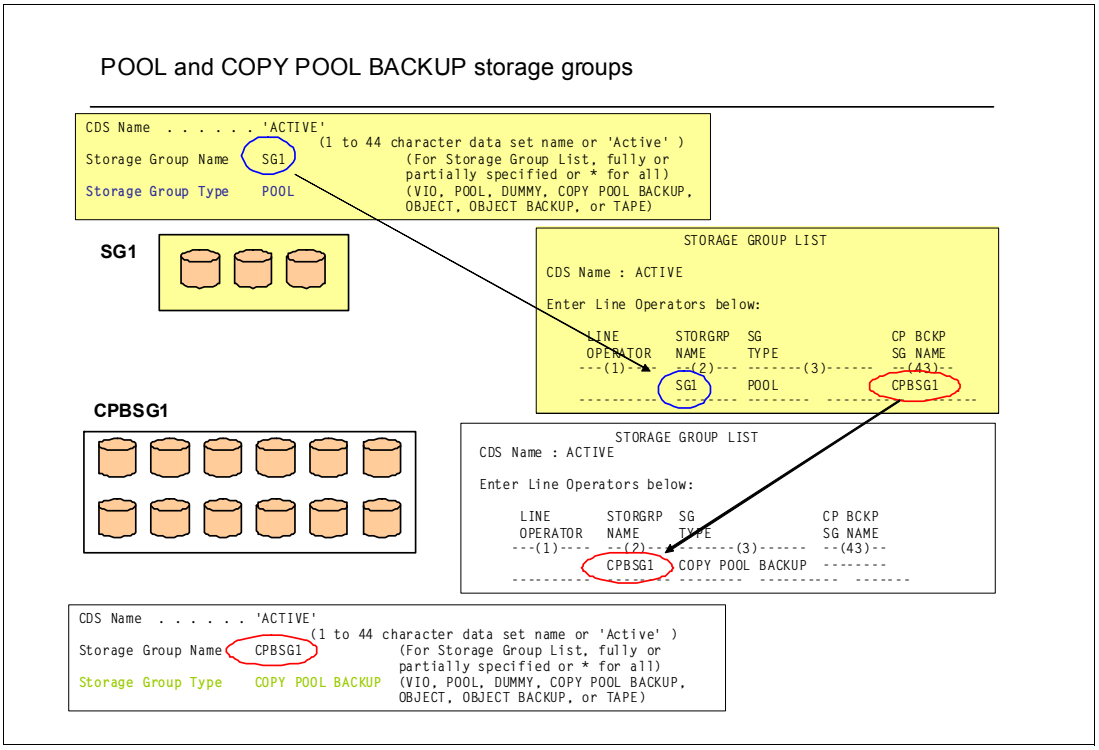

Figure 8-3 POOL storage group and COPY POOL BACKUP relationship

8.3 DB2 backup by using DFSMShsm fast replication

This section describes the DB2 BACKUP SYSTEM utility and the invocation of the DFSMShsm fast replication function.

8.3.1 DB2 BACKUP SYSTEM utility

The BACKUP SYSTEM utility invokes new fast replication services in z/OS DFSMShsm to take volume-level copies of only the database portion of a system (DB2 catalog, directory, and user data) or of the entire DB2 subsystem, which includes the database and log (active logs and BSDS) or data sharing group. These copies are taken without DB2 needing to take any quiesce points. The copies can be used to restore a subsystem or data sharing group to a prior point in time, even when uncommitted data exists.

The following options are available when you run the BACKUP SYSTEM utility:

FULL This option indicates that you want to copy both the database copy pool and the log copy pool. This option is the default option, which backs up the system to DASD.

DATA ONLY This option indicates that you want to copy the database copy pool only. This option does not copy the log copy pool.

DUMP This option creates a fast replication copy of the database copy pool and log copy pool on disk and then initiates a dump to tape of the fast replication copy.

DUMPONLY This option is used when you want to create a dump on tape of an existing fast replication copy (that currently resides on disk) of the database copy pool and log copy pool.

8.3.2 DB2 BACKUP SYSTEM processing

Both types of backups can be used for point-in-time recovery with the RESTORE SYSTEM utility because the utility uses the database copy pool only to restore the data before it applies logs.

A full system backup can also be used to restore a system to the time that the backup was taken, for disaster recovery, or for cloning purposes. In a full system backup, the database copy pool is copied first and the log copy pool is copied next so that normal DB2 restart recovery processing can be used to restore data consistency when you restore to a full backup.

During backup, DB2 records a recovery-based log point (RBLP) in the header page of DBD01. The RBLP is identified as the most recent system checkpoint in most cases before a backup log point, and the point at which DB2 starts scanning logs during a RESTORE SYSTEM recovery operation. DB2 also updates its BSDS with backup version information and can track up to 50 backup versions. For data sharing, the submitting member records the backup version in its BSDS and in the shared communications area (SCA) coupling facility structure.

In general, the BACKUP SYSTEM utility performs locking activities, suspends data set actions, takes system checkpoints, invokes DFSMShsm fast replication, updates backup information, and resumes when backup is completed. The following steps are performed:

1. Takes a new exclusive lock to ensure that no other backup utility can execute. If data sharing, the utility takes a global lock.
2. Suspends 32 KB page writes. You can avoid the write suspension by reorganizing (REORG) these objects. If data sharing, all members are notified.
3. Suspends data set creation (create table space or index), deletion (drop table space or index), renames (online REORG fast switch), and extensions. If data sharing, all members are notified. By setting the VARY DS CONTROL INTERVAL field (DSVCI subsystem parameter) to `YES`, and reorganizing (REORG) a 32 K page size object, this problem is eliminated.
4. Suspends system checkpoints.
5. Prevents data sets from pseudo close. If data sharing, all members are notified.
6. Records the RBLP relative byte address (RBA) or log record sequence number (LRSN) in the header page of DBD01 and writes the page to DASD. If data sharing, the system checkpoint before the lowest LRSN of all active members is used.
7. Invokes DFSMShsm fast replication to back up the database copy pool.
8. Invokes DFSMShsm fast replication to back up the log copy pool if it is a full system backup.
9. Updates the BSDS with the system backup information. If data sharing, only the BSDS for the submitting member is updated.
10. Resumes all suspended activities that are listed. If data sharing, notifies all members.
11. Releases the exclusive lock. If data sharing, notifies all members.
12. Issues an informational message that indicates that the backup is complete.

8.4 Use of DB2 tokens

This option can only be used when dumping to tape and must be used when you want to specify the correct BACKUP SYSTEM that you want to dump to tape; otherwise, the most recent copy of the copy pools (DB and LOG) will be dumped. The utility DSNJU004 reports the token that uniquely identifies the system-level backup, as shown in Example 8-12 on page 179.

Example 8-1 shows how to use this parameter. If you do not specify the TOKEN option, the most recent fast replication copy of the copy pools is dumped to tape.

Example 8-1 TOKEN parameter

```
8:36.09 DSNUGUTC -  BACKUP SYSTEM DUMPONLY TOKEN=X'C4F9C3F1C4EF83491F4AD44BC4EC221659AB'
8:36.09 DSNUVBBD - BACKUP SYSTEM UTILITY FOR DATA STARTING,
   COPYPOOL = DSN$DB9C$DB
   TOKEN = X'C4F9C3F1C4EF83491F4AD44BC4EC221659AB'.
8:36.09 DSNUVBBD - BACKUP SYSTEM UTILITY FOR DATA COMPLETED SUCCESSFULLY,
   COPYPOOL = DSN$DB9C$DB
   TOKEN = X'C4F9C3F1C4EF83491F4AD44BC4EC221659AB'
   ELAPSED TIME = 00:00:00.
8:36.09 DSNUVBBD - BACKUP SYSTEM UTILITY FOR LOGS STARTING,
   COPYPOOL = DSN$DB9C$LG
   TOKEN = X'C4F9C3F1C4EF83491F4AD44BC4EC221659AB'.
8:36.10 DSNUVBBD - BACKUP SYSTEM UTILITY FOR LOGS COMPLETED SUCCESSFULLY,
   COPYPOOL = DSN$DB9C$LG
   TOKEN = X'C4F9C3F1C4EF83491F4AD44BC4EC221659AB'
   ELAPSED TIME = 00:00:00.
8:36.10 DSNUVBBD - BACKUP SYSTEM UTILITY COMPLETED, ELAPSED TIME = 00:00:00.
8:36.10 DSNUGBAC - UTILITY EXECUTION COMPLETE, HIGHEST RETURN CODE=0
```

Example 8-2 shows a sample LIST command and the 18-character token.

Example 8-2 LIST COPYPOOL backups taken with tokens

```
F HSM,LIST CP(DSN$DB9A$DB) TERM

COPYPOOL= DSN$DB9A$DB                    VER=002, VALID=Y, VTOCENQ=N,

TKN(C)=C'DB8B & U+       - '
TKN(H)=X'C4C2F8C2BA5053E44E472848000002426090'
SGNAME=DB9A SOURCE=MHL125  TARGET=MHL213
SGNAME=DB9A SOURCE=MHL126  TARGET=MHL214
COPYPOOL= DSN$DB9A$DB                    VER=001, VALID=Y, VTOCENQ=N,
MADE ON 2003/11/12 AT 17:46:29
TKN(C)=C'DB8B & !   [    - '
TKN(H)=X'C4C2F8C2BA50514FB03D684A000002426090'
SGNAME=DB9A SOURCE=MHL125  TARGET=MHL013
SGNAME=DB9A SOURCE=MHL126  TARGET=MHL014
ARC0140I LIST COMPLETED,       10 LINE(S) OF DATA 958
```

Table 8-1 on page 174 shows the DB2 token breakout.

Table 8-1 Token breakout

Field contents	Length	Value
DB2 Subsystem ID (SSID)	4	C4C2F8C2
Time of day (TOD) of FRBACKUP when called by DSNUPROC to take a BACKUP	8	BA5053E44E472848
RBA or LRSN	6	000002426090

The following definitions refer to Table 8-1:

- SSID = Subsystem ID
- TOD = Time of day
- RBA = Relative Byte Address
- LRSN = Log Record Sequence Number
- RBA (non-data sharing) or an LRSN (data sharing)

You can use the REXX program CONVTOD to calculate the Julian date and time in Greenwich mean time (GMT) as shown in Example 8-3.

Example 8-3 Time of day clock conversion exec

```
The TOD from above: BA5053E44E472848
TOD Clock Conversion - Enter the time in 12 to 16 digits , or END
BA5053E44E472848
 TOD value of BA5053E44E472848  = 03316,22:58:01.939058 JJDDD date, GMT time
```

The REXX program CONVTOD is documented in Appendix A, “Sample REXX execs” on page 243.

8.5 BACKUP SYSTEM

BACKUP SYSTEM support was introduced in DB2 for z/OS V8 to provide an easier and less disruptive way for fast volume-level backup and recovery. Its implementation was based on the usage of FlashCopy to back up DB2 data and logs, eliminating the need to suspend logs. System-level backups are managed by DB2 and DFSMShsm to support system-level point-in-time (PIT) recovery.

BACKUP SYSTEM works in an online fashion and allows concurrent applications to continue to access the database for read and write operations. To use the BACKUP SYSTEM support, all DB2 data sets and logs must be SMS-managed and part of DB2 DFSMShsm copy pools.

Important: If you plan to use the BACKUP SYSTEM utility, a dedicated DASD must exist for each DB2 subsystem or data sharing group. If you have table spaces from more than one DB2 subsystem in the same DASD volume, when you execute a RESTORE SYSTEM for a specific DB2 subsystem, you might restore inconsistent data.

BACKUP SYSTEM requires that you define two copy pools for each DB2 system:

- A data copy pool that contains all application data and the DB2 catalog and directory and corresponding ICF catalogs
- A log copy pool that contains the DB2 log data sets, BSDS, and corresponding ICF catalogs

With BACKUP SYSTEM, you can either copy both copy pools or copy the data copy pool only. If you want to restore the DB2 system or an object to an arbitrary point in time, copying only the data copy pool ought to be sufficient. However, if you plan to clone DB2 at the system level or if you want to restore DB2 to the point when the backup was created, copying both copy pools is required.

The copy pools must follow this format:

DSN$<*location-name*>$<*cp-type*>

The various parts of this expression have the following meanings:

DSN	The unique DB2 product identifier
$	A fixed character delimiter
<*location-name*>	The DB2 location name
$	A fixed character delimiter
<*cp-type*>	The copy pool type

Use DB for data copy pool and LG for log copy pool, for example:

```
DATA COPYPOOL (DSN$DB9A$DB)
LOG COPYPOOL (DSN$DB9A$LG)
```

Example 8-4 shows the output of the DB2 display distributed data facility (DDF) command, where you can see the location name.

Example 8-4 DB2 DDF display

```
13.06.27 STC17204  DSNL004I  -DB9A DDF START COMPLETE  928
   928                       LOCATION  DB9A
   928                       LU        USIBMSC.SCPDB9A
   928                       GENERICLU -NONE
   928                       DOMAIN    wtsc63.itso.ibm.com
   928                       TCPPORT   12347
   928                       SECPORT   12349
   928                       RESPORT   12348
   928                       IPNAME    -NONE
```

Figure 8-4 on page 176 shows the configuration that we will use to demonstrate the examples in this chapter. DB9ACPB is the name of our CPBSG.

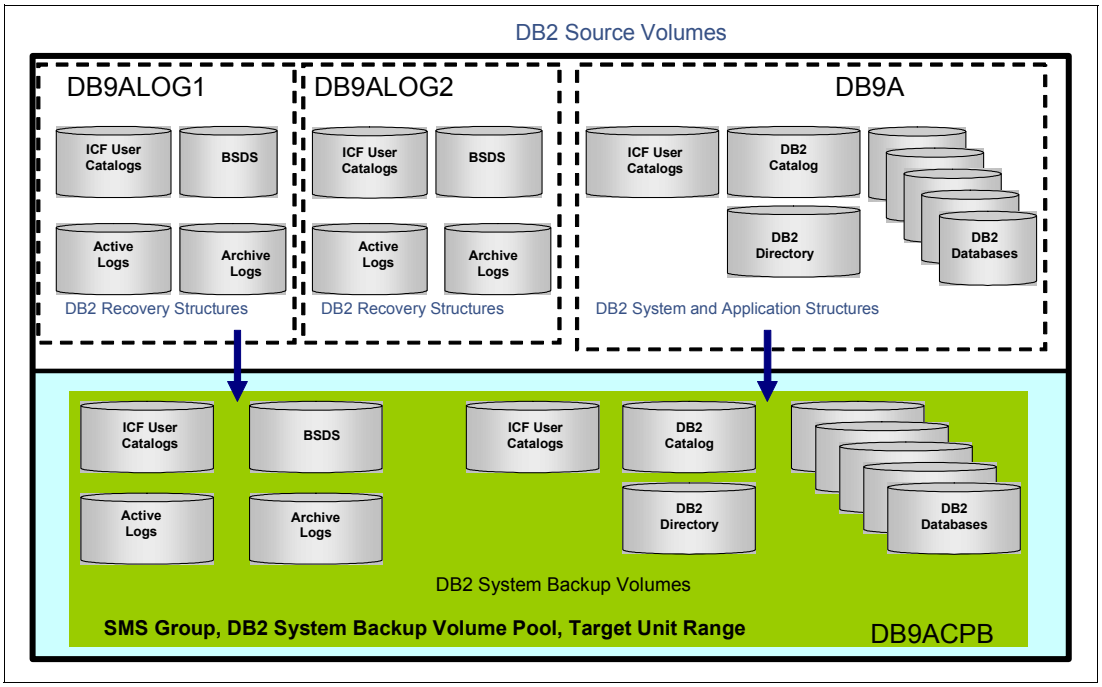

Figure 8-4 Data set layout considerations

Remember: A copy pool represents a set of SMS storage groups.

Example 8-5 shows the output from a copy pool list, which can be obtained by a storage administrator by using the ISMF windows. The copy pool DB (DSN$DB9A$DB) has one storage group DB9A. Copy pool LG has two storage groups, one storage group (DB9ALOG1) for log1 and BSDS1 and the second storage group (DB9ALOG2) for log2 and BSDS2. This information is shown under columns 14 and 15.

Example 8-5 List of copy pool names

```
Enter Line Operators below:

      LINE                                    STORAGE   STORAGE
      OPERATOR          COPY POOL NAME        GRP NAME  GRP NAME
     ---(1)----  ------------(2)-------------- --(14)--  --(15)--
                 DSN$DB9A$DB                   DB9A      --------
                 DSN$DB9A$LG                   DB9ALOG1  DB9ALOG2
     ----------  ------------------------------ ------  BOTTOM  OF  DATA  ------
```

Example 8-6 on page 177 shows a list of storage groups from source volumes (DB9A, DB9ALOG1, and DB9ALOG2). Column 43 shows a relationship between the source volumes in the DB2 copy pools, in which the original data sets that are used by DB2 are located, and the volumes in the CPBSG (DB9ACPB).

Example 8-6 List of storage groups

```
------------------------------------------------------------------------------
                              STORAGE GROUP LIST
 Command ===>                                                 Scroll ===> HALF
                                                              Entries 1-4 of 4
                                                              View in Use
 CDS Name : ACTIVE

 Enter Line Operators below:

      LINE       STORGRP  SG               VIO      VIO   AUTO      CP BCKP
      OPERATOR   NAME     TYPE             MAXSIZE  UNIT  MIGRATE   SG NAME
     ---(1)----  --(2)--- -------(3)------  --(4)--  (5)-  --(6)---  --(43)--
                 DB9A     POOL             -------  ----  NO        DB9ACPB
                 DB9ALOG1 POOL             -------  ----  NO        DB9ACPB
               DB9ALOG2 POOL             -------  ----  NO        DB9ACPB
----------  -------- ------  BOTTOM  OF  DATA  ------  --------  ----------
```

When you use the command LISTVOL, you can view a list of volumes that must be copied, as shown in Example 8-7. Both volumes SBOX5Q and SBOX5R were defined in the DB9A SMS storage group.

Example 8-7 Volumes for storage group

```
------------------------------------------------------------------------------
                                VOLUME LIST
Command ===>                                                 Scroll ===> HALF
                                                          Entries 1-2 of 2
Enter Line Operators below:                               Data Columns 3-8 of 43

     LINE       VOLUME FREE       %     ALLOC      FRAG   LARGEST    FREE
     OPERATOR   SERIAL SPACE      FREE  SPACE      INDEX  EXTENT     EXTENTS
    ---(1)----  -(2)-- ---(3)---  (4)-  ---(5)---  -(6)-  ---(7)---  --(8)--
                SBOX5Q  4078757K    49   4235744K     67   3570773K       20
                SBOX5R  3640053K    44   4674448K     90   3033627K       25
    ----------  ------ -----------  BOTTOM  OF  DATA  -----------  ------  ----
```

Important: Commands at the command-line level must not be issued when you use views. Views are used when you work at the specific column level.

Example 8-8 shows the DFSMShsm LIST COPYPOOL job.

Example 8-8 LIST COPYPOOL job

```
//STEP01 EXEC PGM=IKJEFT01
//SYSTSPRT  DD SYSOUT=*
//SYSPRINT  DD SYSOUT=*
//SYSTSIN   DD *
  HSENDCMD WAIT LIST COPYPOOL(DSN$DB9C$DB) -
     ODS(DB2R7.TEST2)
```

Example 8-9 shows the output of the job in Example 8-8 on page 177. The output reports the following information:

- The relationship between the source and target DASD
- Whether one backup was incremental
- Whether the background copy is complete[1]
- Dumpstate (dumped to tape?)

Example 8-9 Relationship between the source and target volumes

```
COPYPOOL=DSN$DB9C$DB
ALLOWPPRCP FRB=NO FRR=NO

VERSION  VTOCENQ     DATE           TIME     FASTREPLICATIONSTATE  DUMPSTATE
  042      N      2009/10/08      14:58:28   RECOVERABLE           NONE
TOKEN(C)=C'D9C1DY ,    DT $  '
TOKEN(H)=X'C4F9C3F1C4E8156B055314CBC4E3145B2232'
TOTAL NUM OF VOLUMES=00004,INCREMENTAL=Y

SGNAME   SOURCE - TARGET  SOURCE - TARGET  SOURCE - TARGET  SOURCE - TARGET
DB9CDATA SBOX5S - SBOX7A  SBOX5T - SBOX7B  SBOX5U - SBOX7C  SBOX5V - SBOX7D

VERSION  VTOCENQ     DATE           TIME     FASTREPLICATIONSTATE  DUMPSTATE
  041      N      2009/10/07      14:21:15   RECOVERABLE           NONE
TOKEN(C)=C'D9C1DW  ¨   DT $  '
TOKEN(H)=X'C4F9C3F1C4E6CB3BBD2B1A49C4E3145B2232'
TOTAL NUM OF VOLUMES=00004,INCREMENTAL=N

SGNAME   SOURCE - TARGET  SOURCE - TARGET  SOURCE - TARGET  SOURCE - TARGET
DB9CDATA SBOX5S - SBOX6A  SBOX5T - SBOX6B  SBOX5U - SBOX6C  SBOX5V - SBOX6D
```

8.6 BACKUP SYSTEM to DASD

The invocation of the BACKUP SYSTEM utility from a JCL job is shown in Example 8-10.

Example 8-10 BACKUP SYSTEM JCL utility

```
000010 //DB2R7001 JOB CLASS=A,TIME=1440,REGION=0M,
000011 //             MSGCLASS=T,MSGLEVEL=(1,1)
000020 /*JOBPARM S=SC63
000021 //*********************************************************************
000022 //** STEP BACKUP : RUN BACKUP SYSTEM FOR DB9A                         **
000023 //*********************************************************************
000031 //BACKUP EXEC PGM=DSNUTILB,PARM=(DB9A,BKSYS),REGION=0M
000032 //STEPLIB   DD DISP=DHR,DSN=DB9A9.SDSNEXIT
000033 //          DD DISP=SHR,DSN=DB9A9.SDSNLOAD
000034 //SYSOUT    DD SYSOUT=*
000035 //SYSPRINT  DD SYSOUT=*
000036 //SYSIN     DD *
000037   BACKUP SYSTEM FULL
```

[1] FASTREPLICATIONSTATE RECOVERABLE means that the background copy is complete and the volume can be flashed back.

Example 8-11 shows the BACKUP SYSTEM output and the order in which COPYPOOL is executed (the data copy pool and then the log copy pool). The token that is passed from DB2 to hierarchical storage management (HSM) is also displayed. This token can be used to identify backup versions in HSM.

Example 8-11 BACKUP SYSTEM output

```
DSNUGUTC -  BACKUP SYSTEM FULL
  DSNUVBBD - BACKUP SYSTEM UTILITY FOR DATA STARTING,
             COPYPOOL = DSN$DB9A$DB
             TOKEN = X'C2C1D740C4DA58F83EE37183D083CC8644E4'.
  DSNUVBBD - BACKUP SYSTEM UTILITY FOR DATA COMPLETED SUCCESSFULLY,
             COPYPOOL = DSN$DB9A$DB
             TOKEN = X'C2C1D740C4DA58F83EE37183D083CC8644E4'
             ELAPSED TIME = 00:00:05.
  DSNUVBBD - BACKUP SYSTEM UTILITY FOR LOGS STARTING,
             COPYPOOL = DSN$DB9A$LG
             TOKEN = X'C2C1D740C4DA58F83EE37183D083CC8644E4'.
  DSNUVBBD - BACKUP SYSTEM UTILITY FOR LOGS COMPLETED SUCCESSFULLY,
             COPYPOOL = DSN$DB9A$LG
             TOKEN = X'C2C1D740C4DA58F83EE37183D083CC8644E4'
             ELAPSED TIME = 00:00:00.
  DSNUVBBD - BACKUP SYSTEM UTILITY COMPLETED, ELAPSED TIME = 00:00:06
  DSNUGBAC - UTILITY EXECUTION COMPLETE, HIGHEST RETURN CODE=0
```

In a data sharing environment, the submitting member records the backup information in its BSDS and also in the SCA. If you want to see backup system entries, run DSNJU004 with the GROUP DD statement pointing to the BSDSs to merge all the BSDS information from all the members.

Example 8-12 shows the BACKUP SYSTEM information that is registered on BSDS.

Example 8-12 Output of BSDS

```
BACKUP SYSTEM UTILITY HISTORY
                         SUBSYSTEM ID DB9A
                     19:17:42 SEPTEMBER 28, 2009
START STCK                             DATA COMPLETE   DATA/LOG COMPL
     DATA                 LOG             RBLP          LRSN         DATE      LTI
----------------  ----------------  ------------  ------------  ----------------
C4DAF9F658BEF785  C4DAF9FD1EFE0A83  D084F438F000  D084F438F000  2009/09/28  10:4
                 TOKEN = C2C1D740C4DAF9F658BEF785D084F438F000
C4DA58F83EE37183  C4DA58FD5480C003  D083CC8644E4  D083CC8644E4  2009/09/27  22:4
                 TOKEN = C2C1D740C4DA58F83EE37183D083CC8644E4
C4D9B816CCD4FD05  C4D9B81EAF168E84  D082EADA09F6  D082EADA09F6  2009/09/27  10:4
                 TOKEN = C2C1D740C4D9B816CCD4FD05D082EADA09F6
```

Tip: When a TOKEN is deleted from HSM for any reason, DB2 does not know about it.

8.7 BACKUP SYSTEM to tape

In DB2 9, the BACKUP SYSTEM utility can copy the data directly to tape. The new options that allow this capability are DUMP and DUMPONLY. DUMP takes a copy directly to the tape. DUMPONLY takes a copy from the target copy pool to tapes.

To have a minimal impact on your (production) system, use BACKUP SYSTEM. Then, when the background copy is complete, invoke BACKUP SYSTEM DUMPONLY. Because the background copy is complete, DUMPONLY minimizes the effect to the I/O subsystem for the source/production volumes. Otherwise, both the I/O between the DASD copy pools and the I/O between the target copy pool and the tapes are active concurrently.

8.7.1 DUMP

Use this option when you need to create a fast replication copy of the database copy pool and log copy pool on disk and then initiate a dump to tape of the fast replication copy. The dump to tape begins after DB2 successfully establishes relationships for the fast replication copy. The DUMP option requires z/OS Version 1.8. You must define DUMPCLASS to execute this function.

8.7.2 DUMPONLY

Use this option when you want to create a dump on tape of an existing fast replication copy (that currently resides on the disk) of the database copy pool and the log copy pool. This option requires z/OS Version 1.8.

Important: Directly copying data to tape affects the speed of your restore.

Restoring from tape is not as fast as restoring from a FlashCopy that was made to disk. However, keeping your data on tape can help in terms of storage management, disaster recovery, and offsite data storage. Be aware of the tradeoffs before you create system-level backups on tape.

The output of DUMP or DUMPONLY is directed to the DFSMShsm *dumpclass*. Each dumpclass specifies the unit type to which the data will be directed.

DB2 allows up to five dumpclasses to be specified. Each specification results in a complete copy of the copy pools that is backed up and directed to each dumpclass. When you have multiple dumpclasses, you can, for example, send one copy to remote devices for disaster recovery and keep another copy for local operations.

The dump to tape is always a full dump even if incremental FlashCopy is used.

When you issue a DFSMShsm LIST COPYPOOL command, the status of the DUMPSTATE column can be one of the following statuses:

- NONE: The backup for the DB2 data and log copy pools only resides on DASD.
- PARTIAL: The backup was not completely dumped to tape yet.
- ALLCOMPLETE: All of the volumes were successfully dumped to tape.

To take a backup on tape, create and associate a dumpclass with your copy pool, or you receive message ARC0635I on the MVS log. This message states that your dumpclass is invalid, as shown in Example 8-13.

Example 8-13 DFSMShsm message on the MVS log

```
ARC0635I DUMP OF COPYPOOL DSN$DB9C$DB NOT PERFORMED, 607
ARC0635I (CONT.) REASON=4
```

Example 8-14 shows the job output with error messages for the same problem.

Note: The DFSMShsm messages do not appear in the DB2 joblog, but they appear in the MVS log, the DFSMShsm started tasks activity log, or the DFSMShsm backup activity log.

Example 8-14 Output for the DUMP parameter

```
DSNU000I    287 14:32:26.61 DSNUGUTC - OUTPUT START FOR UTILITY, UTILID = BKSYS
DSNU1044I   287 14:32:26.65 DSNUGTIS - PROCESSING SYSIN AS EBCDIC
DSNU050I    287 14:32:26.65 DSNUGUTC -  BACKUP SYSTEM DUMP
DSNU1600I   287 14:32:27.21 DSNUVBBD - BACKUP SYSTEM UTILITY FOR DATA STARTING,
                       COPYPOOL = DSN$DB9C$DB
                       TOKEN = X'C4F9C3F1C4EF9ACAA9CAD6CBC4EC221659AB'.
DSNU1631I   287 14:32:27.21 DSNUVBBD - BACKUP SYSTEM UTILITY FAILED BECAUSE THE CALL TO
DFSMSHSM FAILED WITH RC =
X'00000018'
REASON = X'00000008'.
                       SEE THE HSM ACTIVITY LOG FOR HSM MESSAGES INDICATING THE CAUSE OF
THE ERROR.
DSNU012I    287 14:32:27.82 DSNUGBAC - UTILITY EXECUTION TERMINATED, HIGHEST RETURN CODE=8
```

In Example 8-14, scenario number 9 shows one dump taken to tape.

A restore from tape dumps uses parallelism that is limited by the number of distinct tape volumes on which the dump resides, capped by tape units.

Important: Due to the BACKUP SYSTEM utility's design, take the backup to tape with the DUMPONLY option rather than the DUMP option. If a problem occurs with HSM, DB2 does not register the token in the BSDS and you lose the correct time to take the backup. This issue occurs because DB2 works in a stand-alone fashion from HSM.

8.8 BACKUP SYSTEM additional considerations

Additional topics to consider with BACKUP SYSTEM are described.

8.8.1 DATA ONLY

This option indicates that you want to copy only the database copy pool. The logical part of the copy is created in a matter of seconds. However, the physical creation of the copy in the backup storage groups is performed asynchronously through a background I/O process. Depending on the size of the database, this phase of FlashCopy processing might take minutes or hours.

If a track on the source volume changes before the background copy is complete, that track will be copied to the target volume before the new contents of the track are written to the source volume.

8.8.2 FORCE

You can use the FORCE option only when you create a backup on tape. When you create a backup on DASD, the utility ignores the FORCE option and takes another BACKUP SYSTEM.

You must use this option when you decide to overwrite the oldest DFSMShsm version copy of the copy pool. You can overwrite these copy pools if the dump to tape was initiated but only partially completed. For example, if the BACKUP SYSTEM with the oldest DASD version is still in the process of being dumped to tape, but you need to take a new BACKUP SYSTEM on DASD (and you are willing to sacrifice the oldest DASD version even though it is not yet saved to tape), you must use the FORCE option.

Example 8-15 shows no extra information, which means that this backup overwrote the oldest version.

Example 8-15 BACKUP FORCE

```
18:49:54.42 DSNUGUTC -  BACKUP SYSTEM FORCE
18:49:54.92 DSNUVBBD - BACKUP SYSTEM UTILITY FOR DATA STARTING,
       COPYPOOL = DSN$DB9C$DB
       TOKEN = X'C4F9C3F1C4EE92794AF0F086C4EC221659AB'.
18:49:55.63 DSNUVBBD - BACKUP SYSTEM UTILITY FOR DATA COMPLETED SUCCESSFULLY,
       COPYPOOL = DSN$DB9C$DB
       TOKEN = X'C4F9C3F1C4EE92794AF0F086C4EC221659AB'
       ELAPSED TIME = 00:00:00.
18:49:55.63 DSNUVBBD - BACKUP SYSTEM UTILITY FOR LOGS STARTING,
       COPYPOOL = DSN$DB9C$LG
       TOKEN = X'C4F9C3F1C4EE92794AF0F086C4EC221659AB'.
18:50:04.97 DSNUVBBD - BACKUP SYSTEM UTILITY FOR LOGS COMPLETED SUCCESSFULLY,
       COPYPOOL = DSN$DB9C$LG
       TOKEN = X'C4F9C3F1C4EE92794AF0F086C4EC221659AB'
       ELAPSED TIME = 00:00:09.
18:50:04.97 DSNUVBBD - BACKUP SYSTEM UTILITY COMPLETED, ELAPSED TIME = 00:00:10.
18:50:04.98 DSNUGBAC - UTILITY EXECUTION COMPLETE, HIGHEST RETURN CODE=0
```

8.8.3 TOKEN

You can use this option only when dumping to tape. This option must be used when you want to specify the correct BACKUP SYSTEM that you want to dump to tape; otherwise, the most recent copy of the copy pools (DB and LOG) will be dumped. The utility DSNJU004 reports the token that uniquely identifies the system-level backup, as shown in Example 8-12 on page 179. Example 8-16 shows how to use this parameter. If you do not specify the TOKEN option, the most recent fast replication copy of the copy pools is dumped to tape.

Example 8-16 TOKEN parameter

```
8:36.09 DSNUGUTC -  BACKUP SYSTEM DUMPONLY TOKEN=X'C4F9C3F1C4EF83491F4AD44BC4EC221659AB'
8:36.09 DSNUVBBD - BACKUP SYSTEM UTILITY FOR DATA STARTING,
   COPYPOOL = DSN$DB9C$DB
   TOKEN = X'C4F9C3F1C4EF83491F4AD44BC4EC221659AB'.
8:36.09 DSNUVBBD - BACKUP SYSTEM UTILITY FOR DATA COMPLETED SUCCESSFULLY,
   COPYPOOL = DSN$DB9C$DB
```

```
   TOKEN = X'C4F9C3F1C4EF83491F4AD44BC4EC221659AB'
   ELAPSED TIME = 00:00:00.
8:36.09 DSNUVBBD - BACKUP SYSTEM UTILITY FOR LOGS STARTING,
   COPYPOOL = DSN$DB9C$LG
   TOKEN = X'C4F9C3F1C4EF83491F4AD44BC4EC221659AB'.
8:36.10 DSNUVBBD - BACKUP SYSTEM UTILITY FOR LOGS COMPLETED SUCCESSFULLY,
   COPYPOOL = DSN$DB9C$LG
   TOKEN = X'C4F9C3F1C4EF83491F4AD44BC4EC221659AB'
   ELAPSED TIME = 00:00:00.
8:36.10 DSNUVBBD - BACKUP SYSTEM UTILITY COMPLETED, ELAPSED TIME = 00:00:00.
8:36.10 DSNUGBAC - UTILITY EXECUTION COMPLETE, HIGHEST RETURN CODE=0
```

8.8.4 FlashCopy consistency group support

The DFSMShsm FlashCopy consistency group option “freezes” the source volumes, which cause subsequent writes to be held while a source to target volume pair are copied. After the FlashCopy completes, the I/O is resumed.

Note: The consistency group must be formed and completed within a default value of 2 minutes. The consistency group option is best used for backing up the small log copy pools.

For additional information, see the latest version of *DFSMShsm Storage Administration*, SC35-0421.

9

Using DFSMShsm fast replication in an environment outside of DB2

The DFSMShsm fast replication function can be used outside of a DB2 environment. This chapter shows how to set up the environment and use it. Specific examples in a z/OS file system (zFS) environment are provided.

9.1 Environments outside of DB2

Although the focus of the DFSMShsm fast replication function is its interaction with DB2 to back up and recover databases and logs, its implementation and benefit are not specific to DB2. Data Facility Storage Management Subsystem (DFSMS) provides a volume-level fast replication so that you can create a point-in-time backup that is managed by DFSMShsm with minimal application outage. The DFSMShsm fast replication function supports the FlashCopy and Snapshot functions only.

DFSMShsm fast replication works on the volume level, not the data set level. When you use DFSMShsm fast replication, an application must be stopped or must flash its in-storage buffers to force the application data to be written to DASD before the point-in-time backup by DFSMShsm fast replication can be taken. When the DFSMShsm fast replication FRBACKUP is complete, the application can again update its data sets.

9.1.1 Candidates

Good candidates include large data sets that grow rapidly, reach sizes of several hundred gigabytes, and are used by a single application, such as hierarchical file system (HFS) or zFS data sets. The data set can reside on up to 59 volumes. A normal backup that uses the DFSMShsm HBACKDS function or DFSMSdss logical data set dump to tape might require 50 or more tape mounts for 3490 volumes. DFSMShsm currently supports only up to 40 volumes for ML2 and backup tape for a single data set. Although 3590 cartridges are a better target for these large data sets, clients at many installations want to use Virtual Tape Server (VTS), which emulates 3490 only for ML2 or backup.

9.1.2 Planning a copy pool

DFSMShsm fast replication only supports storage-management subsystem (SMS)-managed volumes. Applications or volumes that are not supported by SMS are not candidates for DFSMShsm fast replication, for example:

- z/OS SYSTEM resident volumes that are needed during IPL
- Linux or any other volumes that are not MVS (not z/OS) volumes

The native DFSMSdss fast replication function can be used for non-SMS managed volumes through batch jobs. The disadvantage of batch jobs is that the FlashCopy environment is not managed by DFSMShsm and is not defined through DFSMS constructs.

Identify the storage groups that you want managed by a DFSMShsm fast replication backup, then determine which of those storage groups you want to put into the same copy pool. Consider these guidelines:

- If a single storage group contains data that you want to assign to separate copy pools, you must place the data into separate storage groups.
- DFSMS does not verify that the storage groups that are listed in the copy pool include any associated extend and overflow storage groups. Therefore, if you implemented extend or overflow storage groups, ensure that you include them in the correct copy pools.

9.1.3 Prevent DFSMShsm functions from processing target volumes

The DFSMShsm automatic functions (primary space management, autobackup, autodump, and interval migration) only process pool-type storage groups.

These automatic functions do not process copy pool backup storage group (CPBSG) types. The BACKVOL STORAGEGROUP command processes pool-type storage groups only. This BACKVOL command does not process CPBSGs.

The BACKVOL VOLUME and the MIGRATE VOLUME commands do not process any volumes that reside in a CPBSG.

9.1.4 Serialization

It is the responsibility of the caller of DFSMShsm to ensure that the source volumes are in a state in which they can be processed for meaningful recovery. The source volumes need to be protected against data set-level updates (actual changes to the data) and volume-level changes (direct access device space management (DADSM) functions, such as allocations, renames, extends, and scratches).

For volume-level changes, DFSMSdss by default serializes on the volume table of contents (VTOC) of each volume as it is processed to prevent DADSM functions from occurring against that volume. If the caller needs to prevent DADSM functions from being performed against the set of volumes in the copy pool during the backup, it is the caller's responsibility to serialize on all of the VTOCs before invoking DFSMShsm.

Serializing on the VTOC prevents DADSM functions and also prevents DFSMSdss functions, such as DEFRAG, COPY, and RESTORE, from modifying the VTOCs. When the caller performs this serialization, the new optional keyword NOVTOCENQ must be used to indicate that DFSMSdss must not serialize on the VTOC of each volume.

Multi-volume data sets

Special consideration must be given to multi-volume data sets. Because VTOC enqueues are obtained as each volume is processed, a multi-volume data set can be updated on one of its volumes while the other volume is being fast replicated. To avoid this situation, you must ensure that data set activity for multi-volume data sets is quiesced during the fast replication process.

9.1.5 Preparing copy pools for fast replication

The storage administrator establishes the copy pool environment and then must issue a FRBACKUP PREPARE command against each copy pool. The storage administrator must also issue a FRBACKUP PREPARE command any time that a change to the copy pool environment occurs. This command validates the fast replication environment. DFSMShsm pairs a target volume with each source volume for each version that is specified in the copy pool definition.

The copy pool owners issue the FRBACKUP COPYPOOL command to create point-in-time backups of their copy pools.

9.1.6 Obtaining DFSMShsm fast replication backup information

The DFSMShsm QUERY and LIST commands and the ARCXTRCT macro are updated to include information about the fast replication backup versions that DFSMShsm is managing.

ARCXTRCT macro

With the ARCXTRCT macro, you can extract or better, retrieve DFSMShsm data within a program. The data can be used to issue other DFSMShsm user macros. The ARCXTRCT macro is described in *DFSMShsm Managing Your Own Data*, SC35-0420.

ARCXTRCT was modified to support a new data type of COPYPOOL and a new COPYPOOL parameter. The COPYPOOL parameter is used to extract data about each backup version of the specified copy pool. The extract buffer is a header that is followed by one or more entries that describe each valid backup version. As many as 85 versions are returned for a single copy pool. The data that is associated with each copy is returned.

Tip: When you specify DATA=COPYPOOL, you must specify the COPYPOOL=cpnameaddr keyword.

For each version of a specified copy pool, ARCXTRCT returns the version number, generation number, valid or invalid indicator, VTOC enqueue indicator, date and time, and token.

Table 9-1 shows the layout of the DATA=COPYPOOL extract header.

Table 9-1 Extract header layout

Offset	Type	Bytes	Name	Description
Dec/Hex				
0 (0)	Character	8	XHEADER	EXTRACT AREA HEADER
0 (0)	Fixed	1	XSUBPOOL	EXTRACT DATA SUBPOOL
1 (1)	Fixed	3	XLENGTH	EXTRACT AREA SIZE (TOTAL)
4 (4)	Fixed	2	XENTRIES	NUMBER OF ENTRIES THAT FOLLOW
6 (6)	Fixed	2	XENTRLEN	SIZE OF EACH ENTRY

Table 9-2 shows the layout of each DATA=COPYPOOL backup version entry.

Table 9-2 Entry for DATA=COPYPOOL backup version

Offset	Type	Bytes	Name	Description
Dec/Hex				
0 (0)	Character	108	CPENT	ENTRY FOR COPY POOL BACKUP VERSION
0 (0)	Fixed	4	CPVER	VERSION NUMBER 001 - 999
4 (4)	Fixed	4	CPGEN	GENERATION NUMBER 00 - 84
8 (4)	Bit	2	CPFLAG	FLAGS
	1...		CPFVALID	ON = VERSION IS VALID

Offset	Type	Bytes	Name	Description
Dec/Hex				
	.1..		CPFNVTOC	ON = NOVTOCENQ WAS SPECIFIED
	..XX XXXX		*	RESERVED
10 (8)	Character	4	CPDATE	DATE WHEN BACKUP MADE *YYYYDDDF*
14 (14)	Character	4	CPTIME	TIME WHEN BACKUP MADE *HHMMSSTH*
18 (18)	Character	40	CPTOKEN	TOKEN
58 (58)	Character	50	*	RESERVED

DFSMShsm did not change other macros in support of DFSMShsm fast replication. Users, such as DB2, issue the existing ARCHSEND macro to send all of the commands that are mentioned in this chapter (for example, FRBACKUP or FRRECOVER) to the DFSMShsm address space.

9.1.7 Recovering

The target volume of a DFSMShsm fast replication backup is unsuitable to use as a source volume. If the source volume becomes corrupted, the new DFSMShsm FRRECOV command must be used to recover the target to the source volume.

FRRECOV command

To recover all of the volumes from a copy pool, use this command:

```
FRRECOV COPYPOOL(cpname) VERIFY(Y)
```

When recovering a copy pool, many volumes might fail the recovery process. This situation is not expected, but it is possible. If Snapshot is the fast replication utility, another recovery of the entire copy pool can be resubmitted after the reason for the failures is addressed.

If FlashCopy Version 1 is the fast replication utility, the FlashCopy relationships that were established successfully during the first recovery must be completed before the subsequent recovery can be started. If FlashCopy Version 2 is the fast replication utility, the recovery can be tried again immediately.

To recover an individual volume, use the following command:

```
FRRECOV TOVOLUME(volser) FROMCOPYPOOL(cpname)
```

Tip: No keyword is provided to perform a recovery at the storage group level.

When COPYPOOL is specified, DFSMShsm attempts to recover all of the volumes that are associated with that copy pool. The volumes that were associated with the copy pool at the time of the backup are the volumes that will be recovered. If one or more volumes fail, the FRRECOV command ends with a nonzero return code, and the user can reattempt to recover the failed volumes by using the TOVOLUME keyword.

FROMCOPYPOOL(*cpname*) is an optional parameter that must be specified if the volume that is being recovered is contained within a storage group that is defined within multiple copy pools.

If a version other than the most recent version must be recovered, either the GENERATION, VERSION, DATE, or TOKEN keyword can be specified. The correct generation or version can be selected from the available versions that are returned by the DFSMShsm LIST command or ARCXTRCT macro. A token can be passed with the new TOKEN keyword to recover the unique version that corresponds to that token. If the token is not unique, the most recent version that corresponds to the token will be recovered. If no version exists with the specified token, the recovery fails.

If DATE is specified, and multiple versions exist for the specified date, the most recent version for that date will be recovered.

For the HSENDCMD command, the results that are sent back to the user depend on whether the WAIT parameter was specified and the success or failure of one or more volumes:

- If WAIT was specified and all volumes are successfully processed, a successful return code of zero will be returned.
- If WAIT was specified and one or more volumes failed, a nonzero return code, and associated messages, will be returned to the caller.
- If WAIT is not specified, control is returned to the caller after the command is accepted and verified. All messages will continue to be issued, but the command initiator will not be notified when the command completes.

When FlashCopy is used as the fast replication utility, a recovery from a fast replication backup cannot be performed if any of the volumes are in an existing FlashCopy relationship. The recovery of a copy pool must not be attempted until all of the background copies are complete from an invocation of the last FRBACKUP command.

QUERY COPYPOOL command

The QUERY COPYPOOL command can be used to determine whether any of the source volumes for a copy pool are in a FlashCopy relationship. In addition, the VERIFY keyword is provided to prevent the initiation of a recovery of a copy pool for which all of the background copies from the backup are not completed. When VERIFY(Y) is specified, before initiating any volume recoveries, DFSMShsm determines whether any of the volumes are in an existing FlashCopy relationship. If one or more volumes are in an existing FlashCopy relationship, the recovery fails. If an immediate recovery must be performed, two options are available:

- Wait until all of the background copies complete. Then, the latest backup version can be used for the recovery.
- For FlashCopy Version 1, withdraw the outstanding FlashCopy relationships by using the new DFSMShsm FRBACKUP COPYPOOL(*cpname*) WITHDRAW command. This command invalidates the latest version of the backup, but it enables an immediate recovery from the prior version. This process works for FlashCopy Version 2 only if the generation 1 background copies completed.

> **Important:** Use the LIST COPYPOOL command or ARCXTRCT macro first to see what you have so that you do not invalidate the only valid fast replication backup version. Using the LIST COPYPOOL command or ARCXTRCT macro can help you prevent any recovery from being performed.

When Snapshot is used as the fast replication utility, a recovery can be performed immediately after the DFSMShsm backup command completes.

9.1.8 Withdrawing DFSMShsm background copies

A FlashCopy relationship between a source volume and a target volume that was established through a FRBACKUP command must never be withdrawn outside of DFSMShsm control. This withdrawal will invalidate the backup version, but DFSMShsm will still manage the version as though it were valid, which can result in a data integrity exposure.

FRBACKUP command

When it is necessary to withdraw one or more relationships that were established by a FRBACKUP command, you must use the WITHDRAW option:

```
FRBACKUP COPYPOOL(cpname) WITHDRAW
```

This command withdraws all current FlashCopy relationships that are associated with the volumes in the most recent VALID version for the specified copy pool. That version of the backup will be marked as invalid. If the most recent valid version is not generation zero, and any relationships were withdrawn, the withdrawn version will also be deleted because it is no longer usable.

Important: Use the LIST COPYPOOL command or ARCXTRCT macro to ensure that they do not withdraw the only valid backup version. Using the LIST COPYPOOL command or ARCXTRCT macro will prevent any recovery from being performed.

The withdrawal can be performed at the copy pool level only. If any part of a copy pool backup version is invalidated, the entire version is invalidated.

9.1.9 Deleting unneeded fast replication backup versions

Through normal processing, new backup versions replace older backup versions. But two instances exist in which a process other than the normal roll-off case is required to delete an unneeded copy version. The first situation is when the number of versions that is specified for a copy pool is decreased. The second situation is when a copy pool is renamed or no longer needed.

Decreasing the number of copy pool versions

When the number of versions for a copy pool is decreased (by modifying the SMS copy pool definition), the unneeded versions will be deleted the next time that the FRBACKUP COPYPOOL command is issued for that copy pool. The target volumes that contained those versions will be made available for other use.

When a copy pool is renamed or no longer needed, the storage administrator must delete the backup versions that relate to that copy pool. You can use the new DFSMShsm FRDELETE command:

```
FRDELETE COPYPOOL(cpname) VERSIONS(bvn)
```

When the optional VERSIONS keyword is specified, the named backup versions will be deleted.

If the optional TOKEN keyword is specified, the version with the specified token will be deleted.

If the optional ALL keyword is specified, all backup versions will be deleted.

Before a version is deleted, any outstanding FlashCopy relationships will be withdrawn.

9.1.10 Recovery after increasing the number of volumes in a copy pool

When one or more volumes are added to a storage group within a copy pool, DFSMShsm includes those new volumes with any subsequent backup versions.

If a recovery must be performed from a version that does not contain the new volumes, and data was placed onto those volumes, after the recovery, those volumes will contain residual unusable data that must be cleaned up.

For example, for a storage group that has two volumes (volumes MHL100 and MHL120), a fast replication of those two volumes is made. Then, a third volume, volume MHL130, is added to the storage group. New data is placed onto volume MHL130. Then, it is discovered that an error occurred and a recovery of the last backup version is performed.

During the recovery, volumes MHL100 and MHL120 will be recovered to the point of the fast replication. Because volume MHL130 was not a part of the fast replication backup, it will not be processed during the recovery. It might contain data that is no longer valid. Volume MHL130 will have to be addressed by the user.

DFSMShsm provides a warning message for each volume that fits this scenario.

9.1.11 Recovery after decreasing the volumes in a copy pool

If a volume must be removed from a storage group that is defined to a copy pool, special care must be taken to avoid data loss.

Data loss can occur if a recovery of the copy pool from which the volume was defined is performed. For this reason, during the recovery of a copy pool, DFSMShsm will fail the recovery of any individual volumes that existed within the copy pool at the time of the backup but that are not a part of the copy pool at the time of recovery. These volumes can still be recovered individually.

For example, assume two copy pools, COPYPOOLA and COPYPOOLB. Each copy pool contains a single storage group (COPYPOOLA contains SGA and COPYPOOLB contains SGB). A daily fast replication backup is made of each copy pool. SGA has an empty volume, VOLA, that is moved to SGB for space needs. After VOLA is moved, data for COPYPOOLB is allocated on it.

The potential for data loss arises because a fast replication backup version might exist for COPYPOOLA that contains VOLA. That backup version represents VOLA in its empty state. If that fast replication backup version for COPYPOOLA is recovered, the recovery of COPYPOOLA will recover VOLA to its empty state and overlay any new data was allocated on VOLA since VOLA was moved to SGB.

To prevent this scenario and others that are similar, during the recovery of a copy pool, DFSMShsm will fail individual volumes that are no longer defined to the copy pool that is being recovered.

Perform the following steps to recover a backup version of a copy pool that contains a volume that was removed from the copy pool:

1. Recover the copy pool. Each volume that was removed from the copy pool since the time the backup version was created will be failed with message ARC1811E.
2. For each of those failed volumes, determine whether the volume must be recovered as a part of the copy pool. Perform the remaining steps for volumes that must be recovered.
3. Determine whether the existing data on the volume must be preserved. If the data must be preserved, the data must be moved off the volume and onto another volume because the recovery of the volume overwrites all the existing data.
4. Issue an individual volume recovery command to recover the volume:

   `FRRECOV TOVOLUME(`*`volser`*`) FROMCOPYPOOL(`*`cpname`*`) VERSION(`*`vernum`*`)`

   `FROMCOPYPOOL` and `VERSION` are optional parameters.
5. Determine whether the volume must be put back into the copy pool and return it, if necessary. The volume must be returned to the copy pool if another backup version will be created after the recovery, and that backup version must include the data that was recovered to the volume and any subsequent changes to that volume.

9.1.12 Decreasing volumes in a copy pool backup storage group

Special care must be taken when you remove a volume from a CPBSG. Before you remove the volume, you must ensure that the volume is not the target of a valid DFSMShsm fast replication backup version by examining the output from the DFSMShsm LIST COPYPOOLBACKUPSTORAGEGROUP command.

If a target volume must be removed from a valid source-target pairing, first use the FRDELETE command to delete the DFSMShsm backup version that the volume is a part of.

9.1.13 Catalogs

Because a fast replication backup is a physical copy of the data, special care must be taken to ensure that the catalogs stay synchronized with the data. Catalogs must be copied with the data that they represent so that both can be recovered to the same point in time.

If it is necessary to recover an individual volume and not the corresponding catalog, the user must be aware that the data on the volume will not be synchronized with the catalog:

- Data sets might exist on the volume but not in the catalog.
- The catalog might have entries for data sets on the volume that are not present.
- Data set information for existing data sets in the catalog might be inaccurate.

To correct these problems, software from Rocket Mainstar Software Corporation that is called Mirroring Solutions/Volume Conflict Rename **(**MS/VCR) can be used to solve data access problems that appear after a volume restore. IBM is a reseller of Rocket Mainstar software solutions. The Redbooks publication, *Mainstar MS/VCR The Tool for Efficient Device Cloning*, SG24-6860, provides an overview of the product and how to use it.

9.2 zFS aggregate environments

Using DFSMShsm fast replication in zFS aggregate environments is described.

9.2.1 zFS aggregate backup example

A zFS aggregate backup example that uses DFSMShsm fast replication is described:

- In this scenario, a pool storage group (SG2) exists with two volumes (MHL1A0 and MHL1A1) that contain zFS aggregate files.
- Copy pool CP2 is defined as the copy pool for storage group SG2 with two backup versions.
- The CPBSG that is used for the backups is CPBSG1 (Figure 9-1).

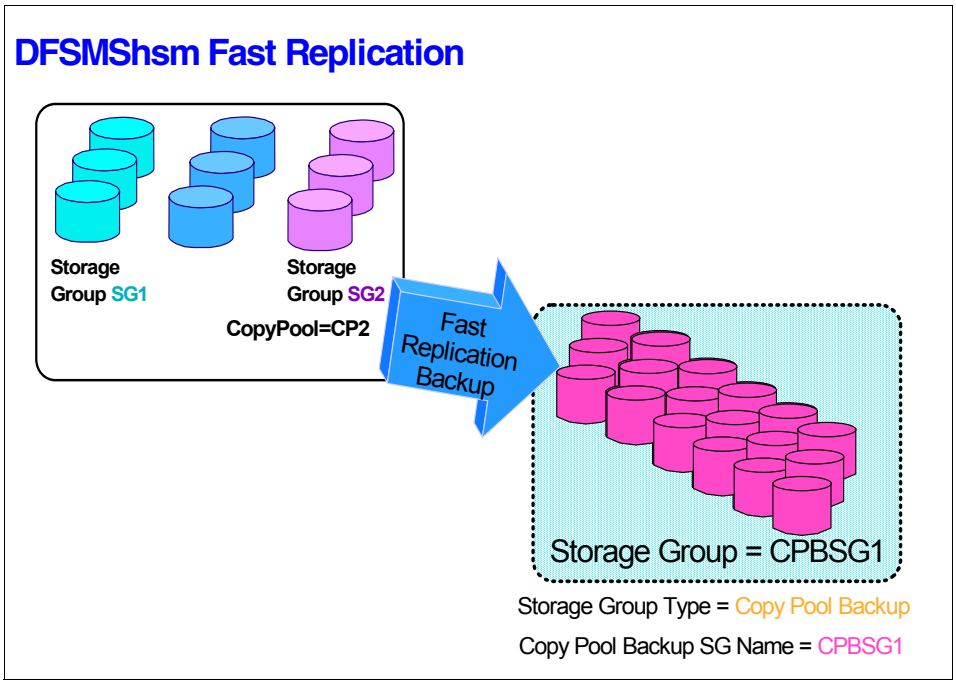

Figure 9-1 Copy pools that are used for the zFS scenario

We use the following tasks to back up the zFS aggregates by using DFSMShsm fast replication:

- QUIESCE to stop the use of the aggregates
- FRBACKUP of the copy pool
- UNQUIESCE to enable the use of the aggregates

Example 9-1 shows the quiesce for two zFS aggregates (ZFSFR.ZFSA.ZFS and ZFSFR.ZFSB.ZFS) and the FRBACKUP of copy pool CP2, followed by unquiesce steps for the two aggregates.

The REXX procedure RXZFS that is used in the quiesce step is documented in Appendix A, “Sample REXX execs” on page 243.

Example 9-1 Backup of zFS aggregates by using FRBACKUP

```
//* ------------------------------------------------------------------
//* Backup of zFS aggregates using DFSMShsm Fast Replication
//* Property of IBM  (C) Copyright IBM Corp. 2003
//* ------------------------------------------------------------------
//  SET TIMEOUT=0          <=== Timeout value in seconds, 0=no timeout
//  SET REXXLIB=MHLRES3.ZFS.REXX.EXEC             <=== SYSEXEC library
//* ------------------------------------------------------------------
//  SET AGGRNAMA=ZFSFR.ZFSA.ZFS                    <=== zFS aggregate
```

```
//  SET AGGRNAMB=ZFSFR.ZFSB.ZFS                    <=== zFS aggregate
//* ---------------------------------------------------------------------
//* These steps quiesce the aggregates.
//* ---------------------------------------------------------------------
//QUIESCE  EXEC PGM=IKJEFT01,
// PARM='RXZFS &TIMEOUT. zfsadm quiesce -aggregate &AGGRNAMA.'
//SYSEXEC  DD DSNAME=&REXXLIB.,DISP=SHR
//STDENV   DD DUMMY
//STDIN    DD DUMMY
//SYSTSIN  DD DUMMY
//SYSTSPRT DD SYSOUT=*,LRECL=136,RECFM=V
//* ---------------------------------------------------------------------
//QUIESCE  EXEC PGM=IKJEFT01,
// PARM='RXZFS &TIMEOUT. zfsadm quiesce -aggregate &AGGRNAMB.'
//SYSEXEC  DD DSNAME=&REXXLIB.,DISP=SHR
//STDENV   DD DUMMY
//STDIN    DD DUMMY
//SYSTSIN  DD DUMMY
//SYSTSPRT DD SYSOUT=*,LRECL=136,RECFM=V
//* ---------------------------------------------------------------------
//* This step does FRBACKUP of the Copy Pool.
//* ---------------------------------------------------------------------
//  IF QUIESCE.RC EQ 0 THEN
//HSMFR EXEC PGM=IKJEFT01
//SYSPRINT DD SYSOUT=*
//SYSIN    DD SYSOUT=*
//SYSTSPRT DD SYSOUT=*
//SYSTSIN DD *
 HSEND WAIT FRBACKUP COPYPOOL(CP2)
//* ---------------------------------------------------------------------
//* These steps unquiesce the aggregates.
//* ---------------------------------------------------------------------
//UNQUSCE  EXEC PGM=IKJEFT01,
// PARM='RXZFS &TIMEOUT. zfsadm unquiesce -aggregate &AGGRNAMA.'
//SYSEXEC  DD DSNAME=&REXXLIB.,DISP=SHR
//STDENV   DD DUMMY
//STDIN    DD DUMMY
//SYSTSIN  DD DUMMY
//SYSTSPRT DD SYSOUT=*,LRECL=136,RECFM=V
//* ---------------------------------------------------------------------
//UNQUSCE  EXEC PGM=IKJEFT01,
// PARM='RXZFS &TIMEOUT. zfsadm unquiesce -aggregate &AGGRNAMB.'
//SYSEXEC  DD DSNAME=&REXXLIB.,DISP=SHR
//STDENV   DD DUMMY
//STDIN    DD DUMMY
//SYSTSIN  DD DUMMY
//SYSTSPRT DD SYSOUT=*,LRECL=136,RECFM=V
//* ---------------------------------------------------------------------
//  ENDIF
```

Example 9-2 shows the output from the batch job that is printed in the SYSTSPRT DD output.

Example 9-2 Output from the zFS aggregate batch job that uses FRBACKUP

```
zfsadm quiesce -aggregate ZFSFR.ZFSA.ZFS
IOEZ00163I Aggregate ZFSFR.ZFSA.ZFS successfully quiesced
READY
END

zfsadm quiesce -aggregate ZFSFR.ZFSB.ZFS
IOEZ00163I Aggregate ZFSFR.ZFSB.ZFS successfully quiesced
READY
END

‘READY
  HSEND WAIT FRBACKUP COPYPOOL(CP2)
 FRBACKUP COPYPOOL(CP2) COMMAND PROCESSING ENDED
 READY
 END

zfsadm unquiesce -aggregate ZFSFR.ZFSA.ZFS
IOEZ00166I Aggregate ZFSFR.ZFSA.ZFS successfully unquiesced
READY
END

zfsadm unquiesce -aggregate ZFSFR.ZFSB.ZFS
IOEZ00166I Aggregate ZFSFR.ZFSB.ZFS successfully unquiesced
READY
END
```

The DFSMShsm fast replication output is written to SYSLOG and in the DFSMShsm backup log data set (Example 9-3).

Example 9-3 Output in syslog from FRBACKUP

```
ARC1801I FAST REPLICATION BACKUP IS STARTING FOR
ARC1801I (CONT.) COPY POOL CP2, AT 17:16:36 ON
ARC1801I (CONT.) 2003/11/10
ARC1805I THE FOLLOWING 00002 VOLUME(S) WERE
ARC1805I (CONT.) SUCCESSFULLY PROCESSED BY FAST
ARC1805I (CONT.) REPLICATION BACKUP OF COPY POOL CP2
ARC1805I (CONT.) MHL1A0
ARC1805I (CONT.) MHL1A1
ARC1802I FAST REPLICATION BACKUP HAS COMPLETED FOR
ARC1802I (CONT.) COPY POOL CP2, AT 17:16:39 ON
ARC1802I (CONT.) 2003/11/10, FUNCTION RC=0000,
ARC1802I (CONT.) MAXIMUM VOLUME RC=0000
```

9.2.2 zFS aggregate recover example

To recover zFS aggregates by using the DFSMShsm fast replication backups, the aggregates must be unmounted and detached to remove allocation from the zFS aggregate volumes. When performing the FRRECOV command, the source volumes might not be allocated.

Use the following actions for the recovery of the compatibility mode aggregates and multi-file mode aggregates.

Compatibility mode aggregates

A compatibility mode aggregate has exactly one read/write file system in the aggregate, and it is not attached before being mounted. It is only mounted and unmounted. An implicit attach occurs during the mount; an implicit detach occurs during the unmount. We used these tasks:

- Unmount the aggregate.
- Perform the FRRECOV.
- Mount the aggregate.

Multi-file mode aggregates

A multi-file mode aggregate can contain one or more zFSs. Before detaching a multi-file mode aggregate, all file systems in the aggregate must be unmounted:

- Unmount the file systems in the aggregate.
- Detach the aggregate.
- Perform the FRRECOV.
- Attach the aggregate.
- Mount each file system in the aggregate.

Example 9-4 shows a **zfsadm detach** command, which you use to detach multi-file mode aggregates before a FRRECOV of a zFS copy pool.

Example 9-4 zfsadm detach command

```
zfsadm detach -aggregate omvs.prv.aggr001.lds0001
```

Example 9-5 shows a **zfsadm attach** command. Use this command to attach a multi-file mode aggregate after a FRRECOV of a zFS copy pool.

Example 9-5 zfsadm attach command

```
zfsadm attach -aggregate omvs.prv.aggr001.lds0001
```

For a detailed description of zFS modes, related commands, and procedures, see the following publications:

- *z/OS Distributed File Service zFS Administration*, SC24-5989
- *z/OS Distributed File Service zSeries File System Implementation*, SG24-6580

Example 9-6 shows a sample job that can be used for both unmount and mount of zFS aggregates. A test is performed and if the aggregate is mounted, it will be unmounted. If it is not mounted, the aggregate will be mounted.

Example 9-6 zFS unmount /mount JCL

```
//* ------------------------------------------------------------------
//* Run zFS related and other shell commands in batch mode
//* Property of IBM  (C) Copyright IBM Corp. 2002, 2003
//* ------------------------------------------------------------------
//  SET TIMEOUT=R0         <=== Timeout value in seconds, 0=no timeout
//  SET REXXLIB=MHLRES3.ZFS.REXX.EXEC             <=== SYSEXEC library
//* ------------------------------------------------------------------
//ZFSADM   EXEC PGM=IKJEFT01,PARM='RXSUSH &TIMEOUT.'
//SYSEXEC  DD DSNAME=&REXXLIB.,DISP=SHR
//STDENV   DD DATA,DLM=##
# ------------------------------------------------------------------
 FILESYSTEM=ZFSFR.ZFSA.ZFS
 MOUNTPOINT=/SC65/z/zfsa
# ------------------------------------------------------------------
```

```
##
//STDIN    DD DATA,DLM=##
# ---------------------------------------------------------------------
mnted=$(/usr/sbin/mount -q $MOUNTPOINT | grep $MOUNTPOINT | wc -l);-
if test $mnted -eq 0;-
  then; C="/usr/sbin/mount -f $FILESYSTEM -t ZFS $MOUNTPOINT"; $C;-
  else; C="/usr/sbin/unmount $MOUNTPOINT"; $C;-
fi+
# ---------------------------------------------------------------------
##
//SYSTSIN  DD DUMMY
//SYSTSPRT DD SYSOUT=*,LRECL=136,RECFM=V
//* ---------------------------------------------------------------------
//ZFSADM1  EXEC PGM=IKJEFT01,PARM='RXSUSH &TIMEOUT.'
//SYSEXEC  DD DSNAME=&REXXLIB.,DISP=SHR
//STDENV   DD DATA,DLM=##
# ---------------------------------------------------------------------
 FILESYSTEM=ZFSFR.ZFSB.ZFS
 MOUNTPOINT=/SC65/z/zfsb
# ---------------------------------------------------------------------
##
//STDIN    DD DATA,DLM=##
# ---------------------------------------------------------------------
mnted=$(/usr/sbin/mount -q $MOUNTPOINT | grep $MOUNTPOINT | wc -l);-
if test $mnted -eq 0;-
  then; C="/usr/sbin/mount -f $FILESYSTEM -t ZFS $MOUNTPOINT"; $C;-
  else; C="/usr/sbin/unmount $MOUNTPOINT"; $C;-
fi+
# ---------------------------------------------------------------------
##
//SYSTSIN  DD DUMMY
//SYSTSPRT DD SYSOUT=*,LRECL=136,RECFM=V
//* ---------------------------------------------------------------------
```

The JCL in Example 9-6 on page 197 unmounts and mounts aggregates ZFSFR.ZFSA.ZFS and ZFSFR.ZFSB.ZFS. These aggregates are compatibility mode aggregates and are detached when the unmount is done.

The REXX procedure RXSUSH that is used in the quiesce step is documented in Appendix A, “Sample REXX execs” on page 243.

When executing the unmount of compatibility mode aggregates, the messages in Example 9-7 are written to SYSLOG.

Example 9-7 Unmount and detach of the zFS aggregates

```
IOEZ00048I Detaching aggregate ZFSFR.ZFSA.ZFS
IOEZ00048I Detaching aggregate ZFSFR.ZFSB.ZFS
```

Stopping zFS address space

Unmounting and mounting can also be performed by stopping the zFS address space. However, this method affects all users of zFSs.

To stop the zFS address space, you can use the stop command **P ZFS** from an MVS console to detach all aggregates and unmount all file systems. Example 9-8 on page 199 contains the command and the output.

Example 9-8 Stop the zFS address space

```
P ZFS
IOEZ00050I zFS kernel: Stop command received.
IOEZ00048I Detaching aggregate ZFSFR.ZFSA.ZFS
IOEZ00061I zFS kernel: forcing unmount of file system ZFSFR.ZFSA.ZFS.
IOEZ00048I Detaching aggregate ZFSFR.ZFSB.ZFS
IOEZ00061I zFS kernel: forcing unmount of file system ZFSFR.ZFSB.ZFS.
IOEZ00057I zFS kernel program IOEFSCM is ending
BPXF063I FILE SYSTEM ZFSFR.ZFSA.ZFS
WAS SUCCESSFULLY UNMOUNTED.
BPXF063I FILE SYSTEM ZFSFR.ZFSB.ZFS
WAS SUCCESSFULLY UNMOUNTED.
*098 BPXF032D FILESYSTYPE ZFS TERMINATED.  REPLY 'R' WHEN READY TO
 RESTART. REPLY 'I' TO IGNORE.
```

FRRECOV of zFS copy pool

When the volumes in the zFS copy pool are unallocated, the FRRECOV command can be executed, either as a DFSMShsm command or in a batch job. Example 9-9 shows the command as executed from a TSO user and the output that is written to SYSLOG.

Example 9-9 FRRECOV command and output

```
F HSM,FRRECOV  CP(CP2)

ARC1801I FAST REPLICATION RECOVERY IS STARTING FOR
ARC1801I (CONT.) COPY POOL CP2, AT 15:05:54 ON
ARC1801I (CONT.) 2003/11/10
ARC1805I THE FOLLOWING 00002 VOLUME(S) WERE
ARC1805I (CONT.) SUCCESSFULLY PROCESSED BY FAST
ARC1805I (CONT.) REPLICATION RECOVERY OF COPY POOL
ARC1805I (CONT.) CP2
ARC1805I (CONT.) MHL1A0
ARC1805I (CONT.) MHL1A1
ARC1802I FAST REPLICATION RECOVERY HAS COMPLETED FOR
ARC1802I (CONT.) COPY POOL CP2, AT 15:05:56 ON
ARC1802I (CONT.) 2003/11/10, FUNCTION RC=0000,
ARC1802I (CONT.) MAXIMUM VOLUME RC=0000
ARC1000I COPY POOL CP2 FRRECOV PROCESSING ENDED
```

More detailed output from the FRRECOV command, which also contains DFSMSdss messages, is written to the DFSMShsm backup log data set.

The FRRECOV command can also be executed in a batch job, as shown in Example 9-10.

Example 9-10 FRRECOV in a batch job

```
//* ------------------------------------------------------------------
//* This step does FRRECOV  of the CopyPool.
//* Before executing this job stop the ZFS address space. (P ZFS)
//* ------------------------------------------------------------------
//HSMFR EXEC PGM=IKJEFT01
//SYSPRINT DD SYSOUT=*
//SYSIN    DD SYSOUT=*
//SYSTSPRT DD SYSOUT=*
//SYSTSIN DD *
 HSEND WAIT FRRECOV  COPYPOOL(CP2)
/*
//* ------------------------------------------------------------------
```

Starting the zFS address space

If the zFS address space was stopped before the FRRECOV command, it can be restarted by replying R to the outstanding write to operator with reply (WTOR) from the zFS shutdown, as shown in Example 9-11.

Example 9-11 START of the zFS address space

```
*098 BPXF032D FILESYSTYPE ZFS TERMINATED.  REPLY 'R' WHEN READY TO
 RESTART. REPLY 'I' TO IGNORE.
R 98,R
IEE600I REPLY TO 098 IS;R
IAT6100 ( DEMSEL ) JOB ZFS      (JOB17915), PRTY=15, ID=DFS
ICH70001I DFS      LAST ACCESS AT 15:06:12 ON MONDAY, NOVEMBER 10,
2003
IEF403I ZFS - STARTED - TIME=15.06.13 - ASID=0418 - SC65
IOEZ00052I zFS kernel: Initializing z/OS    zSeries File System
Version 01.05.00 Service Level OA04833.
Created on Fri Oct 10 09:47:16 EDT 2003.
IOEZ00178I SYS1.TEST.PARMLIB(IOEFSPRM) is the
configuration dataset currently in use.
IOEZ00055I zFS kernel: initialization complete.
```

When the FRRECOV function is complete and the zFS address space is active, the zFS aggregates can be attached and file systems can be mounted.

Dumping zFS aggregates

In addition to the DFSMShsm fast replication function, you can use DFSMSdss to dump the target volumes to tape for additional backup or other purposes, such as data mining or cloning to other systems.

The DFSMSdss backup of copy pools is described in Chapter 7, “Using DFSMSdss to back up copy pools” on page 157.

10

Reporting on the DFSMShsm fast replication environment

This chapter shows how to create reports that provide useful information about what is happening in your environment. The focus is on Function Statistics Records (FSRs). Sample programs are provided to format the FSRs.

10.1 Statistics records

DFSMShsm writes its own statistics records. This record is not a statistical record that is created by a z/OS function, such as dynamic allocation. The command SETSYS SMF or NOSMF tells DFSMShsm to write or not write System Management Facilities (SMF) records.

The optional parameters SMF(*smfid*) and NOSMF are mutually exclusive. They specify whether DFSMShsm writes SMF records that contain DFSMShsm statistics:

- SMF(*smfid*) specifies that DFSMShsm write SMF records in the SYS1.MAN*x* or SYS1.MAN*y* system data sets.

  For *smfid*, substitute a record identification. Use SMF user codes for the record identification in the range of 128 - 255.

  If you specify *smfid*, DFSMShsm writes records with SMF identifications of *smfid* and *smfid*+1. Records with an identification of *smfid* contain daily statistics (DSR) and volume statistics (VSR). Records with an identification of *smfid*+1 contain Function Statistics Records (FSR) and aggregate backup and recovery support (ABARS) Function Statistics (WWFSR).

  Important: When a DFSMShsm function executes, only selected fields within the FSR record are set. The fields that are set depend on the function that is being performed and the method that is used to request the function. The fields that are set are required by the DFSMShsm REPORT command.

- NOSMF specifies that no SMF records are to be written.

10.2 REPORT command

The REPORT command is updated to support DFSMShsm fast replication.

10.2.1 REPORT DAILY command

The REPORT DAILY command is updated to report the total number of volumes for which a fast replication backup or recovery was requested. The total number of failures is also reported.

The two lines in Example 10-1 were added to the REPORT DAILY heading.

Example 10-1 Updates to the REPORT DAILY heading

```
FAST REPLICATION VOLUME BACKUPS = 00000004 REQUESTED, 00000000 FAILED
FAST REPLICATION VOLUME RECOVERS = 00000001 REQUESTED, 00000000 FAILED
```

10.2.2 REPORT VOLUMES command

The REPORT VOLUMES command is updated to report the total number of times that a fast replication backup was successfully created for the volume and the number of failed attempts for that volume. Recover statistics are also reported.

The two lines in Example 10-2 were added to the REPORT VOLUMES heading.

Example 10-2 Updates to the REPORT VOLUMES heading

```
FAST REPLICATION BACKUP = 0000 REQUESTED, 0000 FAILED
FAST REPLICATION RECOVER = 0000 REQUESTED, 0000 FAILED
```

10.2.3 REPORT statistics

The two REPORT options show the current statistics (DSR and VSR) for the DFSMShsm address space. The statistics are accumulated in the DFSMShsm workspace and are written to the migration control data set (MCDS) and to SMF under the following conditions:

- For DSR:
  - At the start of a new hour
  - When a REPORT command is entered
  - When a QUERY STATISTICS command is entered
  - When DFSMShsm shuts down
  - At the start of a new day (the previous day's record is written)

  Tip: DFSMShsm activity (recalls, migrations, backups, recovers, dumps, recycles, restores, and deletions of migrated data sets) must occur in order for DFSMShsm to recognize the start of a new hour or day.

- For VSR:
  - Whenever a daily statistics record is written
  - At the end of secondary space management
  - After space management is performed on a volume
- For FSR:
  - The FSR is both one of the DFSMShsm statistics records and a control block that contains statistics for a particular function that is performed. The FSR is maintained in the DFSMShsm workspace until a function, such as FRBACKUP, completes.
  - Upon completion of the function, the record is written to the DFSMShsm log and accumulated by category in to the daily and volume statistics records in the MCDS.
  - The FSR is also written to the SMF data sets (SYS1.MAN*x* or SYS1.MAN*y*) if SETSYS SMF is specified.

Tip: If statistics are needed for a week or several days, they can be extracted more easily from the SMF data, not only out of the address space or MCDS. It is also easier to use REXX or other programs to analyze them.

10.3 Updated DSR records

Table 10-1 shows the new fields of the DSR records.

Table 10-1 Daily statistics record: New fields

Offsets	Type	Length	Name	Description
88 (58)	FIXED	4	DSR_FR_BACKUP_TOTAL	Total number of fast replication backups
92 (5C)	FIXED	4	DSR_FR_BACKUP_FAILED	Total number of failed fast replication backups
96(60)	FIXED	4	DSR_FR_RECOVER_TOTAL	Total number of fast replication recovers
176(B0)	FIXED	4	DSR_FR_RECOVER_FAILED	Total number of failed fast replication recovers

10.4 Updated VSR records

Table 10-2 shows the new fields in the VSR records.

Table 10-2 Volume statistics record: New fields

Offsets	Type	Length	Name	Description
136(88)	FIXED	1	VSR_FR_BACKUP_TOTAL	Total number of fast replication backups
137(89)	FIXED	1	VSR_FR_BACKUP_FAILED	Total number of failed fast replication backups
138(8A)	FIXED	1	VSR_FR_RECOVER_TOTAL	Total number of fast replication recovers
139(8B)	FIXED	1	VSR_FR_RECOVER_FAILED	Total number of failed fast replication recovers

10.5 New FSR records

Three new Function Statistics Records (FSRs) are provided for copy pools.

10.5.1 FSR type 21

A functional statistics record of type 21 is created for each volume that is backed up as part of the copy pool. In addition to the standard FSR fields, such as date and time, the following fields are set: FSRCPU, FSRFNONQ, FSRTVOL, FSRFVOL, FSRGEN, and FSRFVER.

10.5.2 FSR type 22

A functional statistics record of type 22 is created for each volume that is recovered as part of the copy pool. The new type 22 record is also used when FROMCOPYPOOL is used. In addition to the standard FSR fields, such as date and time, the following fields are set: FSRCPU, FSRFNONQ, FSRTVOL, FSRFVOL, FSRGEN, and FSRFVER.

10.5.3 FSR type 23

A functional statistics record of type 23 is created for each version that is deleted. In addition to the standard FSR fields, such as date and time, the following fields are set: FSRGEN and FSRFVER.

Fields that relate to fast replication are shown in bold in Table 10-3. For additional information about FSR record collection and reporting, see the *DFSMShsm Implementation and Customization Guide*, SC35-0418, and *MVS System Management Facilities*, SA22-7630.

Table 10-3 Function Statistics Record extract of the new and updated fields

Offsets	Type	Length	Name	Description
42 (2A)	FIXED	1	**FSRTYPE**	DFSMShsm function type. The function types are listed: 1=Primary to level 1 migration 2=Level 1 to level 2 migration, or level 1 to level 1 migration, or level 2 to level 2 migration 3=Primary to level 2 migration 4=Recall from level 1 to primary 5=Recall from level 2 to primary 6=Delete a migrated data set 7=Daily backup 8=Spill backup 9=Recovery 10=Recycle backup volume 11=Data set deletion by age 12=Recycle migration volume 13=Full volume dump 14=Volume or data set restore 15=ABACKUP function (see WWFSR control block) 16=ARECOVER function (see WWFSR control block) 17=Expire primary or migrated data sets 18=Partrel function 19=Expire or roll off incremental backup version 20=(H)BDELETE an incremental backup version **21=Fast replication backup function** **22=Fast replication recover function** **23=Fast replication delete function**
43 (2B)	BITSTRING	1	**FSRFLAGS**	This byte contains the following flags:
	1...		FSRFFSTR	When set to 1, from a striped data set.
	.1..		FSRFTSTR	When set to 1, to a striped data set.
	..1.		FSRF32K	When set to 1, data set is greater than 32 K tracks. Use fields FSRTRKKR and FSRTRKKW instead of FSRTRKR and FSRTRKW.
	...1		FSRFKB	When set to 1, data set is greater than 2 GB. Fields FSRBYTR and FSRBYTW represent KB (1024 bytes).
	.... 1...		**FSRFVER**	**When set to 1, FSRGEN contains a version number.**
	.... .1..		**FSRFNONQ**	**When set to 1, DFSMShsm was directed to not serialize (enqueue) before making a backup copy.**
	.... ..1.		FSRFNQN	When set to 1, data set was backed up even though enqueue failed (once).

Offsets	Type	Length	Name	Description
	1		FSRFNQN2	When set to 1, attempted enqueue failed, backup was tried again, and enqueue failed again.
44 (2C)	CHARACTER		FSRDATA	Start of function data.
44 (2C)	CHARACTER	92	FSRMWE	The next 92 bytes contain information from the management work element for the request.
44 (2C)	CHARACTER	44	**FSRDSN**	**Data set name. For types 21, 22, and 23, this field contains the copy pool name.**
88 (58)	CHARACTER	6	**FSRTVOL**	**Receiving volume from the management work element. Also used for fast replication.**
98 (62)	CHARACTER	6	**FSRFVOL**	**Serial number of the original volume from the management work element.**
104 (68)	FIXED	4	**FSRGEN**	**Backup copy generation number if FSRFDAT is set to 0 and FSRFVER is set to 0. Backup copy version number if FSRFDAT is set to 0 and FSRFVER is set to 1.**
104 (68)	CHARACTER	4	**FSRDATE**	**Backup date if FSRFDAT is set to 1 and a recovery command with a from date was specified. The date is obtained from the TIME DEC macro in the format: *X'0cyyddds'***
178 (B2)	BITSTRING	2	**FSRFLG2**	The next two bytes contain the following request flags:
	1...		FSRFMNT	When set to 1, the volume is mounted.
	.1..		FSRTSO	When set to 1, it is TSO requested. When set to 0, it is batch requested.
	..1.		FSRUSER	When set to 1, it is a data set request from a user address space. When set to 0, it is system requested.
	...1		FSRWAIT	When set to 1, a wait was requested. When set to 0, the user did not wait for the request to complete.
	.... 1...		**FSRFDAT**	**When set to 1, the FSRDATE has the date when the functional statistics record was created. When set to 0, the FSRDATE contains the generation number.**
	.... .1..		FSRFRSV	When set to 1, the user specified the volume for a recall of a data set.
	.... ..1.		FSRFML2	When set to 1, the user specified migration directly to level 2.
	1		FSRFFRV	When set to 1, the user specified the FROM volume for a data set recovery.
180 (B4)	FIXED	4	**FSRCPU**	**CPU time in .01 second for request.**

The FSR SMF record number depends on the setting of SETSYS SMF(*smfid*). If *smfid* is specified as 240, the FSRs will be 241 SMF records. The FSR SMF record type is always equal to *smfid*+1.

For more information about SMF records or DFSMShsm FSR records, see the following publications:

- *z/OS MVS System Management Facilities (SMF)*, SA22-7630
- *DFSMShsm Diagnosis Guide,* LY35-0114
- *DFSMShsm Diagnosis Reference,* LY35-0115
- *DFSMShsm Implementation and Customization Guide*, SC35-0418

10.5.4 Gathering the data

Before you produce reports for DFSMShsm fast replication, gather the appropriate data. The first step is to determine the SMF ID that relates to DFSMShsm Functional Statistics Records. Use one of the following methods:

- Method 1: Use the QUERY SETSYS command. The output in the ARC0150I message contains the SMFID as shown in Example 10-3.

  Example 10-3 SMFID in QUERY SETSYS output

```
ARC0150I JOURNAL={NONE | SPEED | RECOVERY}, LOG={YES | NO | HELD}, TRACE={YES |
NO}, SMFID={smfid | NONE}, DEBUG={YES | NO}, EMERG={YES | NO}, JES={2 | 3},
SYS1DUMP={YES | NO}, RACFIND={YES | NO}, ERASEONSCRATCH={YES | NO}
```

- Method 2: Review the system ARCCMD*xx* member of SYS1.PARMLIB.

  Look for SETSYS SMFID(*smfid*) and use it to determine whether SMF records are being generated, and if so which one to use:

  - DSR and VSR = *smfid*.
  - FSR and WWFSR = *smfid* +1.
    (WWFSRs are the ABARSs functional statistics.)

    For example, an SMFID=240 means that FSR records are type 241.
  - SMFID=NONE *means that no records are being collected.*

All FSR types are shown in Table 10-4:

- Function types 1 - 14 and 17 - 23 are FSR records.
- Function types 15 and 16 are ABARS WWFSR records.

For details, see Appendix 1.2.1 in the manual *DFSMShsm Implementation and Customization Guide*, SC35-0418.

Table 10-4 FSR type records

DFSMShsm function type (FSRTYPE)
1=Primary to level 1 migration
2=Level 1 to level 2 migration, or level 1 to level 1 migration, or level 2 to level 2 migration
3=Primary to level 2 migration
4=Recall from level 1 to primary
5=Recall from level 2 to primary
6=Delete a migrated data set
7=Daily backup
8=Spill backup

DFSMShsm function type (FSRTYPE)
9=Recovery
10=Recycle backup volume
11=Data set deletion by age
12=Recycle migration volume
13=Full volume dump
14=Volume or data set restore
15=ABACKUP function
16=ARECOVER function
17=Expire primary or migrated data sets
18=Partrel function
19=Expire or roll off incremental backup version
20=(H)BDELETE an incremental backup version
21=Fast replication backup function
22=Fast replication recover function
23=Fast replication delete function

10.5.5 Preparing for analysis

To begin analyzing the data, first combine SMF data for all of the systems that share the same DFSMShsm control data sets (MCDS, backup control data set (BCDS), or offline control data set (OCDS)) into a single file. We eventually want to convert the SMF data to Variable-Blocked (VB) format to be processed by a REXX exec.

The SMF dump program (IFASMFDP) is used to transfer the contents of the SMF data set to another data set and to reset the status of the dumped data set to empty so that SMF can use it again for recording data. The SMF dump program dumps the contents of multiple Virtual Storage Access Method (VSAM) or queued sequential access method (QSAM) data sets to sequential data sets on either tape or direct-access devices. The SMF dump program enables the installation to route different records to separate files and produce a summary activity report.

The IFASMFDP program typically produces data as RECFM=VBS. For the REXX tool FSRSTAT to process the IFASMFDP output, you must convert the format to RECFM=VB. You can use IDCAMS REPRO to convert the DFSMShsm SMF data to RECFM=VB, LRECL=4096. Do not be tempted to use the IFASMFDP program to create RECFM=VB, LRECL=4096 data directly.

Sample JCL is provided in Example 10-4 and Example 10-6.

Example 10-4 IFASMFDP JCL example

```
//STEP1    EXEC PGM=IFASMFDP
   //INDD1    DD DSN=SYS1.MANX,DISP=SHR
   //OUTDD1   DD DSN=MHLRES2.DATA,UNIT=3390,VOL=SER=WORK01,
   //            DISP=(NEW,CATLG,KEEP),SPACE=(CYL,(10,1))
   //SYSPRINT DD    SYSOUT=A
   //SYSIN    DD    *
          INDD(INDD1,OPTIONS(DUMP))
          OUTDD(OUTDD1,TYPE(241))
          DATE(2003120,2003126)
   /*

use TYPE(241) - select this to match FSR records
or use TYPE(240:241) - select this to match DSR,VSR and all FSR records
DATE(2003120,2003126) - select a period of 7 or 14 days,
             using YYYYddd Julian date format.
             2003020 is Year 2003, 120th day
```

The output data set that is specified in the OUTDD1 DD statement in Example 10-4 contains the Summary Activity Report. Example 10-5 shows a sample report.

Example 10-5 SMF dump Summary Activity Report

```
                                SUMMARY ACTIVITY REPORT
START DATE-TIME  10/22/2003-13:10:01                        END DATE-TIME  10/22/2003-13:35:08
RECORD       RECORDS         PERCENT      AVG. RECORD   MIN. RECORD   MAX. RECORD       RECORDS
  TYPE          READ        OF TOTAL          LENGTH        LENGTH        LENGTH       WRITTEN
   240             7           .15 %        1,036.00         1,036         1,036             7
   241             4           .09 %          300.00           300           300             4
TOTAL          4,591           100 %          888.24            18        32,720            13
NUMBER OF RECORDS IN ERROR             0
```

Sample JCL is shown in Example 10-6.

Example 10-6 IDCAMS REPRO example

```
//* INPUT FILE IS RECFM=VBS FROM IFASMFDP
     //STEP1    EXEC PGM=IDCAMS
     //SYSPRINT DD SYSOUT=A
     //INDATA   DD DISP=OLD,DSNAME=MHLRES2.DATA
     //OUTDATA  DD DSNAME=MHLRES2.FSR,UNIT=3390,
     //            DISP=(NEW,CATLG),VOL=SER=WORK01,
     //            SPACE=(CYL,(1,1)),RECFM=VB,LRECL=4096
     //SYSIN    DD   *
           REPRO -
                INFILE(INDATA) -
                OUTFILE(OUTDATA)
     /*
```

10.5.6 Report Generator

DFSMShsm reports can be run with the DFSMSrmm Report Generator. The reports are based on FSR and WWFSR (SMF) data and DFSMShsm control data set data that is obtained by DCOLLECT.

Follow these steps to run the reports:

1. You can start from the Interactive Storage Management Facility (ISMF) storage administrator Primary Option Menu panel by selecting option **G Report Generation - Create Storage Management Reports** (Figure 10-1).

```
                ISMF PRIMARY OPTION MENU - z/OS DFSMS V1 R12
Selection or Command ===>

0  ISMF Profile             - Specify ISMF User Profile
1  Data Set                 - Perform Functions Against Data Sets
2  Volume                   - Perform Functions Against Volumes
3  Management Class          - Specify Data Set Backup and Migration
Criteria
4  Data Class               - Specify Data Set Allocation Parameters
5  Storage Class            - Specify Data Set Performance and Availability
6  Storage Group             - Specify Volume Names and Free Space
Thresholds
7  Automatic Class Selection - Specify ACS Routines and Test Criteria
8  Control Data Set         - Specify System Names and Default Criteria
9  Aggregate Group          - Specify Data Set Recovery Parameters
10 Library Management       - Specify Library and Drive Configurations
11 Enhanced ACS Management   - Perform Enhanced Test/Configuration
Management
C  Data Collection          - Process Data Collection Function
G  Report Generation        - Create Storage Management Reports
L  List                     - Perform Functions Against Saved ISMF Lists
P  Copy Pool                - Specify Pool Storage Groups for Copies
R  Removable Media Manager   - Perform Functions Against Removable Media
X  Exit                     - Terminate ISMF
Use HELP Command for Help; Use END Command or X to Exit.
```

Figure 10-1 ISMF Primary Option Menu

2. The Report Generator initial setup needs to be performed only once for a specific user. Select option **0 Options - Specify dialog options and defaults** from the DFSMSrmm Report Generator menu (Figure 10-2).

```
                        DFSMSrmm Report Generator
Option ===> 0

0  OPTIONS         - Specify dialog options and defaults
1  REPORT          - Work with reports
2  REPORT TYPE     - Work with report types
3  REPORTING TOOL  - Work with reporting tools
4  MIGRATION       - Migration tasks for reporting
X  EXIT            - Exit DFSMSrmm dialog
Enter selected option or END command. For more info., enter HELP or PF1.









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```

Figure 10-2 Report Generator Menu

3. Select option **1 User - Specify processing options** on the Dialog Options Menu (Figure 10-3) to specify the User report options.

```
                        DFSMSrmm Dialog Options Menu
Option ===> 1

1  USER      - Specify processing options
2  SORT      - Specify list sort options
3  REPORT    - Specify report options

Enter selected option or END command. For more info., enter HELP or PF1.









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```

Figure 10-3 DFSMSrmm Dialog Options Menu

4. Figure 10-4 shows the DFSMSrmm Dialog User Options panel. Use this panel to specify information, such as the jobcard to use and the date and time formats.

```
 DFSMSrmm Dialog User Options
Command ===>

Date format  . . . . . JULIAN           ( American, European, Iso or Julian
)
Time zone  . . . . . .      LOCAL      ( zone  offsetHH:MM:SS )

Confirm deletes  . . . YES             ( Yes or No )

Processing option  . . F                F - Foreground, B - Background
DSNAME case option . . U                M - Mixed, U - Upper
Eject option . . . . . C                C - Convenience, B - Bulk

Variable reuse . . . . Y                Y - Yes, N - No

Job statement information:-

 ===> //MHLRES1R JOB (ACCOUNT),'NAME'
 ===> //*
 ===> //*
 ===> //*

      Enter END command to save changes, or CANCEL to end without saving.
```

Figure 10-4 DFSMSrmm Dialog User Options

5. Figure 10-5 shows the DFSMSrmm Report Options panel. Specify the user and system report libraries to use.

```
                          DFSMSrmm Report Options
Command ===>

Report definition libraries:
  User . . . . . . . . . . . 'MHLRES1.REPORT.LIB'
  Installation . . . . . . .
  Product  . . . . . . . . . 'SYS1.SAMPLIB'

User report JCL library  . . 'MHLRES1.REPORT.JCL'









DFSMSrmm allocates user libraries if they do not exist.
```

Figure 10-5 DFSMSrmm Report Options

6. After you customize the report options, you are ready to work with the reporting tool. Select option **3 Reporting Tool - Work with reporting tools** from the main DFSMSrmm Report Generator panel as shown in Figure 10-6.

```
                          DFSMSrmm Report Generator
Option ===> 3

0  OPTIONS         - Specify dialog options and defaults
1  REPORT          - Work with reports
2  REPORT TYPE     - Work with report types
3  REPORTING TOOL  - Work with reporting tools
4  MIGRATION       - Migration tasks for reporting
X  EXIT            - Exit DFSMSrmm dialog
Enter selected option or END command. For more info., enter HELP or PF1.









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```

Figure 10-6 DFSMSrmm Report Generator panel

7. Selecting option 3 Reporting Tool - Work with reporting tools from the DFSMSrmm Report Generator panel brings you to the DFSMSrmm Reporting Tools panel that is shown in Figure 10-7. This panel displays the available tools.

```
                        DFSMSrmm Reporting Tools            Row 1 to 3 of 3
Command ===>                                                 Scroll ===> CSR

The following line commands are valid: A,C, and D

S Reporting tool                Exec     Skeleton Colspace Group sort
- ------------------------------ -------- -------- -------- ----------
  DFSORT                        EDGRGDFS EDGSGDFS     0        U
  ICETOOL                       EDGRGGEN EDGSGICE     3        U
  SYNCTOOL                      EDGRGGEN EDGSGSYN     3        U
```

Figure 10-7 DFSMSrmm Reporting Tools

8. Selecting option 2 Report Type - Work with report types from the DFSMSrmm Report Generator panel (Figure 10-6 on page 212) displays the DFSMSrmm Report Types panel as shown in Figure 10-8.

```
                         DFSMSrmm Report Types             Row 1 to 4 of 32
Command ===>                                                 Scroll ===> CSR

The following line commands are valid: A,C,D,H,L,M,R, and S

S Name     Description
- -------- ------------------------------------------------------------------
  DCOLLECT DFSMS DCOLLECT for Data Sets
    Macro library . . :  'SYS1.MACLIB'
    Applicable macros :  IDCDOUT
    Input data set. . :  'DFSMS.DCOLLECT.DATA'
ssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssss
  ARCGWFSR DFSMShsm ABARS Report
    Macro library . . :  'SYS1.MACLIB'
    Applicable macros :  ARCWFSR2
    Input data set. . :  'DFHSM.EXTRACT.ABARS.REFORMAT'
ssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssss
  ARCGDBCK DFSMShsm DCOLLECT BACKUP
    Macro library . . :  'SYS1.MACLIB'
    Applicable macros :  ARCUTILP
    Input data set. . :  'DFHSM.DCOLLECT.DATA'
ssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssss
  ARCGDDSD DFSMShsm DCOLLECT DASD CAP
    Macro library . . :  'SYS1.MACLIB'
    Applicable macros :  ARCUTILP
    Input data set. . :  'DFHSM.DCOLLECT.DATA'
ssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssss
```

Figure 10-8 DFSMSrmm Report Types

9. By selecting option **1 Report - Work with reports** from the main DFSMSrmm Report Generator panel (Figure 10-9), you can begin to define a report.

```
 DFSMSrmm Report Generator
Option ===> 1

0  OPTIONS         - Specify dialog options and defaults
1  REPORT          - Work with reports
2  REPORT TYPE     - Work with report types
3  REPORTING TOOL  - Work with reporting tools
4  MIGRATION       - Migration tasks for reporting
X  EXIT            - Exit DFSMSrmm dialog
Enter selected option or END command. For more info., enter HELP or PF1.









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```

Figure 10-9 DFSMSrmm Report Generator

10. The first panel is the DFSMSrmm Report Definition Search panel as shown in Figure 10-10. The libraries to use for reporting that you specified previously are shown.

```
 DFSMSrmm Report Definition Search
Command ===>

Report name . .            May be generic.  Leave blank for all reports.

User id . . . .             Leave blank for all user ids.

Select one or more library. Default is all defined libraries.
Libraries (enter S):        Currently defined libraries:
     User                   MHLRES1.REPORT.LIB
     Installation
     Product                SYS1.SAMPLIB


The following line commands will be available when the list is displayed:
  A - Add a new report definition    D - Delete a report definition
  G - Generate and save the JCL      H - View the report help information
  J - Edit and submit the JCL        L - List macro assembly results
  M - Browse macros for the report   N - Copy a report definition
  S - Display/change the report       T - Select a reporting tool
```

Figure 10-10 DFSMSrmm Report Definition Search panel

11. Figure 10-11 shows you the reports that you can select. We select the **Statistics for FRBACKUP** report by entering s to the left of the report name.

```
                      DFSMSrmm Report Definitions         Row 1 to 22 of 43
Command ===>                                               Scroll ===> PAGE

The following line commands are valid: A,D,G,H,J,L,M,N,S, and T

S Name     Report title                   Report type                User id
- -------- ------------------------------ ------------------------  -----
  ARCGAB01 ABARS ABACKUP Statistics       DFSMShsm ABARS Report       HSM
  ARCGAR01 ABARS ARECOVER Statistics      DFSMShsm ABARS Report       HSM
  ARCGDB01 DCOLLECT BACKUP DATA           DFSMShsm DCOLLECT BACKUP    HSM
  ARCGDD01 DCOLLECT DASD CAPACITY PLANNIN DFSMShsm DCOLLECT DASD CAP  HSM
  ARCGDM01 DCOLLECT MIGRATION DATA        DFSMShsm DCOLLECT MIGRATION HSM
  ARCGDT01 DCOLLECT TAPE CAPACITY PLANNIN DFSMShsm DCOLLECT TAPE CAP  HSM
  ARCGS001 Statistics for DFSMShsm        DFSMShsm FSR-SMF Records    HSM
  ARCGS002 Statistics for Backup          DFSMShsm FSR-SMF Records    HSM
  ARCGS003 Statistics for Migration       DFSMShsm FSR-SMF Records    HSM
  ARCGS004 Statistics for Recall          DFSMShsm FSR-SMF Records    HSM
  ARCGS005 Statistics for Recovery        DFSMShsm FSR-SMF Records    HSM
  ARCGS006 Statistics for Volume Dump     DFSMShsm FSR-SMF Records    HSM
  ARCGS007 Statistics for Restore from Du DFSMShsm FSR-SMF Records    HSM
s ARCGS008 Statistics for FRBACKUP        DFSMShsm FSR-SMF Records    HSM
  ARCGS009 Statistics for FRRecover       DFSMShsm FSR-SMF Records    HSM
  ARCGS010 DFSMShsm Thrashing Report      DFSMShsm FSR-SMF Records    HSM
  ARCHS009 Statistics for FRRecover Data  DFSMShsm FSR-SMF Records    HSM
  EDGGAHLD Held Volumes by Volume Serial, Extended Extract Records    RMM
  EDGGAUD1 SMF Audit of Volumes by Volser SMF Records for Volumes     RMM
  EDGGAUD2 SMF Audit of Volume by Rack    SMF Records for Volumes     RMM
  EDGGAUD3 SMF42 Audit of Volumes by Vols SMF42 Records for Volumes   RMM
  EDGGAUD4 SMF42 Audit of Volume by Rack  SMF42 Records for Volumes    RMM
```

Figure 10-11 DFSMSrmm Report Definitions: Statistics for FRBACKUP

12. On Figure 10-12, select the fields to include in the report.

```
                 DFSMSrmm Report Definition - ARCGS008    Row 1 to 15 of 82
Command ===>                                               Scroll ===> PAGE

Report title . . . Statistics for FRBACKUP
+
Report footer  . .
Reporting tool . : ICETOOL                                Report width:  115
Enter "/" to select option
   Edit the help information for this report

Use END to save changes or CANCEL
The following line commands are valid: S, and R

S CO SO  Field name          Column header text                  CW  Len Typ
- -- --- ------------------- ----------------------------------- --- ---
---
   G  1A FSR2DSN             CP NAME                              44  44 C
s  1  2A FSR2DATR            DATE                                  8   8 C
   2     FSR2TIMR            TIME REQ                              8   4 B
   3  3A FSR2TIME            TIME COMP                             9   4 B
   4     FSR2FVOL            SOURCE                                6   6 C
   5     FSR2TVOL            TARGET                                6   6 C
   6     FSR2RC              RC (hex)                              8   4 B
   7     FSR2REAS            RSN (hex)                             9   4 B
   8     FSR2HOST            HOSTID                                6   2 C
*        FSR2TYPE            FUNCTION TYPE - Use browse (M) macro  12   1 B
         FSR2FLG             SMF OPERATING ENVIRONMENT             8   1 B
         FSR2RTY             SMF RECORD TYPE                       5   1 B
         FSR2TME             SMF TOD REC WRITTEN                   6   4 B
         FSR2DTE             SMF DATE REC WRITTEN                  6   4 B
          FSR2SID             SYSTEM ID FROM INSTALLATION           9   4 C
```

Figure 10-12 DFSMSrmm Report Definition panel for a selected report

13. On the next panel (Figure 10-13), you can customize the information to display in the report.

```
                  DFSMSrmm Report Criteria - ARCGS008       Row 1 to 3 of 3
Command ===>                                                 Scroll ===>
PAGE

Report title : Statistics for FRBACKUP

Use END to save changes or CANCEL
The following line commands are valid: B,D,N,P,R,T, and I (for details)
Operators: EQ = NE <> GT > GE >= LT < LE <= IN BW SE SN BO BM BZ NO NM NZ
Conjunction: AND, OR, AND(, )AND

S Field name           Op Compare value(s)                        Conj Len
Typ
- -------------------- -- ---------------------------------------- ---- ---
---
                          +
  FSR2DATR             BW &TODAY - 7 Days,&TODAY                     8 C
  FSR2TYPE             EQ X'15'                                      1 B
  FSR2DATR                                                             8 C
```

Figure 10-13 Customize the data to include in the report

14. After we customize the data to include in the report, we are ready to generate the report as shown in Figure 10-14 by entering g to the left of the report name.

```
                      DFSMSrmm Report Definitions         Row 1 to 22 of 43
Command ===>                                               Scroll ===> PAGE

The following line commands are valid: A,D,G,H,J,L,M,N,S, and T

S Name     Report title                   Report type                User id
- -------- ------------------------------ -------------------------  -----
  ARCGAB01 ABARS ABACKUP Statistics       DFSMShsm ABARS Report       HSM
  ARCGAR01 ABARS ARECOVER Statistics      DFSMShsm ABARS Report       HSM
  ARCGDB01 DCOLLECT BACKUP DATA           DFSMShsm DCOLLECT BACKUP    HSM
  ARCGDD01 DCOLLECT DASD CAPACITY PLANNIN DFSMShsm DCOLLECT DASD CAP  HSM
  ARCGDM01 DCOLLECT MIGRATION DATA        DFSMShsm DCOLLECT MIGRATION HSM
  ARCGDT01 DCOLLECT TAPE CAPACITY PLANNIN DFSMShsm DCOLLECT TAPE CAP  HSM
  ARCGS001 Statistics for DFSMShsm        DFSMShsm FSR-SMF Records    HSM
  ARCGS002 Statistics for Backup          DFSMShsm FSR-SMF Records    HSM
  ARCGS003 Statistics for Migration       DFSMShsm FSR-SMF Records    HSM
  ARCGS004 Statistics for Recall          DFSMShsm FSR-SMF Records    HSM
  ARCGS005 Statistics for Recovery        DFSMShsm FSR-SMF Records    HSM
  ARCGS006 Statistics for Volume Dump     DFSMShsm FSR-SMF Records    HSM
  ARCGS007 Statistics for Restore from Du DFSMShsm FSR-SMF Records    HSM
g ARCGS008 Statistics for FRBACKUP         DFSMShsm FSR-SMF Records   HSM
  ARCGS009 Statistics for FRRecover        DFSMShsm FSR-SMF Records   HSM
  ARCGS010 DFSMShsm Thrashing Report      DFSMShsm FSR-SMF Records    HSM
  ARCHS009 Statistics for FRRecover Data  DFSMShsm FSR-SMF Records    HSM
  EDGGAHLD Held Volumes by Volume Serial, Extended Extract Records    RMM
  EDGGAUD1 SMF Audit of Volumes by Volser SMF Records for Volumes     RMM
  EDGGAUD2 SMF Audit of Volume by Rack    SMF Records for Volumes     RMM
  EDGGAUD3 SMF42 Audit of Volumes by Vols SMF42 Records for Volumes   RMM
  EDGGAUD4 SMF42 Audit of Volume by Rack  SMF42 Records for Volumes    RMM
```

Figure 10-14 Generate the selected report

15. The variables that are used to generate the report are now displayed (Figure 10-15). You can use this panel to change the input for the report and variables.

```
                    DFSMSrmm Report Generation - ARCGS008
Command ===>

Enter or change the skeleton variables for the generated JCL:

Input data set  . . . . 'SMFDATA.HSMRECS.G0023V00.REFORMAT'

Date format . . . . . . YYYYDDD
    (American, European, Iso, Julian, or free form)
   Required if you use variable dates (&TODAY) in your selection criteria.

Create report data  . . Y  (Y/N)
   Choose Y if you want an extract step included into your generated JCL.

Additional skeleton variables, for example if an extract step is included:
Skeleton Variable_1 . . X'F1'
Skeleton Variable_2 . . SMFDATA.HSMRECS.G0023V00
Skeleton Variable_3 . .
   The skeleton selection depends on the reporting macro . . . : ARCFSR2
                                          and macro keyword . . :
  Enter END command to start the report generation or CANCEL
```

Figure 10-15 Specify the input source for the report

16. Specify option `j` to create the job JCL that is based on your input as shown in Figure 10-16.

```
                      DFSMSrmm Report Definitions        Row 1 to 22 of 43
Command ===>                                              Scroll ===> PAGE

The following line commands are valid: A,D,G,H,J,L,M,N,S, and T

S Name     Report title                   Report type                User id
- -------- ----------------------------- ------------------------  -----
  ARCGAB01 ABARS ABACKUP Statistics       DFSMShsm ABARS Report       HSM
  ARCGAR01 ABARS ARECOVER Statistics      DFSMShsm ABARS Report       HSM
  ARCGDB01 DCOLLECT BACKUP DATA           DFSMShsm DCOLLECT BACKUP    HSM
  ARCGDD01 DCOLLECT DASD CAPACITY PLANNIN DFSMShsm DCOLLECT DASD CAP  HSM
  ARCGDM01 DCOLLECT MIGRATION DATA        DFSMShsm DCOLLECT MIGRATION HSM
  ARCGDT01 DCOLLECT TAPE CAPACITY PLANNIN DFSMShsm DCOLLECT TAPE CAP  HSM
  ARCGS001 Statistics for DFSMShsm        DFSMShsm FSR-SMF Records    HSM
  ARCGS002 Statistics for Backup          DFSMShsm FSR-SMF Records    HSM
  ARCGS003 Statistics for Migration       DFSMShsm FSR-SMF Records    HSM
  ARCGS004 Statistics for Recall          DFSMShsm FSR-SMF Records    HSM
  ARCGS005 Statistics for Recovery        DFSMShsm FSR-SMF Records    HSM
  ARCGS006 Statistics for Volume Dump     DFSMShsm FSR-SMF Records    HSM
  ARCGS007 Statistics for Restore from Du DFSMShsm FSR-SMF Records    HSM
j ARCGS008 Statistics for FRBACKUP         DFSMShsm FSR-SMF Records   HSM
  ARCGS009 Statistics for FRRecover        DFSMShsm FSR-SMF Records   HSM
  ARCGS010 DFSMShsm Thrashing Report      DFSMShsm FSR-SMF Records    HSM
  ARCHS009 Statistics for FRRecover Data  DFSMShsm FSR-SMF Records    HSM
  EDGGAHLD Held Volumes by Volume Serial, Extended Extract Records    RMM
  EDGGAUD1 SMF Audit of Volumes by Volser SMF Records for Volumes     RMM
  EDGGAUD2 SMF Audit of Volume by Rack    SMF Records for Volumes     RMM
  EDGGAUD3 SMF42 Audit of Volumes by Vols SMF42 Records for Volumes   RMM
  EDGGAUD4 SMF42 Audit of Volume by Rack  SMF42 Records for Volumes    RMM
```

Figure 10-16 Specify the job JCL to generate

17. Figure 10-17 shows the resulting job JCL.

```
EDIT       MHLRES1.REPORT.JCL(ARCGS008) - 01.00            Columns 00001
00072
Command ===>                                                 Scroll ===> CSR
000036 //SYSPRINT DD  SYSOUT=*
000037 //SORTIN   DD  DISP=SHR,
000038 //            DSN=SMFDATA.HSMRECS.G0023V00
000039 //SORTOUT  DD  DISP=(NEW,PASS),
000040 //            UNIT=SYSALLDA,
000041 //            LIKE=SMFDATA.HSMRECS.G0023V00,
000042 //            DSN=SMFDATA.HSMRECS.G0023V00.REFORMAT
000043 //MSGOUT1  DD  SYSOUT=*
000044 //SYSOUT   DD  SYSOUT=*
000045 //SYSIN    DD  *
000046    OPTION VLSHRT,VLSCMP
000047    INCLUDE COND=((6,1,BI,EQ,X'F1'),  DFSMSHSM FSR
000048             AND,(43,1,CH,NE,X'0F'),
000049             AND,(43,1,CH,NE,X'10'))
000050    RECORD TYPE=V
000051    INREC IFTHEN=(WHEN=INIT,
000052      BUILD=(1,18, 1 FM  1 x 18 - CH  FSRHDR
000053        19,8,     19 FM 19 x  8 - CH  FSRJBN
000054        27,4,     27 FM 27 x  4 - BI  FSRRST
000055        31,4,4X'00',  31x4+4          FSRRSD
000056        35,8,     39 FM 35 x  8 - CH  FSRUID
000057        43,1,     47 FM 43 x  1 - BI  FSRTYPE
000058        44,1,     48 FM 44 x  1 - BI  FSRFLAGS
000059        45,44,    49 FM 45 x 44 - CH  FSRDSN
000060        89,6,     93 FM 89 x  6 - CH  FSRTVOL
000061        95,4,     99 FM 95 x  4 - CH  FSRDEVT
000062         99,6,    103 FM 99 x  6 - CH  FSRFVOL
```

Figure 10-17 Generated report JCL

18. Figure 10-18 shows a portion of the report output.

```
Statistics for FRBACKUP        - 1 -        2010/10/22        17:12:16

CP NAME  CPNSPANBOX07

DATE       TIME REQ   TIME COMP   SOURCE   TARGET   RC (hex)   RSN (hex)   HOSTI
--------   --------   ---------   ------   ------   --------   ---------   -----
2010293    21163691   21163720    MHL0A0   YYDF20   00000000   00000000    3
2010293    21163691   21163720    MHL1A0   YY8140   00000000   00000000    3
2010293    21163691   21163721    MHL1A1   YY8141   00000000   00000000    3
```

Figure 10-18 Generated report sample output

10.5.7 Sample REXX execs

The FSRSTAT program is a REXX sample program that reads DFSMShsm FSR records and generates a statistical summary report. The FSRSTAT program is shipped with DFSMShsm in SYS1.SAMPLIB member ARCTOOLS. You must modify the FSRSTAT program so that it selects DFSMShsm fast replication FSRTYPE records only.

The installation of DFSMShsm places a member that is called ARCTOOLS in the SYS1.SAMPLIB data set. When you supply a valid jobcard and run the ARCTOOLS program, it creates the following partitioned data sets:

HSM.SAMPLE.TOOL Sample REXX execs and JCL to manage your DFSMShsm data

HSM.ABARUTIL.JCL JCL that is used by the ABARS utilities

HSM.ABARUTIL.PROCLIBJCL PROCs that are used by the ABARS utilities

HSM.ABARUTIL.DOCS Documentation for the ABARS utilities

The HSM.SAMPLE.TOOL data set contains the FSRSTAT PGM along with other tools. FSRSTAT is written in REXX, so the following considerations apply:

- Does not require any special programs or languages, such as SAS or MICS
- Can be modified easily and customized to meet your needs
- Can be slow, so consider running it in batch by using PGM=IKJEFT01
- Requires input data to be converted to RECFM=VB format

10.5.8 Creating reports

You can run the FSRSTAT exec in batch by using PGM=IKJEFT01. Example 10-7 shows the sample JCL. The following information refers to the sample JCL:

- The `SYSEXEC DD` statement references the location of the FSRSTAT REXX program.
- The output file name is the same as the input file name with the added low-level qualifier of FSRSTAT, for example:
  - Input file name: MHLRES2.FSR
  - Output file name: MHLRES2.FSR.FSRSTAT

Example 10-7 IKJEFT01 FSRSTAT report JCLI

```
//STEP1 EXEC PGM=IKJEFT01
//SYSEXEC  DD DSN=HSM.SAMPLE.TOOL,DISP=SHR
//SYSTSPRT DD SYSOUT=*
//SYSTSIN  DD *
  FSRSTAT 'MHLRES2.FSR' FSRID(241)
/*
```

Example 10-8 shows the FSRSTAT report output.

Example 10-8 FSRSTAT report output

```
Data Set Analyzed: 'MHLRES2.FSR'
Number of lines read: 13

FSR records by type
021                4

FSR records by host
SC65               4    100.00%    100.00%

FSR records by Return Code
0000               4    100.00%    100.00%

FSR records by Date
0103295F           4
```

10.5.9 Customizing reports

You can use DFSORT to produce customized reports. In our example, we first extract the FSR type 21, type 22, and type 23 records in to separate data sets, for example, in the SYSIN statements:

- `X'15'` is the value for FSR record type 21.
- `X'16'` is the value for FSR record type 22.
- `X'17'` is the value for FSR record type 23.

Example 10-9 shows a DFSORT job.

Example 10-9 DFSORT example JCL

```
//STEPNN   EXEC PGM=SORT
//SYSPRINT DD SYSOUT=*
//PLDTRACE DD DUMMY
//SYSOUT   DD SYSOUT=*
//SORTIN   DD DISP=SHR,DSN=MHLRES2.FSR
//SORTOF1  DD LIKE=MHLRES2.FSR,
//         DISP=(NEW,CATLG),UNIT=SYSDA,
//         DSN=MHLRES2.FSR.TYPE21
//SORTOF2  DD LIKE=MHLRES2.FSR,
//         DISP=(NEW,CATLG),UNIT=SYSDA,
//         DSN=MHLRES2.FSR.TYPE22
//SORTOF3  DD LIKE=MHLRES2.FSR,
//         DISP=(NEW,CATLG),UNIT=SYSDA,
//         DSN=MHLRES2.FSR.TYPE23
//SYSIN    DD *
  OPTION COPY,VLSHRT
  OUTFIL FILES=1,
         INCLUDE=(43,1,BI,EQ,X'15')
  OUTFIL FILES=2,
         INCLUDE=(43,1,BI,EQ,X'16')
  OUTFIL FILES=3,
         INCLUDE=(43,1,BI,EQ,X'17')
```

You can use an ICETOOL job, as shown in Example 10-10, to generate a report about the specific data that you want to analyze. A good field for performance reports might be the FSRCPU value.

Example 10-10 ICETOOL sample to extract FSR data

```
//MHLRES2Y JOB (999,POK),'MHLRES2',CLASS=A,MSGCLASS=K,
// NOTIFY=&SYSUID,TIME=1440,MSGLEVEL=(1,1)
/*JOBPARMBL=999,SYSAFF=*
//JOBLIB DD DSN=SYS1.SICELINK,DISP=SHR
//ICETL2  EXEC PGM=ICETOOL,REGION=4096K
//TOOLMSG  DD  SYSOUT=*
//DFSMSG   DD  SYSOUT=*
//LIST1    DD  SYSOUT=*
//DFSPARM  DD *
//INO1     DD DSN=MHLRES2.FSR.TYPE21,DISP=SHR
//OUTO1    DD DSN=MHLRES2.FSR.TYPE21.CREATE,DISP=SHR
//*           DISP=(NEW,CATLG,DELETE),UNIT=SYSDA,
//*           SPACE=(CYL,(5,1),RLSE),
//*           DCB=(*.INO1)
//TOOLIN   DD *
  COPY FROM(INO1) USING(CPY1)
  DISPLAY FROM(OUTO1) LIST(LIST1) BLANK            -
          TITLE('FSRTYPES           ') -
```

```
          ON(1,4,CH)
//CPY1CNTL  DD *
  INCLUDE COND=(43,1,BI,EQ,X'15')
  OUTFIL FNAMES=OUT01,
  OUTREC=(1,4,C'FSRTYPE',43,1,FI,44,1,HEX,
         45,44,
         89,6,
         99,6,
        105,4,HEX,
        179,2,HEX,
        181,4,HEX)
/*
```

Example 10-11 shows the output that was generated from the job in the previous example.

Example 10-11 Output of an ICETOOL job

```
 BROWSE    MHLRES2.FSR.TYPE21.CREATE
 Command ===>
****************************************************** Top of Data ******************
FSRTYPE 21 00DSN$DB8B$DB                                MHL213MHL12500000000300000000001
FSRTYPE 21 00DSN$DB8B$DB                                MHL214MHL12600000000300000000000
FSRTYPE 21 00DSN$DB8B$LG                                MHL225MHL03700000000300000000000
FSRTYPE 21 00DSN$DB8B$LG                                MHL226MHL14700000000300000000000
FSRTYPE 21 00CP1                                        MHL0ACMHL0A00000000300000000000
FSRTYPE 21 00CP1                                        MHL0ADMHL0A10000000300000000000
FSRTYPE 21 00CP2                                        MHL1ACMHL1A00000000300000000000
FSRTYPE 21 00CP2                                        MHL1ADMHL1A10000000300000000000
FSRTYPE 21 00CP3                                        MHL2AEMHL1A00000000300000000000
FSRTYPE 21 00CP3                                        MHL2AFMHL1A10000000300000000000
FSRTYPE 21 00DSN$DB8B$DB                                MHL013MHL12500000000300000000001
FSRTYPE 21 00DSN$DB8B$DB                                MHL014MHL12600000000300000000001
FSRTYPE 21 00DSN$DB8B$LG                                MHL025MHL03700000000300000000000
FSRTYPE 21 00DSN$DB8B$LG                                MHL026MHL14700000000300000000000
FSRTYPE 21 00CP1                                        MHL0AEMHL0A00000000300000000001
```

10.6 Other report sources

In addition to SMF records, you can use other sources of information to generate reports.

10.6.1 Log data sets

You can also format the DFSMShsm LOGX and LOGY log data sets by using the ARCPRLOG and ARCPEDIT programs. The *z/OS DFSMShsm Storage Administration Guide*, SC35-0421, has more information about how to use the programs.

10.6.2 Problem Determination Aid trace

The Problem Determination Aid (PDA) trace can be helpful for measurements, too. The ARCPRPDO program helps to extract the fields that you want to see. Each trace entry will contain the date and time stamp when it is formatted. See the *DFSMShsm Diagnosis Guide*, LY35-0114, for details.

The following examples show how to use the Formatter Tool to see how long a resource is used. The time between the enqueue and the dequeue can be used as a measurement.

Example 10-12 contains sample JCL to use the ARCPRPDO program.

Example 10-12 ARCPRPDO sample JCL

```
//MHLRES2  JOB (999,POK),'MHLRES2',CLASS=A,MSGCLASS=T,
// NOTIFY=&SYSUID,TIME=1440,REGION=6M
/*JOBPARM L=999,SYSAFF=*
//COPY    EXEC PGM=ARCPRPDO
//SYSPRINT DD SYSOUT=*
//ARCMSG   DD SYSOUT=*
//ARCPDO   DD DISP=SHR,DSN=HSM.SC65.HSMPDOY
//ARCOUT   DD DISP=OLD,DSN=MHLRES2.SC65.HSMPDOY
//ARCPRINT DD SYSOUT=*
//SYSIN    DD  *
    FORMAT
    LOGIC(ENQ,DEQ)
```

Example 10-13 shows the output from the ARCPRPDO sample job.

Example 10-13 ARCPRPDO example output

```
03323----------------------------------------------------------------------------
161818.933664  0C 007BAB HOST=5  ZSERL ENQ
  ENQLIST=       C1D9C3C5D5D8C740                          *ARCENQG.............*
    ADD-DATA=    C3D6D7E8D7D6D6D3C4E2D55BC4C2F8C25BC4C2  *COPYPOOLDSN$DB8B$DB.*
    ADD-DATA=    E2                                        *S...................*
    ADD-DATA=    C3                                        *C...................*
03323----------------------------------------------------------------------------
161819.363792  20 007BAB HOST=5  ZSERL DEQ
  DEQLIST=       C1D9C3C5D5D8C740                          *ARCENQG.............*
    ADD-DATA=    C3D6D7E8D7D6D6D3C4E2D55BC4C2F8C25BC4C2  *COPYPOOLDSN$DB8B$DB.*
    ADD-DATA=    C3                                        *C...................*
```

10.7 Messages with DFSMShsm fast replication

DFSMShsm introduced new messages for fast replication and updated messages for existing commands. This section introduces the new messages and helps you to recognize them.

10.7.1 Updated messages

The following messages were updated in support of DFSMShsm fast replication:

- ARC0026E
- ARC0103I
- ARC0138I
- ARC0167I
- ARC0168I
- ARC0301I
- ARC0570I
- ARC0640I
- ARC0708I
- ARC0744E
- ARC0814I
- ARC0860E
- ARC0910E
- ARC0935I

- ARC1000I
- ARC1001I
- ARC1605I

10.7.2 New messages

New messages have the prefix *ARC18xx*. The following messages are either informational messages (I) or error messages (E) for single volumes that DFSMShsm fast replication did not fail:

- ARC1801I
- ARC1802I
- ARC1803E
- ARC1805I
- ARC1807I
- ARC1809I
- ARC1810I
- ARC1811E
- ARC1820I
- ARC1821I
- ARC1822I
- ARC1823I
- ARC1825I
- ARC1826I
- ARC1831I
- ARC1832I
- ARC1833I
- ARC1835I
- ARC1836I
- ARC1852I
- ARC1899I

The following messages are issued when the DFSMShsm fast replication functions FRBACKUP, FRRECOVER, or FRDELETE fail:

- ARC1622I
- ARC1806E
- ARC1808E
- ARC1816E
- ARC1840I
- ARC1852I
- ARC1874I

Tip: Message ARC1622, `VOLUME NOT ELIGIBLE FOR COMMAND BACKUP OR COMMAND MIGRATION`, is the only new message for DFSMShsm fast replication that does not have the ARC18*xx* prefix.

11

Error recovery and debugging

This chapter contains basics for error recovery. Debugging your DFSMShsm fast replication environment is also explained.

11.1 Messages with DFSMShsm fast replication

DFSMShsm introduced new messages for fast replication and updated messages for existing commands. This section explains how the messages are issued and helps you to understand where to look if you encounter a problem.

DFSMShsm fast replication function has several layers:

- User interface layer:
  - TSO command.
  - Batch job.
  - DB2 backup utility.
- DFSMShsm layer:
  - DFSMShsm updates control data set (CDS) records.
  - Pairs source and target volumes based on information from the hardware.
  - Passes the volume pairs to DFSMSdss for processing.
- DFSMSdss layer:
  - DFSMSdss passes the volume pairs to the system data mover (SDM) for processing.
  - SDM performs the I/O and returns information to DFSMShsm.

In all cases, when DFSMShsm receives any form of a FRBACKUP or FRRECOV command, an ARC1801I is issued to show that the function is starting. When the function completes, an ARCI1802I is used to show completion with the completion return codes. If an error occurs, the return codes point the user to the messages that provide more information about the error. The complete flow of these messages is written to the DFSMShsm backup activity log.

11.1.1 DFSMShsm fast replication volume error messages

Beginning with z/OS DFSMShsm 1.11, whenever an error occurred on a particular volume in the copy pool, an ARC1803E message lists the volume with the DFSMSdss error message that caused the volume to fail. In Figure 11-1, you can see the inclusion of the volume and DFSMSdss error message to help you to know why a volume failed. Depending on the DFSMSdss error message, you might want to research the backup activity log to view additional error messages.

```
ARC1801I FAST REPLICATION BACKUP IS STARTING FOR COPY 090
ARC1801I (CONT.) POOL CP2, AT 06:19:11 ON 2010/10/26
ARC1803E THE FOLLOWING 00004 VOLUME(S) FAILED DURING 091
ARC1803E (CONT.) FAST REPLICATION BACKUP OF COPY POOL CP2
ARC1803E (CONT.) MHL200, ADR849E
ARC1803E (CONT.) MHL201, ADR849E
ARC1803E (CONT.) MHL202, ADR849E
ARC1803E (CONT.) MHL203, ADR849E
ARC1802I FAST REPLICATION BACKUP HAS COMPLETED FOR 096
ARC1802I (CONT.) COPY POOL CP2, AT 06:19:12 ON 2010/10/26, FUNCTION
ARC1802I (CONT.) RC=0008, MAXIMUM VOLUME RC=0008, CAPTURE CATALOG
ARC1802I (CONT.) RC=0000
```

Figure 11-1 Sample ARC1803E failure messages 1.11 and higher

Tip: The ARC1803E volume failure message now contains the corresponding DFSMSdss error message that caused the command to fail (when the message is known). If the DFDSS message is unknown, the volume is listed and the message area shows ******** instead of a message.

11.1.2 Message routing

DFSMShsm sends starting and ending messages about functions to SYSLOG. The detailed messages, which include the following information, are sent to the DFSMShsm activity logs:

- DFSMShsm copy command and parameters that were sent to DFSMSdss
- DFSMSdss messages that show the progress of the FlashCopy activity
- SDM errors if DFSMSdss encounters an error from SDM

FRBACKUP messages are routed to the BACKUP ACTIVITY log. FRRECOV and FRDELETE command messages are sent to the COMMAND ACTIVITY log. The activity log is defined in the DFSMShsm STARTUP procedure.

The amount of data that is sent to the logs is controlled by the SETSYS ACTLOGMSGLVL command. The preferred practice is to use the FULL setting. The following example shows this command:

```
SETSYS ACTLOGMSGLVL (FULL)
```

The data set naming convention for the activity logs differs by client environment. However, the data set naming convention for the activity logs usually follows this standard:

mcvtactn.Hmcvthost.function.Dyyddd.Thhmmss

The variables in this expression are defined:

mcvtactn	Activity log high-level qualifier
Hmcvthost	Host identifier for the DFSMShsm host that creates these activity logs
function	BAKLOG or CMDLOG
Dyyddd	Year and day of allocation
Thhmmss	Hour, minute, and second of allocation

For more information about the BACKUP and COMMAND ACTIVITY log, see the *DFSMShsm Implementation and Customization Guide*, SC35-0418.

Any messages that result from commands that are issued from a TSO user are sent to the TSO user by issuing the command through the TPUT macro, and are issued at the panel to the TSO user. The messages are not shown in the SYSLOG. An example might be a QUERY command or a LIST command with the TERM (Terminal) option.

If the command is sent to DFSMShsm through TSO batch jobs by using PGM EXEC=IKJEFT01, the output messages are routed to the JOBLOG. The actions when you use a WAIT option differ from the actions with a NOWAIT option. When the WAIT option is used and an error occurs, all information messages and the condition code are issued at the panel. The JOBLOG contains the command and the sent message information and the ARC18*xx*E error message. The error message is issued on the panel when you use the NOWAIT option.

In all cases, either through TSO commands or batch job, the detailed messages from the FRBACKUP or FRRECOV commands can be found in the DFSMShsm backup activity logs.

11.1.3 Messages with DB2

When you use the DB2 BACKUP SYSTEM utility, the JOBLOG output shows the DB2 error messages. The DFSMShsm messages are sent to the DFSMShsm backup activity log. The DB2 message contains a return code that explains why the fast replication function failed. The hexadecimal values in the DSNU1631I message correlate to the decimal values of the ARC1806E error message as shown in Figure 11-2.

```
DSNU000I 290 13:15:17.26 DSNUGUTC - OUTPUT START FOR UTILITY, UTILID = SC70.SYSBACKUP
DSNU1044I 290 13:15:17.39 DSNUGTIS - PROCESSING SYSIN AS EBCDIC
DSNU050I  290 13:15:17.40 DSNUGUTC - BACKUP SYSTEM FULL DUMP
DSNU1600I 290 13:15:18.18 DSNUVBBD - BACKUP SYSTEM UTILITY FOR DATA STARTING,
COPYPOOL = DSN$CPSE1$DB
TOKEN = X'D7C2F0C2C654657F2F24AF0EC65463FF1E04'.
DSNU1631I 290 13:15:19.84 DSNUVBBD - BACKUP SYSTEM UTILITY FAILED BECAUSE THE CALL TO
DFSMSHSM FAILED WITH RC = X'00000006' REASON = X'0000000A'.
SEE THE HSM ACTIVITY LOG FOR HSM MESSAGES INDICATING THE CAUSE OF THE ERROR.
DSNU012I  290 13:15:24.07 DSNUGBAC - UTILITY EXECUTION TERMINATED, HIGHEST RETURN CODE=8


ARC1806E FAST REPLICATION BACKUP HAS FAILED FOR COPY POOL DSN$CPSE1$DB, RC=0010.
```

Figure 11-2 Failing DB2 JOBLOG DSNU1631I

Example 11-1 shows a JOBLOG example where four commands were issued through IKJEFT01 with the NOWAIT option without any errors.

Example 11-1 Sample TSO output with NOWAIT option

```
READY
 HSEND QUERY ACTIVE
READY
 HSEND QUERY REQUEST
READY
 HSEND FRBACKUP COPYPOOL(DSN$DBCP1$DB) EXECUTE TOKEN(MHLRES1-TEST7)
ARC1007I COMMAND REQUEST 00000152 SENT TO DFSMSHSM
READY
 HSEND FRBACKUP COPYPOOL(DSN$DBCP1$LG) EXECUTE TOKEN(MHLRES1-TEST7)
ARC1007I COMMAND REQUEST 00000153 SENT TO DFSMSHSM
READY
```

Example 11-2 shows a JOBLOG example with the WAIT option. The last of the four commands failed, and the message ARC1808E has the *****0F***** style. The message book leads you to the previous message to derive the command that was used and the copy pool name from it. The complete message ARC1808E with FAST REPLICATION BACKUP of COPY POOL name is shown on the console.

Example 11-2 Sample TSO output with WAIT

```
READY
 HSEND W QUERY ACTIVE
READY
 HSEND W QUERY REQUEST
READY
 HSEND W FRBACKUP COPYPOOL(DSN$DBCP1$DB) EXECUTE TOKEN(MHLRES1-TEST7)
ARC1000I FRBACKUP COPYPOOL(DSN$DBCP1$DB) EXECUTE TOKEN(MHLRES1-TEST7) COMMAND PROCESSING
ENDED
READY
```

```
 HSEND W FRBACKUP COPYPOOL(DSN$DBCP1$LG) EXECUTE TOKEN(MHLRES1-TEST7)
ARC1001I FRBACKUP COPYPOOL(DSN$DBCP1$LG) EXECUTE TOKEN(MHLRES1-TEST7) COMMAND FAILED,
RC=0008, REAS=0000
ARC1808E ONE OR MORE VOLUMES FAILED DURING FAST REPLICATION ***** OF *****
READY
```

Example 11-3 shows the TSO panel that contains the NOWAIT option output.

Example 11-3 TSO panel with NOWAIT option output

```
ARC1001I COPY POOL DSN$DBCP1$LG FRBACKUP FAILED, RC=0008, REAS=0000
ARC1808E ONE OR MORE VOLUMES FAILED DURING FAST REPLICATION BACKUP OF COPY
ARC1808E (CONT.) POOL DSN$DBCP1$LG
***
```

The BACKUP ACTIVITY log has additional messages but *it does not contain the ARC1808E message*, as shown in Example 11-4.

Example 11-4 BACKUP ACTIVITY log

```
ARC0640I ARCFRTM - ADR918I (002)-DDTFP(07), FAST REPLICATION COULD NOT BE USED
                                    FOR VOLUME MHL037, RETURN CODE 3
ARC0640I ARCFRTM -1 VOLUME WAS REJECTED FOR QFRVOLS
EXTENT REASON CODE 2 - ALREADY ACTIVE
2010.299 16:23:04 DFSMSDSS PROCESSING COMPLETE. HIGHEST RETURN CODE IS 0008
ARC0640I ARCFRTM - FROM: TASK    002
ARC1803E THE FOLLOWING 00001 VOLUME(S) FAILED DURING FAST REPLICATION BACKUP OF
                                      COPY POOL DSN$DBCP1$LG
ARC1803E (CONT.) MHL037, ADR918I
ARC1805I THE FOLLOWING 00001 VOLUME(S) WERE SUCCESSFULLY PROCESSED BY FAST
                                  REPLICATION BACKUP OF COPY POOL DSN$DBCP1$LG
ARC1805I (CONT.) MHL147
ARC1802I FAST REPLICATION BACKUP HAS COMPLETED FOR COPY POOL DSN$DBCP1$LG, AT 16:23:04 ON
2010/10/26, FUNCTION RC=0008, MAXIMUM VOLUME RC=0008
 DFSMSHSM BACKUP LOG, TIME 16:24:29,  DATE 10/26/10
```

11.2 Patches for performance measurements

To determine how long DFSMSdss takes to process a set of volumes, DFSMShsm provides a patch that is shown in Example 11-5. This patch causes the starting and ending messages to be issued for each set of volumes that is passed to DFSMSdss.

Example 11-5 Performance patch for starting and ending messages

```
PATCH .MCVT.+D8 BITS(.1......)
```

11.2.1 Overview

The DFSMShsm command output can be routed to a data set by using the OUTDATASET optional parameter, for example, ODS('MHLRES2.OUT.DATSET1'). This parameter is not a valid subparameter for commands, such as QUERY. If you need to capture the output of a QUERY command, you can submit the command within the System Display and Search Facility (SDSF) LOG by using the MODIFY HSM, QUERY command. The output will be sent to the SYSLOG.

A patch is available to send most messages, such as messages that relate to the data set, to the SYSLOG and the ACTIVITY log. You can turn on this patch in addition to the previously mentioned patch for the performance measurements. Use the patch command that is shown in Example 11-6.

Example 11-6 Patch for messages to go to SYSLOG

```
PATCH .MCVT.+2 BITS(......1.)
```

Important: Be careful when you set the patch to send messages to SYSLOG. Because FRBACKUP and FRRECOV can potentially process hundreds of volumes and data sets, the messages can flood SYSLOG. *Only use this function when it is required. Be sure to patch off the bits after you obtain the information that you need.*

11.2.2 Patching to turn off performance and additional messages

When you finish gathering the additional messages, you can turn off the patches with the following commands:

```
PATCH .MCVT.+2 BITS(......0.)
PATCH .MCVT.+D8 BITS(.0......)
```

As with all patches, these patches can be added to the ARCCMD*xx* parmlib member so that they are in effect after each DFSMShsm restart. Use caution when you patch DFSMShsm to send messages to SYSLOG.

11.3 Debugging FRBACKUP errors

Common errors that can occur when you prepare to run FRBACKUP or with an existing FRBACKUP environment are described. Several patch commands are available that can help you identify what went wrong.

11.3.1 DFSMShsm Problem Determination Aid (PDA) tool

The DFSMShsm Problem Determination Aid (PDA) tool is described.

What is the PDA

DFSMShsm captures certain information when a user specifies SETSYS PDA(ON) in the user's ARCCMD*xx* parmlib member. You can also issue SETSYS PDA(ON) as a modify command if PDA is not already set to gather information. ARCPDOX and ARCPDOY data sets must already be allocated at STARTUP.

This PDA trace is useful to capture detailed information whenever an error occurs. For more detailed information, see the *IBM z/OS DFSMShsm Primer*, SG24-5272.

11.3.2 Preparing for problems with source to target volume pairing

When a user starts to use DFSMShsm FRBACKUP or when a user's configuration changes, volume pairing can be a common problem.

Source to target volume pairing

The initial setup of the environment for DFSMShsm fast replication might not be trivial, depending on your configuration. For example, completing the source to target volume pairing for hundreds or thousands of volumes is complex. Message ARC1806E points to message ARC1807I, which provides useful information when pairing fails.

SETSYS FASTREPLICATION VOLUMEPAIRINGMESSAGES(YES|NO)

Additional messages can be used to determine why source and target volumes fail to pair. The new VOLUMEPAIRMESSAGES parameter was added to the SETSYS FASTREPLICATION command as shown in Example 11-7.

Example 11-7 SETSYS for volume pairing messages

```
SETSYS FASTREPLICATION(DSR(PREFERRED) FCREL(FULL) VOLUMEPAIRINGMESSAGES(YES))
```

For more information about the other parameters of the SETSYS FASTREPLICATION command, see Example 5-2 on page 72 in Chapter 5, “DFSMShsm fast replication commands” on page 65.

Note: This new parameter replaces the patch command to turn on these messages. If you used the following patch, you can remove it now:

```
PATCH .FRGCB.+9 BITS(.1......)
```

One example of a common volume pairing error is during HyperSwap. The remote location volumes must be configured exactly like the current location volumes. If the remote location volumes are configured at a different size, the FRBACKUP fails.

Before you use the VOLUMEPAIRINGMESSAGES parameter and run the FRBACKUP command again, check all of the possible reasons for which a volume pairing can fail as documented in the ARC1807I message:

- The volumes might be offline.
- The volumes might be of a different device type.
- The target volume might be a different size than the source volume.
- The volumes might be in a different control unit.

11.3.3 FORCE situations

Always use caution when you issue the FRBACKUP FORCE command. (For DB2 users, use caution when you issue the BACKUP SYSTEM FORCE utility.) FORCE is useful only if you want to replace an incomplete failed dump copy with a new dump copy version.

The same caution is true for individuals who want to use this FORCE option on the FRRECOV command. With FORCE, you can force the fast replication recovery of a copy pool from a DASD backup copy with an in-progress dump to tape or otherwise incomplete dump copy. Any in-progress dump to tape of the DASD backup copy is terminated.

11.3.4 Capturing catalog information errors

A catalog that is to be captured by DFSMShsm FRBACKUP and used for FRRECOV must be free of any errors, such as the errors that are encountered with highly used catalogs. Those catalogs might contain invalid entries and yet the structure of the catalog might still be valid. These types of invalid entries can cause a nonzero return code back to DFSMShsm. Although the catalog is fine, these invalid entries, which are entries that are no longer associated with anything, produce a nonzero return code to DFSMShsm.

FRBACKUP requires a clean catalog at FRBACKUP time to ensure that a restore to a particular point in time does not cause the catalog to be returned to an undesirable state.

For users who specified REQUIRED in the copy pool definition, ARC1812I RC0008 is issued. No catalog information is obtained, and the FRBACKUP command fails.

For users who specified PREFERRED in the copy pool definition, ARC1812I RC0004 is issued. Only partial catalog information can be obtained. The FRBACKUP command continues but the catalog information is limited or none.

To help debug catalog errors, a patch was created so that users can capture additional PDA trace entries that might help identify the root cause of the problem. The PATCH command in Example 11-8 enables the additional catalog search interface (CSI) tracing.

Example 11-8 Capture CSI PDA trace entry patch ON

```
PATCH .MCVT.+558 BITS(.....1..)
```

After the problem is identified, the patch can be turned off as shown in Example 11-9.

Example 11-9 Capture CSI PDA trace entry patch OFF

```
PATCH .MCVT.+558 BITS(.....0..)
```

11.4 FRDELETE considerations

Considerations for using the DFSMShsm fast replication FRDELETE command are explained.

The FRDELETE command is used to delete unneeded fast replication backup versions. New copy versions replace older copy versions through normal processing.

Two instances, other than normal roll off, cause unneeded copy versions to be deleted:

- The number of versions specified is decreased by modifying the storage management subsystem (SMS) copy pool definition.

  This decrease causes subsequent FRBACKUP commands to remove unneeded versions.
- When a copy pool is renamed and no longer needed, the copy pool must be deleted by the storage administrator. Use the FRDELETE COPYPOOL command and ensure that you use one of the following options:
  - ALL: Specify the ALL keyword when all copies of the version are to be deleted.
  - VERSIONS: Specify the VERSIONS keyword to delete an individual version or group of individual versions.
  - TOKEN: Specify the TOKEN keyword to delete the version that is associated with the token. If the token is not unique to an individual version, the delete fails.

– If none of these options is specified, the FRDEL fails as shown in Example 11-10.

Example 11-10 FRDEL PARSE ERROR

```
ARC1001I FRDEL CP(DSN$R3P1$DB) COMMAND FAILED, RC=0005, REAS=0037
ARC1605I COMMAND HAD PARSE ERROR
13.48.57 JOB00045 $HASP165 HSEND    ENDED AT TPC238  MAXCC=0 CN(INTERNAL)
***
```

When the command is submitted correctly, the ARC183xI completion message is returned to the TSO user as shown in Example 11-11.

Example 11-11 FRDEL ALL ARC1831I completion messages

```
HSEND FRDEL CP(DSN$DB8B$DB) ALL
will return
ARC1831I BACKUP VERSION NUMBER 1 OF COPY POOL DSN$DB8B$DB WAS DELETED
ARC1831I (CONT.) SUCCESSFULLY
ARC1832I 1 VERSION(S) DELETED FOR COPYPOOL DSN$DB8B$DB
13.50.01 JOB00046 $HASP165 HSEND    ENDED AT TPC238  MAXCC=0 CN(INTERNAL)
***
```

Any outstanding FlashCopy relationships are withdrawn before a version is deleted. *Never withdraw the relationship outside of DFSMShsm*. Withdrawing the relationship outside of DFSMShsm causes the backup version to be invalidated, but DFSMShsm assumes that the backup version is still valid. Withdrawing the relationship outside of DFSMShsm also can result in a data integrity exposure.

11.5 Decreasing copy pool backup volumes

When you decrease the number of volumes in a copy pool backup storage group (CPBSG), consider the following information:

- You must be careful when you remove a volume from a CPBSG. Before you remove a volume from a CPBSG, you must ensure that the volume is not the target of a valid DFSMShsm backup version.
- You can verify that the volume is not the target of a valid DFSMShsm backup version by examining the output from the DFSMShsm LIST COPYPOOLBACKUPSTORAGEGROUP command.
- If you must remove a target volume from a valid source to target pairing, use the FRDELETE command to delete the DFSMShsm backup version that the volume is a part of before you remove the volume.

11.6 Reuse of invalid backup versions

New copy versions replace invalid copy versions through the next FRBACKUP processing.

11.7 AUDIT COPYPOOLCONTROLS

When FRBACKUP runs, if errors indicate a problem with one of the volume records, you can issue an AUDIT COPYPOOLCONTROLS against the copy pool and all of the copy pools in the DFSMShsm configuration.

By design, the command detects different errors when it is run against the copy pool and when it is run against all copy pools. When you specify AUDIT COPYPOOLCONTROLS without a specific copy pool name, AUDIT reads sequentially through all existing fast replication records and confirms the existence and accuracy of all DFSMShsm records that are associated with each copy pool. The AUDIT function detects and reports orphaned records and other discrepancies.

When you specify AUDIT COPYPOOLCONTROLS (*cpname*), AUDIT reads the fast replication CDS records for that specific copy pool to confirm the existence and accuracy of all DFSMShsm records that are associated with that specific copy pool. No orphaned records are identified.

In all cases, AUDIT COPYPOOLCONTROLS runs with a default action of NOFIX. The *ERR messages indicate the error that is detected. For explanations of the errors that are detected, see the “Using the AUDIT COPYPOOLCONTROLS Parameter” section of the *z/OS DFSMShsm Storage Administration Guide*, SC35-0421. The errors are not described in this book.

Example 11-12 shows the submission of AUDIT COPYPOOLCONTROLS CP(copy pool name) by using IKJEFT01 and routing the output to a data set. Send the output to a data set for later review.

Example 11-12 JCL that uses IKJEFT01 for AUDIT COPYPOOLCONTROLS CP(copy pool name)

```
//HSEND JOB ,TIME=(1440),MSGCLASS=H,MSGLEVEL=1,CLASS=A,
//         NOTIFY=&SYSUID,USER=&SYSUID,REGION=6144K
//STEP1   EXEC PGM=IKJEFT01,DYNAMNBR=150
//SYSABEND DD SYSOUT=*
//SYSTSPRT DD SYSOUT=*
//SYSTSIN  DD *
HSEND AUDIT COPYPOOLCONTROLS CP(DSN$DB8B$DB) ODS('MHLRES2.AUDIT.OUT1')
```

The messages that are shown in Example 11-13 are sent to the user’s system.

Example 11-13 Messages sent to TSO user

```
ARC0801I DFSMSHSM AUDIT STARTING
ARC0802I DFSMSHSM AUDIT ENDING
09.06.12 JOB00038 $HASP165 HSEND    ENDED AT TPC238  MAXCC=0 CN(INTERNAL)
```

AUDIT COPYPOOLCONTROLS for all copy pools takes a long time, depending on the number of copy pools. If you run the AUDIT against all copy pools, select a time when your copy pools are least busy to not affect performance in any way. Example 11-14 shows the submission of the same type of IKJEFT01 job.

Example 11-14 AUDIT COPYPOOLCONTROLS for all copy pools

```
//HSEND JOB ,TIME=(1440),MSGCLASS=H,MSGLEVEL=1,CLASS=A,
//         NOTIFY=&SYSUID,USER=&SYSUID,REGION=6144K
//STEP1   EXEC PGM=IKJEFT01,DYNAMNBR=150
//SYSABEND DD SYSOUT=*
//SYSTSPRT DD SYSOUT=*
```

```
//SYSTSIN  DD *
HSEND AUDIT COPYPOOLCONTROLS ODS('MHLRES2.AUDIT.ALLCP')
```

The messages that are sent to the TSO terminal are the same messages as shown in Example 11-13 on page 236. For more information about the AUDIT COPYPOOL function, see section 14.4, “Auditing HSM” in the *IBM z/OS DFSMShsm Primer*, SG24-5272.

11.7.1 Fast replication and associated control data set records

Seven record types, which are shown in Table 11-1, are involved with fast replication and stored in the DFSMShsm backup control data set (BCDS): K, J, I, F, H, G, and Y records.

Five CDS records directly relate to fast replication in addition to the two CDS records that relate to the dump function.

Table 11-1 Record types

Record	Record type	Hex value	Record name
FRB	F	2E	Fast replication backup volume record
FRD	K	23	Fast replication dump record
FRSV	J	25	Fast replication source volume record
FRTV	I	2D	Fast replication target volume record
FRVP	H	2F	Fast replication volume pairing record
DGN	G	29	Dump volume generation record
DVL	Y	21	Dump volume record

F is the fast replication backup record (FRB)

The FRB record describes the complete fast replication backup occurrence. The FRB record contains information about each backup version and the number of dump versions in the copy pool. The key for a type F FRB record is the name of the copy pool that the record represents. Example 11-15 shows an example of the key that is used with a type F FRB record.

Example 11-15 FIXCDS output of an F (FRB) record

```
FIXCDS F DSN$DB8B$DB ODS(MHLRES2.FIXCDS.CB)
MCH=   01782E00 BA2CE223 4A4F5E4C 00000000 00000000                              *      S
+0000  00000004 00000004 00000000 00000000 00000000 00000000 00000000 00000000   *
+0020  00000000 00000000 00000004 00000000 D4C8D3D9 C5E2F160 E3C5E2E3 00000000   *            MHLRES1 TEST
+0040  00000000 00000000 00000000 00000000 00000000 00000000 14224253 0103288F   *
+0060  00010100 00000000 00000000 00000003 00000000 D4C8D3D9 C5E2F160 E3C5E2E3   *            MHLRES1 TEST
+0080  00000000 00000000 00000000 00000000 00000000 00000000 00000000 11564119   *
+00A0  0103288F 00010100 00000000 00000000 00000002 00000000 00000000 00000000   *
+00C0  00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000   *
+00E0  22101134 0103287F 00010100 00000000 00000000 00000005 00000000 00000000   *
+0100  00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000   *
+0120  00000000 00000000 00000000 00000400 00000000 00000000                      *
ARC0197I TYPE F, KEY DSN$DB8B$DB, FIXCDS DISPLAY SUCCESSFUL
```

K is the fast replication dump volume record (FRD)

The dump volume record describes the information that relates to the dump copy that is associated with the backup version. The key for a type K FRD record is the copy pool name followed by the dump version.

If the copy pool name is less than the allotted 30 bytes, the name is padded with a hexadecimal value (x'4B') for periods (“.....”), as shown in the first line of Example 11-16, so that the whole length of 30 bytes is filled.

Although the version number value is in hexadecimal format, the key can be displayed by specifying the normal EBCDIC characters as shown in Example 11-16.

Example 11-16 K FRD record

```
FIXCDS K DSN$DB8B$DB..................001 ODS('MHLRES2.FIXCDS.CB')
MCH=   01DC2300 C781F98B 9A606784 00000000 00000000                            *    G 9  -
+0000  00010000 00000000 C4C3C6D9 F1F1F200 00010000 0110293F 00050000 00000000  *        DCFR112
+0020  00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000  *
+0040  00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000  *
+0060  00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000  *
+0080  00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000  *
+00A0  00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000  *
+00C0  00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000  *
+00E0  00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000  *
+0100  00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000  *
+0120  00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000  *
+0140  00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000  *
+0160  00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000  *
+0180  00000000 00000000 00000000 00000000 00000000 00000000 00000000           *
ARC0197I TYPE K, KEY DSN$DB8B$DB..................001, FIXCDS DISPLAY SUCCESSFUL
```

J is the fast replication source volume record (FRSV)

The J record describes the source volume record. The key for a type J FRSV record is the volume serial number. An example of the key that is used with a type J FRSV record is shown in Example 11-17.

Example 11-17 FIXCDS output of a J (FRSV) record

```
FIXCDS J MHL126  ODS(‘MHLRES2.FIXCDS.CB’)
MCH=   07AC2500 BA2CE221 E11F1B08 B9CC2CCD 05D66242                            *   S      0
+0000  C4E2D55B C4C2F8C2 5BC4C240 40404040 40404040 40404040 40404040 40400B03  *DSN$DB8B$DB
+0020  00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000  *
+0040  00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000  *
+0060  00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000  *
+0080  00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000  *
+00A0  00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000  *
+00C0  00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000  *
+00E0  00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000  *
+0100  00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000  *
...
+0720  00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000  *
+0740  00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000  *
+0760  00000000 00000000 00000000                                               *
ARC0197I TYPE J, KEY MHL126, FIXCDS DISPLAY SUCCESSFUL
```

I is the fast replication target volume record (FRTV)

The I record describes the target volume. The key for a type I FRTV record is the volume serial number. Example 11-18 shows an example of the key that is used with a type I FRTV record.

Example 11-18 FIXCDS output of an I (FRTV) record

```
FIXCDS I MHL214  ODS('MHLRES2.FIXCDS.CB')
MCH=   00662D00 BA2C090A 71FB6688 BA2C090A 71FB6688                             *
+0000  D4C8D3F1 F2F60000 00000000 00000000 00000000 00000000 00000000 00000000   *MHL126
+0020  00000000 00000000                                                        *
ARC0197I TYPE I, KEY MHL214, FIXCDS DISPLAY SUCCESSFUL
```

H is the fast replication volume pairs record (FRVP)

The FRVP record represents the volume pairing information that is associated with a specific FRB record. Table 11-2 shows the fields that make up a key for a type H FRVP backup record.

Table 11-2 Type H record key fields

Characters	Explanation
1 - 30	The copy pool name is suffixed with periods if the copy pool name is fewer than 30 characters.
31	The type of record: `P` if the record is a prepare record or `B` if the record is a backup record.
32 and 33	The version number in hexadecimal format.
34 - 41	The storage group name is suffixed with periods if the storage group name is fewer than eight characters.
42 and 43	The extent number.

Example 11-19 shows the key (in hexadecimal) that is used for a type H FRVP backup record. In this example, we use a key that consists of the following information:

- A copy pool name of `COPYPL1` (followed by periods to fill field)
- A `B` for a backup record request
- A version number of `1`
- A storage group name of `SRCSG1` (followed by periods to fill field)
- An extent number of `0` (zero)

Example 11-19 FIXCDS output of an H (FRVP) record

```
FIXCDS H X'C3D7F14B4B4B4B4B4B4B4B4B4B4B4B4B4B4B4B4B4B4B4B4B4B4B4B4BC20008E2C7F14B4B4B4B4B0000'
ODS('MHLRES2.DISPLAY.H.OUT')
MCH=   00942F00 00000000 00000000 00000000 00000000                            *
+0000  00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000  *
+0020  D4C8D3F0 C1F0D4C8 D3F0C1C5 80000000 00000000 00000000 0000D4C8 D3F0C1F1  *MHL0A0MHL0AE MHL0A1
+0040  D4C8D3F0 C1C6A000 00000000 00000000 00000000                            *MHL0AF
ARC0197I TYPE H, KEY CP1.........................B..SG1......., FIXCDS DISPLAY SUCCESSFUL H
```

Because the key for the H FRVP record can be difficult to enter correctly, it might be easier to extract the H FRVP records from the BCDS with an IDCAMS job. Example 11-20 on page 240 shows a sample IDCAMS PRINT job to print all H records. This sample job can be used for printing the other records, as well.

Example 11-20 Sample IDCAMS PRINT job to print all H records

```
//PRINT  EXEC PGM=IDCAMS
//*********************************************************
//* PRINT Fast replication and dump records               *
//* X'25' = FRSV (Code J)                                 *
//* X'2D' = FRTV (Code I)                                 *
//* X'2E' = FRB  (Code F)                                 *
//* X'2F' = FRVP (Code H)                                 *
//* X'23' - FRD  (Code K)                                 *
//* X'29' - DGN  (Code G)                                 *
//* X'21' - DVL  (Code Y)                                 *
//*********************************************************
//SYSPRINT  DD SYSOUT=*
//DD1   DD DSN=HSM.BCDS,
//         DISP=SHR
//DD2   DD DSN=MHLRES3.BCDS.PRINT3,DISP=(,CATLG,DELETE),
//         SPACE=(TRK,5),DCB=(LRECL=250,RECFM=VB),UNIT=3390
//SYSIN DD *
 PRINT -
    INFILE(DD1)  OUTFILE(DD2) FROMKEY(X'2F') TOKEY(X'2F')
/*
```

The output from the IDCAMS job is shown in Example 11-21.

Example 11-21 Output from the IDCAMS PRINT job to print all H records

```
IDCAMS  SYSTEM SERVICES                                    TIME: 21:02:52       10/20/10 PAGE      1
LISTING OF DATA SET -HSM.BCDS
KEY OF RECORD - 2FC4E2D55BC4C2F8C25BC4C24B4B4B4B4B4B4B4B4B4B4B4B4B4B4B4B4B4B4BC20009C4C2F8C24B4B4B4B0001
000000  2FC4E2D5 5BC4C2F8 C25BC4C2 4B4B4B4B   4B4B4B4B 4B4B4B4B 4B4B4B4B 4B4B4BC2
                                                                        *.DSN$DB8B$DB..................B
000020  0009C4C2 F8C24B4B 4B4B0001 00942F00   00000000 00000000 00000000 00000000
                                                                        *..DB8B.........................
000040  00000000 00000000 00000000 00000000   00000000 00000000 00000000 00000000
                                                                        *...............................
000060  D4C8D3F1 F2F5D4C8 D3F0F1F3 80000000   00000000 00000000 0000D4C8 D3F1F2F6
                                                                        *MHL125MHL013.............MHL126
000080  D4C8D3F0 F1F4A000 00000000 00000000   00000000
                                                                        *MHL014..............
KEY OF RECORD - 2FC4E2D55BC4C2F8C25BC4C24B4B4B4B4B4B4B4B4B4B4B4B4B4B4B4B4B4B4BC2000AC4C2F8C24B4B4B4B0001
000000  2FC4E2D5 5BC4C2F8 C25BC4C2 4B4B4B4B   4B4B4B4B 4B4B4B4B 4B4B4B4B 4B4B4BC2
                                                                        *.DSN$DB8B$DB..................B
000020  000AC4C2 F8C24B4B 4B4B0001 00942F00   00000000 00000000 00000000 00000000
                                                                        *..DB8B.........................
000040  00000000 00000000 00000000 00000000   00000000 00000000 00000000 00000000   *...............................
000060  D4C8D3F1 F2F5D4C8 D3F2F1F3 80000000   00000000 00000000 0000D4C8 D3F1F2F6
                                                                        *MHL125MHL213.............MHL126
000080  D4C8D3F2 F1F4A000 00000000 00000000   00000000
                                                                        *MHL214..............
KEY OF RECORD - 2FC4E2D55BC4C2F8C25BD3C74B4B4B4B4B4B4B4B4B4B4B4B4B4B4B4B4B4B4BC20009C4C2F8C2D3D6C7F10001
000000  2FC4E2D5 5BC4C2F8 C25BD3C7 4B4B4B4B   4B4B4B4B 4B4B4B4B 4B4B4B4B 4B4B4BC2
                                                                        *.DSN$DB8B$LG..................B
000020  0009C4C2 F8C2D3D6 C7F10001 007A2F00   00000000 00000000 00000000 00000000
                                                                        *..DB8BLOG1...:.................
000040  00000000 00000000 00000000 00000000   00000000 00000000 00000000 00000000   *...............................
000060  D4C8D3F0 F3F7D4C8 D3F0F2F5 A0000000   00000000 00000000 0000
                                                                        *MHL037MHL025.............
KEY OF RECORD - 2FC4E2D55BC4C2F8C25BD3C74B4B4B4B4B4B4B4B4B4B4B4B4B4B4B4B4B4B4BC20009C4C2F8C2D3D6C7F20001
000000  2FC4E2D5 5BC4C2F8 C25BD3C7 4B4B4B4B   4B4B4B4B 4B4B4B4B 4B4B4B4B 4B4B4BC2
                                                                        *.DSN$DB8B$LG..................B
000020  0009C4C2 F8C2D3D6 C7F20001 007A2F00   00000000 00000000 00000000 00000000
                                                                        *..DB8BLOG2...:.................
000040  00000000 00000000 00000000 00000000   00000000 00000000 00000000 00000000
                                                                        *...............................
000060  D4C8D3F1 F4F7D4C8 D3F0F2F6 A0000000   00000000 00000000 0000
                                                                        *MHL147MHL026.............
```

11.7.2 G is the dump generation record (DGN)

In this context, the dump generation record contains information about the dump generation of a certain fast replication target volume when it was processed by the full volume dump function. The key for the type G dump generation record is the volume serial number followed by the time of day (*hhmmssth*) in packed decimal format. The time of day is followed by the year and day (0C*yyddd*F) in packed decimal format. The time and date is in packed decimal format so the key must be specified in hexadecimal format as shown in Example 11-22.

Example 11-22 FIXCDS output of the G DGN dump generation record

```
FIXCDS G X'D4C8D3F0C1F0141845200110293F' ODS('MHLRES2.FIXCDS.CB')
MCH=   06682900 C4C9D3FE 9A192A03 C3C6EE84 3571CB82                        *    DIL     CF
+0000 9B400000 00000003 0000001C C8E2D440 40404040 00000003 D4C8D3F0 C1F00100 *          HSM         MHL0A0
+0020 3030200F 0110293F 00000000 00000000 C4E2D55B C4C2F8C2 5BC4C24B 4B4B4B4B *              DSN$DB8B$DB...
+0040 4B4B4B4B 4B4B4B4B 4B4B4B4B 4B4B0000 00000000 00000000 00000000 00000001 *................
+0060 C4C5E5C4 C1C9D3E8 F3F4F9F0 40404040 0110293F 80000000 00000000 00000001 *DCFR112 3590
+0080 00000000 00000000 00000000 00000000 00000000 00000001 E5E3F0F0 F1F90000 *                      VT0019
+00A0 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000 *
...
+0520 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000 *
+0540 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000 *
+0560 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000 *
+0580 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000 *
+05A0 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000 *
+05C0 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000 *
+05E0 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000 *
+0600 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000 *
+0620 00000000 00000000                                                      *
ARC0197I TYPE G, KEY X'D4C8D3F0C1F0141845200110293F', FIXCDS DISPLAY
SUCCESSFUL
```

11.7.3 Y is the dump volume record (DVL)

The dump volume record contains information that defines the format for CDS data area records that are generated when a dump volume is created. A dump generation record points to a certain dump volume record. The key for the Y DVL record is the volume serial number, which can be displayed as shown in Example 11-23.

Example 11-23 FIXCDS output of the Y DVL dump volume record

```
FIXCDS Y VT0019 ODS('MHLRES2.FIXCDS.CB')
MCH=   00E72100 C3C6F091 9C2D2201 C3C6ECF2 34881982                        * X  CF0     CF 2
+0000 F3F5F9F0 60F14040 94F80002 78048083 00015CC4 C3C6D9F1 F1F20001 09058FD4 *3590-1   8 DCFR112       M
+0020 C8D3F0C1 F0141845 20011029 3F403030 200FD4C8 D3F0C1F0 14184520 0110293F *HL0A0        MHL0A0
+0040 F2303020 0F003341 FD000003 20000000 00A80200 00000000 00000000 00000000 *2
+0060 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000 *
+0080 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000 *
+00A0 00000000 00000000                                                      *
ARC0197I TYPE Y, KEY VT0019, FIXCDS DISPLAY SUCCESSFUL
```

11.8 Messages with DFSMShsm fast replication

All z/OS DFSMShsm messages are documented in the z/OS MVS message manuals. Ensure that you refer to the latest version and release online at the z/OS Internet library:

http://www-03.ibm.com/systems/z/os/zos/library/bkserv/

A

Sample REXX execs

This appendix contains source REXX execs that are used in the z/OS file system (zFS) aggregate backup and recovery scenario as described in Chapter 9, “Using DFSMShsm fast replication in an environment outside of DB2” on page 185.

A sample REXX for time of day (TOD) clock conversion is also provided.

Sample REXX RXZFS

Example A-1 is the RXZFS REXX that is used when performing quiesce and unquiesce on zFS aggregates.

Example A-1 Sample REXX RXZFS

```
Call Syscall_Cmd "seteuid 0", noexit_on_error, no_msgs
    If OK Then Do
      If foreground Then Say "Effective UID switched to 0..."
      switched = 1
    End
  End
End

/* ------------------------------------------------------------------ */
/*  Set home and working directory, setup envvars, open /dev/null     */
/* ------------------------------------------------------------------ */

home = "/"
Call Syscall_Cmd "chdir" home
__environment.1 = "_BPX_SHAREAS=YES"
__environment.2 = "PATH=/bin"
__environment.3 = "HOME="||home
__environment.4 = "LOGNAME="||Userid()
__environment.5 = "PWD="||home
envvars = 5
If background Then Do
  "EXECIO * DISKR STDENV (STEM ENVVAR. FINIS"
  If rc<>0 Then Call Final_Exit 8
  Do i=1 To envvar.0
    envvar_line = Strip(envvar.i)
    If envvar_line="" | Left(envvar_line,1)="#" Then Iterate
    envvars = envvars+1
    __environment.envvars = envvar_line
  End
End
__environment.0 = envvars
Call Syscall_Cmd "open /dev/null (o_rdonly)"
fd.0 = retval

/* ------------------------------------------------------------------ */
/*  Enable for timer interrupts                                       */
/* ------------------------------------------------------------------ */

Call Syscall_Cmd "sigaction" sigalrm sig_cat 0 "ohdl oflg"
sig_enabled = 1
Call Syscall_Cmd "sigprocmask" sig_unblock,
  Sigaddset(Sigsetempty(),sigalrm) "mask"

/* ------------------------------------------------------------------ */
/*  Read in all the commands                                          */
/* ------------------------------------------------------------------ */

If single_cmd="" Then Do
  If background Then Do
    "EXECIO * DISKR STDIN (STEM INPUTD. FINIS"
    If rc<>0 Then Call Final_Exit 8
    in_lines = inputd.0
  End
```

```
  Else in_lines = 0
End
Else Do
  inputd.1 = single_cmd
  in_lines = 1
End

/* ---------------------------------------------------------------- */
/*  Run all the commands                                            */
/* ---------------------------------------------------------------- */

stdin_line = ""
ln = 0
Do Forever
  If in_lines>0 | background Then Do
    If ln=in_lines Then Leave
    ln = ln+1
    indata = inputd.ln
  End
  Else Do
    Say "Enter command input data or ""exit"" to exit processing:"
    Parse Pull indata
    If indata="exit" Then Leave
  End
  If Left(indata,1)="#" Then Iterate
  indata = Strip(indata)
  If Right(indata,1)="-" Then Do
    no_cont = 0
    indata = Left(indata,Length(indata)-1)
  End
  Else no_cont = 1
  stdin_line = stdin_line || indata
  If no_cont Then Do
    If Right(stdin_line,1)<>"+" Then Say stdin_line
    Else stdin_line = Left(stdin_line,Length(stdin_line)-1)
    If stdin_line="exit" Then Leave
    Call Shell_Cmd stdin_line
    stdin_line = ""
  End
End

/* ---------------------------------------------------------------- */
/*  End of processing                                               */
/* ---------------------------------------------------------------- */

Call Final_Exit final_rc
Exit 9999

/* ---------------------------------------------------------------- */
/*  Subroutines                                                     */
/* ---------------------------------------------------------------- */

Final_Exit:
  Parse Arg final_rc
  If sig_enabled Then
    Call Syscall_Cmd "sigaction" sigalrm ohdl oflg "x y",,
      noexit_on_error
  Call Syscalls "SIGOFF"
  Do i=0 To 2
    If fd.i<>-1 Then Call Syscall_Cmd "close (fd.i)", noexit_on_error
```

```
  End
  If pp.1<>-1 Then Call Syscall_Cmd "close (pp.1)", noexit_on_error
  If cur_euid<>0 & switched & foreground Then Do
    Call Syscall_Cmd "seteuid" cur_euid, noexit_on_error
    If not_OK Then Say "Effective UID could not be switched back..."
    Else Say "Effective UID switched back..."
  End
Exit final_rc

Shell_Cmd:
  Parse Arg shell_cmd
  parm.0 = 3
  parm.1 = "sh"
  parm.2 = "-c"
  parm.3 = shell_cmd
  shell_rc = -1
  shell_termsig = -1
  shell_stopsig = -1
  time_out = 0
  Call Syscall_Cmd "pipe pp."
  fd.1 = pp.2
  If not_do_wait Then Call Syscall_Cmd "f_setfl (pp.1) (o_nonblock)"
  Call Syscall_Cmd "dup (fd.1)"
  fd.2 = retval
  Call Syscall_Cmd "spawnp (parm.1) 3 fd. parm. __environment."
  pid = retval
  all_output = ""
  If do_wait Then Do
    Call Syscall_Cmd "alarm" timeout_value /* timeout setting in secs */
    Call Syscall_Cmd "waitpid (pid) stat. 0", info_on_timeout
  End
  Else Do
    time_beg = Time("E")
    Do Forever
      Call Syscall_Cmd "waitpid (pid) stat. (w_nohang)"
      If timeout_value<>0 & Time("E")-time_beg>=timeout_value Then Do
        time_out = 1
        Leave
      End
      If stat.w_ifexited Then Leave
      Call Get_Output_Data
      Call Syscall_Cmd "sleep 1"
    End
  End
  Call Syscall_Cmd "alarm 0"
  If time_out Then Do
    Call Syscall_Cmd "kill (pid)" sigkill, noexit_on_error
    Call Syscall_Cmd "waitpid (pid) stat. 0"
  End
  Select
    When stat.w_ifexited Then shell_rc = stat.w_exitstatus
    When stat.w_ifsignaled Then shell_termsig = stat.w_termsig
    When stat.w_ifstopped Then shell_stopsig = stat.w_stopsig
    Otherwise Nop
  End
  Do j=1 To 2
    If fd.j<>-1 Then Call Syscall_Cmd "close (fd.j)"
    fd.j = -1
  End
  Do Until retval<1000
```

```
    Call Syscall_Cmd "read (pp.1) output_data 1000"
    all_output = all_output||output_data
  End
  Do While Length(all_output)>0
    Parse Var all_output output_line (esc_n) all_output
    Say output_line
  End
  Call Syscall_Cmd "close (pp.1)"
  pp.1 = -1
  If time_out Then Do
    Say "RXZFX004E Timeout occurred during command processing..."
    Say "RXZFX005I Command:" shell_cmd
    Call Final_Exit 8
  End
  If shell_rc<>0 Then Do
    Say "*** non-zero return code: Rc("||shell_rc||")."
    final_rc = 8
  End
Return

Get_Output_Data:
  Do Until retval<1000
    output_data = ""
    Call Syscall_Cmd "read (pp.1) output_data 1000"
    all_output = all_output||output_data
  End
  Do While Length(all_output)>0 & Pos(esc_n,all_output)>0
    Parse Var all_output output_line (esc_n) all_output
    Say output_line
  End
Return

Syscall_Cmd: Trace O
  Parse Arg syscall_cmd, call_type, no_display
  display_msgs = (no_display<>"1")
  exit_on_error = (call_type="")
  Address SYSCALL syscall_cmd
  If rc=0 & retval=-1 & errno=70 & errnojr="59D0135" Then not_OK = 0
  Else not_OK = (rc<>0 | retval<0 | retval=0 & (errno<>0 | errnojr<>0))
  OK = (not_OK = 0)
  If not_OK & display_msgs Then Do
    If call_type=info_on_timeout & errno=78 Then Do
      time_out = 1
      final_rc = 8
    End
    Else Do
      Say "SYSCALL Service:" syscall_cmd
      Say "Syscall Return Code=" rc
      Say "OMVS Return Value  =" retval
      Say "OMVS Return Code   =" errno
      Say "OMVS Reason Code   =" errnojr
      Address SYSCALL "strerror" errno errnojr "err."
      If rc=0 & retval>=0 Then Do
        Say ""
        Say "OMVS Return Code Explanation -"
        Say err.se_errno
        Say "OMVS Reason Code Explanation -"
        Say err.se_reason
        Say ""
      End
```

```
      If exit_on_error Then Call Final_Exit 8
    End
  End
Return

Sigsetempty: Return Copies(0,64)
Sigaddset: Return Overlay(1,Arg(1),Arg(2))
```

Sample REXX RXSUSH

Example A-2 is the RXSUSH REXX that is used when performing unmount and mount on zFS aggregates.

Example A-2 Sample REXX RXSUSH

```
/* REXX ***************************************************************/
/*    Procedure: RXSHELL/RXSUSH                                       */
/*  Description: Run UNIX commands/run UNIX commands in SU mode        */
/*               Property of IBM  (C) Copyright IBM Corp. 2003        */
/*    Format is: rxshell/rxsush < <R>timeout_value > < single_cmd >   */
/**********************************************************************/

Trace O
Parse Source . . myname .
swsu = (myname="RXSUSH")
Parse Arg timeout_value single_cmd
do_wait = 1
not_do_wait = 0
If timeout_value="" Then timeout_value = "R0"
If Translate(Left(timeout_value,1))="R" Then Do
  do_wait = 0
  not_do_wait = 1
  timeout_value = Substr(timeout_value,2)
End
If timeout_value="" Then timeout_value = 0
If Verify(timeout_value,"1234567890")<>0 Then Do
  do_wait = 0
  not_do_wait = 1
  timeout_value = 0
  Parse Arg single_cmd
End

If Syscalls("ON")>4 Then Do
  Say "RXSHX002E The SYSCALL environment could not be established."
  Exit 8
End

If Syscalls("SIGON")<>0 Then Do
  Say "RXSHX003E The SIGNAL interface could not be established."
  Exit 8
End

switched = 0
final_rc = 0
no_msgs = 1
noexit_on_error = 1
info_on_timeout = 2
fd. = -1
```

```
pp. = -1
sig_enabled = 0
foreground = (Sysvar("SYSENV")="FORE")
background = (foreground=0)

/* ------------------------------------------------------------------ */
/*  Switch effective and/or real UID to zero if needed and possible   */
/* ------------------------------------------------------------------ */

If swsu Then Do
  If background Then Do
    Call Syscall_Cmd "getuid"
    cur_uid = retval
    If cur_uid<>0 Then
      Call Syscall_Cmd "setuid 0", noexit_on_error, no_msgs
  End
  Else Do /* foreground */
    Call Syscall_Cmd "geteuid"
    cur_euid = retval
    Call Syscall_Cmd "getuid"
    cur_uid = retval
    If MVSVar("SYSMVS")>="SP7.0.3" Then Do
      If cur_euid<>0 | cur_uid<>0 Then Do
        Call Syscall_Cmd "setreuid 0 0", noexit_on_error, no_msgs
        If OK Then Do
          Say "UID setting switched to 0..."
          switched = 1
        End
      End
    End
    Else Do
      If cur_euid<>0 Then Do
        Call Syscall_Cmd "seteuid 0", noexit_on_error, no_msgs
        If OK Then Do
          Say "Effective UID switched to 0..."
          switched = 1
        End
      End
    End
  End
End

/* ------------------------------------------------------------------ */
/*  Set home and working directory, setup envvars, open /dev/null     */
/* ------------------------------------------------------------------ */

Call Syscall_Cmd "getpid"
mainprocess_pid = retval
If background Then Do
  dash_line = Copies("----",19)
  Say dash_line
  Say "The main process ID for this job is" mainprocess_pid||".",
    "If you should need to stop"
  If do_wait Then signal_type = "SIGALRM"
  Else signal_type = "SIGTERM"
  Say "processing use the following UNIX command to do this smoothly:"
  Say "kill -s" signal_type mainprocess_pid
  Say dash_line
  Say ""
End
```

```
If swsu Then Do
  Call Syscall_Cmd "getcwd cur_cwd"
  home = "/"
  Call Syscall_Cmd "chdir" home
End
Else Do
  Call Syscall_Cmd "getpwnam" Userid() "omvs."
  home = omvs.pw_dir
End
__environment.1 = "_BPX_SHAREAS=YES"
__environment.2 = "PATH=/bin"
__environment.3 = "HOME="||home
__environment.4 = "LOGNAME="||Userid()
__environment.5 = "PWD="||home
envvars = 5
If background Then Do
  "EXECIO * DISKR STDENV (STEM ENVVAR. FINIS"
  If rc<>0 Then Call Final_Exit 8
  Do i=1 To envvar.0
    envvar_line = Strip(envvar.i)
    If envvar_line="" | Left(envvar_line,1)="#" Then Iterate
    envvars = envvars+1
    __environment.envvars = envvar_line
  End
End
__environment.0 = envvars
Call Syscall_Cmd "open /dev/null (o_rdonly)"
fd.0 = retval

/* ---------------------------------------------------------------- */
/*  Enable for timer interrupts                                     */
/* ---------------------------------------------------------------- */

Call Syscall_Cmd "sigaction" sigalrm sig_cat 0 "ohdl oflg"
sig_enabled = 1
Call Syscall_Cmd "sigprocmask" sig_unblock,
  Sigaddset(Sigsetempty(),sigalrm) "mask"
If not_do_wait Then
  Call Syscall_Cmd "sigaction" sigterm sig_cat 0 "xhdl xflg"

/* ---------------------------------------------------------------- */
/*  Read in all the commands                                        */
/* ---------------------------------------------------------------- */

If single_cmd="" Then Do
  If background Then Do
    "EXECIO * DISKR STDIN (STEM INPUTD. FINIS"
    If rc<>0 Then Call Final_Exit 8
    in_lines = inputd.0
  End
  Else in_lines = 0
End
Else Do
  inputd.1 = single_cmd
  in_lines = 1
End

/* ---------------------------------------------------------------- */
/*  Run all the commands                                            */
/* ---------------------------------------------------------------- */
```

```
stdin_line = ""
ln = 0
Do Forever
  If in_lines>0 | background Then Do
    If ln=in_lines Then Leave
    ln = ln+1
    indata = inputd.ln
  End
  Else Do
    Say "Enter command input data or ""exit"" to exit processing:"
    Parse Pull indata
    If indata="exit" Then Leave
  End
  If Left(indata,1)="#" Then Iterate
  indata = Strip(indata)
  If Right(indata,1)="-" Then Do
    no_cont = 0
    indata = Left(indata,Length(indata)-1)
  End
  Else no_cont = 1
  stdin_line = stdin_line || indata
  If no_cont Then Do
    If Right(stdin_line,1)<>"+" Then Say stdin_line
    Else stdin_line = Left(stdin_line,Length(stdin_line)-1)
    If stdin_line="exit" Then Leave
    Call Shell_Cmd stdin_line
    stdin_line = ""
  End
End

/* ---------------------------------------------------------------- */
/*  End of processing                                               */
/* ---------------------------------------------------------------- */

Call Final_Exit final_rc
Exit 9999

/* ---------------------------------------------------------------- */
/*  Subroutines                                                     */
/* ---------------------------------------------------------------- */

Final_Exit:
  Parse Arg final_rc
  If swsu Then Call Syscall_Cmd "chdir" cur_cwd
  If sig_enabled Then
    Call Syscall_Cmd "sigaction" sigalrm ohdl oflg "x y",,
      noexit_on_error
  Call Syscalls "SIGOFF"
  Do i=0 To 2
    If fd.i<>-1 Then Call Syscall_Cmd "close (fd.i)", noexit_on_error
  End
  If pp.1<>-1 Then Call Syscall_Cmd "close (pp.1)", noexit_on_error
  If swsu & switched & foreground Then Do
    If MVSVar("SYSMVS")>="SP7.0.3" Then Do
      Call Syscall_Cmd "setreuid" cur_uid cur_euid, noexit_on_error
      If not_OK Then Say "UID settings could not be switched back..."
    End
    Else Do
      Call Syscall_Cmd "seteuid" cur_euid, noexit_on_error
```

```
      If not_OK Then Say "Effective UID could not be switched back..."
    End
  End
Exit final_rc

Shell_Cmd:
  Parse Arg shell_cmd
  parm.0 = 3
  parm.1 = "sh"
  parm.2 = "-c"
  parm.3 = shell_cmd
  shell_rc = -1
  shell_termsig = -1
  shell_stopsig = -1
  time_out = 0
  Call Syscall_Cmd "pipe pp."
  fd.1 = pp.2
  If not_do_wait Then Call Syscall_Cmd "f_setfl (pp.1) (o_nonblock)"
  Call Syscall_Cmd "dup (fd.1)"
  fd.2 = retval
  Call Syscall_Cmd "spawnp (parm.1) 3 fd. parm. __environment."
  pid = retval
  all_output = ""
  If do_wait Then Do
    Call Syscall_Cmd "alarm" timeout_value /* timeout setting in secs */
    Call Syscall_Cmd "waitpid (pid) stat. 0", info_on_timeout
  End
  Else Do
    time_beg = Time("E")
    Do Forever
      Call Syscall_Cmd "waitpid (pid) stat. (w_nohang)"
      If timeout_value<>0 & Time("E")-time_beg>=timeout_value Then Do
        time_out = 1
        Leave
      End
      If stat.w_ifexited Then Leave
      Call Get_Output_Data
      Call Syscall_Cmd "sigpending sigset"
      If Substr(sigset,sigterm,1)=1 Then Do
        Say "RXSHX006I Signal SIGTERM received, terminating..."
        Say "RXSHX007I Command:" shell_cmd
        If background Then Call Final_Exit 8
        Else Leave
      End
      Call Syscall_Cmd "sleep 1"
    End
  End
  Call Syscall_Cmd "alarm 0"
  If time_out Then Do
    Call Syscall_Cmd "kill (pid)" sigkill, noexit_on_error
    Call Syscall_Cmd "waitpid (pid) stat. 0"
  End
  Select
    When stat.w_ifexited Then shell_rc = stat.w_exitstatus
    When stat.w_ifsignaled Then shell_termsig = stat.w_termsig
    When stat.w_ifstopped Then shell_stopsig = stat.w_stopsig
    Otherwise Nop
  End
  Do j=1 To 2
    If fd.j<>-1 Then Call Syscall_Cmd "close (fd.j)"
```

```
    fd.j = -1
  End
  Do Until retval<1000
    Call Syscall_Cmd "read (pp.1) output_data 1000"
    all_output = all_output||output_data
  End
  Do While Length(all_output)>0
    Parse Var all_output output_line (esc_n) all_output
    Say output_line
  End
  Call Syscall_Cmd "close (pp.1)"
  pp.1 = -1
  If time_out Then Do
    Say "RXSHX004I Signal SIGALRM received or timeout occurred,",
      "terminating..."
    Say "RXSHX005I Command:" shell_cmd
    If background Then Call Final_Exit 8
  End
  If shell_rc<>0 Then Do
    Say "*** non-zero return code: Rc("||shell_rc||")."
    final_rc = 8
  End
Return

Get_Output_Data:
  Do Until retval<1000
    output_data = ""
    Call Syscall_Cmd "read (pp.1) output_data 1000"
    all_output = all_output||output_data
  End
  Do While Length(all_output)>0 & Pos(esc_n,all_output)>0
    Parse Var all_output output_line (esc_n) all_output
    Say output_line
  End
Return

Syscall_Cmd: Trace O
  Parse Arg syscall_cmd, call_type, no_display
  display_msgs = (no_display<>"1")
  exit_on_error = (call_type="")
  Address SYSCALL syscall_cmd
  If rc=0 & retval=-1 & errno=70 & errnojr="59D0135" Then not_OK = 0
  Else not_OK = (rc<>0 | retval<0 | retval=0 & (errno<>0 | errnojr<>0))
  OK = (not_OK = 0)
  If not_OK & display_msgs Then Do
    If call_type=info_on_timeout & errno=78 Then Do
      time_out = 1
      final_rc = 8
    End
    Else Do
      Say "SYSCALL Service:" syscall_cmd
      Say "Syscall Return Code=" rc
      Say "OMVS Return Value  =" retval
      Say "OMVS Return Code   =" errno
      Say "OMVS Reason Code   =" errnojr
      is_omvs_range = X2d(Left(Right(errnojr,8,"0"),4))<=X2d(20FF)
      errno_save = errno
      errnojr_save = errnojr
      If errno<>"A3" & errno<>"A4" & is_omvs_range Then
        show_reason = 1
```

```
      Else
        show_reason = 0
      Address SYSCALL "strerror" errno errnojr "err."
      If rc=0 & retval>=0 Then Do
        If err.se_errno<>"" Then
          Say "OMVS Return Code Explanation -" err.se_errno
        If show_reason & err.se_reason<>"" Then
          Say "OMVS Reason Code Explanation -" err.se_reason
      End
      errno = errno_save
      errnojr = errnojr_save
      If exit_on_error Then Call Final_Exit 8
    End
  End
Return

Sigsetempty: Return Copies(0,64)
Sigaddset: Return Overlay(1,Arg(1),Arg(2))
```

Sample CONVTOD to convert the TOD

Example A-3 contains a REXX program that can be used to calculate the TOD clock of a token that is used by DB2.

Example A-3 Sample REXX CONVTOD

```
/*********  REXX ***************************************************************/
/*  Ask the conversion of TOD   time   Clock = FFFFFFFF FFFFF000              */
/*INVOCATION VAR = Convertod(clock)                                           */
/*  OUTPUT  :      DAYTIME AS JULIAN,HH:MM:SS.MICROSECS                       */
/*                 MyTodA : B8C4D80EE15A2E81                                  */
/*       B8C4D80EE15A2E81 = 03002,09:40:47.274402                             */
/*       B88FF0718831F301 = 02325,07:47:40.902175                             */
/*****************************************************************************/
/*                                            B.BILLY Jan 2003               */
/*****************************************************************************/
 ANSWER_OK=0                       /* INIT                                   */
 typeX = 0
/*************************************/
/* mytoda = "b8c4d80e e15a2e81"x      */
/* mytodb = "b88ff071 8831f301"x      */
/* say "MyTodA :"c2x(mytoda)          */
/* say "MyTodb :"c2x(mytodb)          */
/* todA = convertod(mytoda)           */
/* todb = convertod(mytodb)           */
/* say "ToA convert ="toda            */
/* say "ToB convert ="todb            */
/*************************************/
    DO WHILE (ANSWER_OK <> 1)        /* GET VALID ANSWER   */
       SAY 'TOD Clock Conversion - Enter the time in 12 to 16 '!!,
           'digits , or END'
       PULL ANSWER .
       typeX = datatype(answer,'X')
```

```
       a_le = length(answer)
       select
          when answer = "END" then call ending
          when typeX <> 1 then nop
          when (typeX=1 & a_le=12) then do
             answer = overlay('0000',answer,13,4)
             answer_ok=1
             end
          when (typeX=1 & a_le=13) then do
             answer = overlay('000',answer,14,3)
             answer_ok=1
             end
          when (typeX=1 & a_le=14) then do
             answer = overlay('00',answer,15,2)
             answer_ok=1
             end
          when (typeX=1 & a_le=15) then do
             answer = overlay('0',answer,16,1)
             answer_ok=1
             end
          when (typeX=1 & a_le=16) then do
             answer_ok=1
             end
          otherwise
       end
       if answer_ok = 1 then do
          an1 = x2c(answer)
          tod = convertod(an1)
          say "TOD value of "answer"  = "TOD
          say "-----------------------------------------------------"
       end
       answer_ok = 0
    end
 exit
/*****************************************/
Ending:
  Say "Thanks to use the TOD Clock Rexx ."
  EXIT
/*****************************************/
/************** REXX ***************************************************/
/*CONVERT TOD TO JULIAN AND TIME       tod = ffffffff ffffffff bit51 /micsec  */
/*INVOCATION VAR = CONVERTOD(TODVAR)         FFFFFFFF FFFFF000                */
/*INPUT TOD                 OUTPUT DAYTIME AS JULIAN,HH:MM:SS.MICROSECS       */
/*                MyTodA : B8C4D80EE15A2E81                                   */
/*      convertod(mytoda) : 03002,09:40:47.274402                             */
/*  B8C4D80EE15A2E81 = 02/01/2003 09:40:47.274402                             */
/*****************************************************************************/
CONVERTOD:
   TOD=ARG(1)
   NUMERIC DIGITS 16
```

```
 LTDM = C2X(TOD)
 LTDM = SUBSTR(LTDM,1,13) /* GET MICROSECS */
 LTDM=X2D(LTDM)
 REM=LTDM//86400000000 /* DISCARD WHOLE DAY PERIODS  */
 HH=REM%3600000000     /* REMAINING HOURS INTO THIS DAY */
 REM=REM//3600000000   /* DISCARD WHOLE HOURS  */
 MM=REM%60000000       /* REMAINING MINUTES INTO THIS HOUR */
 REM=REM//60000000     /* DISCARD WHOLE MINUTES */
 SS=REM%1000000        /* REMAINING SECONDS INTO THIS MINUTE */
 UU=REM//1000000       /* REMAINING MICROSECONDS INTO THIS SECOND */
 TIMH=RIGHT(HH,2,0)            /* SET HOUR AND MARK IT VALID*/
 TIMM=RIGHT(MM,2,0)            /* SET MINUTES AND MARK IT VALID*/
 TIMS=RIGHT(SS,2,0)            /* SET SECONDS AND MARK IT VALID*/
 TIMU=RIGHT(UU,6,0)            /* SET MICROSEC AND MARK IT VALID*/
IF LTDM<126144000000000 THEN /*PRIOR TO YEAR 4*/
  Y4=0 /* WITHIN FIRST 4-YEAR PERIOD OF CENTURY (NO LEAP YEAR)*/
ELSE DO
  LTDM=LTDM+86400000000 /*ADJUST FOR CENTURY NON-LEAP YEAR */
  Y4=LTDM%126230400000000 /*COUNT 4-YEAR PERIODS FROM 01/01/00*/
  Y4=Y4*4            /* ELAPSED YEARS FROM YEAR 00 TO CURRENT */
  LTDM=LTDM//126230400000000 /*REMAINING MICRO SEC IN THIS PERIOD*/
 END
DAYS=LTDM%86400000000 /* ELAPSED DAYS INTO THIS PERIOD */
SELECT
  WHEN (Y4>0)&(DAYS>=366) THEN DO/* PAST LEAP YEAR IN NORMAL 4-YRS*/
    DAYS=DAYS-1         /* ADJUST FOR LEAP YEAR   */
    YEARS=DAYS%365+Y4  /* ELAPSED YEARS */
    DAYS=DAYS//365+1 /*1ST DAY IS 1 NOT 0 */
   END
  WHEN (Y4>0)&(DAYS<366) THEN DO/*IN LEAP YEAR OF NORMAL 4-YR PERIOD*/
    DAYS=DAYS+1
    YEARS=Y4
   END
 END
JJDY=RIGHT(YEARS,2,0)
JJDD=RIGHT(DAYS,3,0)
    DAYTIME = JJDY!!JJDD','TIMH':'TIMM':'TIMS'.'TIMU ". JJDDD date. GMT time"
RETURN DAYTIME
/*********************************************************************/
```

Related publications

The publications listed in this section are considered particularly suitable for a more detailed discussion of the topics covered in this book.

IBM Redbooks

The following IBM Redbooks publications provide additional information about the topic in this document. Note that some publications referenced in this list might be available in softcopy only.

- *DB2 UDB for z/OS V8: Through the Looking Glass and What SAP Found There*, SG24-7088
- *DB2 UDB for z/OS Version 8 Technical Preview*, SG24-6871
- *Mainstar MS/VCR The Tool for Efficient Device Cloning*, SG24-6860
- *IBM z/OS V2.1 DFSMS Technical Update*, SG24-8190
- *IBM z/OS DFSMShsm Primer*, SG24-5272

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ibm.com/redbooks

Other publications

These publications are also relevant as further information sources:

- *DFMSdfp Storage Administration Reference*, SC26-7402
- *DFSMSdss Storage Administration Guide*, SC35-0423
- *z/OS DFSMShsm Storage Administration Guide*, SC35-0421
- *DFSMS Advanced Copy Services*, SC35-0428
- *DFSMS Implementing System-Managed Storage*, SC26-7407
- *DFSMShsm Implementation and Customization Guide*, SC35-0418
- *DFSMShsm Managing Your Own Data*, SC35-0420
- *z/OS Distributed File Service zFS Administration*, SC24-5989
- *z/OS Distributed File Service zSeries File System Implementation*, SG24-6580
- *z/OS MVS System Management Facilities (SMF)*, SA22-7630
- *DFSMShsm Diagnosis Guide,* LY35-0114
- *DFSMShsm Diagnosis Reference,* LY35-0115

Online resources

These websites are also relevant as further information sources:

- z/OS Internet library:

  http://www-03.ibm.com/systems/z/os/zos/library/bkserv/

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