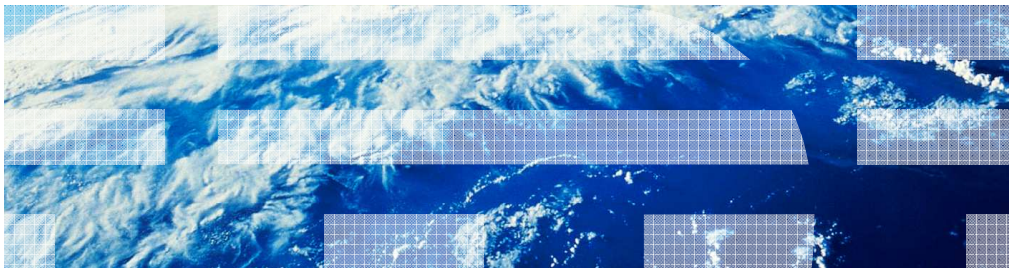


# z/OS Operating System

## DFSMSHsm fast reverse restore overview



Systems and servers

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This education topic provides a high-level overview of the DFSMSHsm fast reverse restore support in System z® (z/OS®).

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This presentation will begin with an overview of the DFSMSHsm fast replication function using FlashCopy. It then describes the fast reverse restore enhancement and how it can be used to recover point-in-time disk backup copies. The presentation will conclude with a list of publication references.

## Fast replication overview (1 of 4)

- DFSMSHsm invokes volume-level fast replication to create backup versions for sets of volumes
  - Backup hundreds of volumes in a matter of minutes
  - DFSMSHsm manages copying the disk copies to tape
  - Combined with DB2® BACKUP SYSTEM utility, provides non-disruptive backup and recovery to any point in time for DB2 databases and subsystems (SAP)
- Generic term of “fast replication”
  - Multiple Point-in-Time copy functions supported by DFSMSDss
  - FlashCopy (any vendor disk that supports FlashCopy interface)
  - SnapShot
- Recovery can be performed for the entire volume set, individual volumes, or individual data sets

DFSMSHsm invokes volume-level fast replication to create point-in-time backup versions for sets of volumes. This enables DFSMSHsm to backup hundreds of volumes in a matter of minutes. DFSMSHsm can also create tape copies from the disk copies that are generated. DFSMSHsm manages both the disk and tape copies. This solution was developed jointly with DB2 and is an integral part of the DB2 BACKUP SYSTEM utility.

The generic term ‘fast replication’ is used to indicate that DFSMSHsm supports any point-in-time backup copy technique supported by DFSMSDss. Today, DFSMSHsm supports FlashCopy and SnapShot. This means that this function can be used on any vendor disk that supports the FlashCopy interface.

Besides being able to recover the entire set of volumes that was backed up, DFSMSHsm can also recover individual volumes and even individual data sets.

## Fast replication overview (2 of 4)

- When FlashCopy is used, the following options are supported:
  - Copy mode
    - Physical background copy is performed
  - NOCOPY mode
    - Only changed tracks on source are copied to target volume
    - Target volume is used as a cache to create a dump copy
    - Flash back was not supported before V1R12
  - Incremental FlashCopy
    - Initial copy initiates background copy and copies the entire volume including free space
    - Subsequent increment only copies the tracks that changed since the last incremental copy was created

DFSMSHsm supports several FlashCopy options: Copy, NOCOPY, Incremental FlashCopy, Preserve Mirror operation, and space efficient (SE) FlashCopy.

Full copy, which is the default, copies tracks from the source volume to the target volume. Physical background copy is performed after source to target FlashCopy relationship has been established. When the copy is complete, the target volume will be identical to the source volume, except for the volser. The volser remains unchanged so that the target volume can remain online. This option requires a minimum of one dedicated target volume for each source volume.

When the NOCOPY option is used, there is no background copy performed by the storage controller. Only tracks that are updated on the source are copied to the target volume. The NOCOPY option enables the target volumes to serve as a cache from which a tape copy of the point-in-time disk copy can be created. Before V1R12, DFSMSHsm did not support disk recovery when the NOCOPY option was used. This option does not require a dedicated target volume for each source volume.

The Incremental option reduces the amount of time required to create the background copy. With the Incremental option, the storage controller keeps track of which source tracks were updated since the last incremental copy. When a new copy is created, only the tracks that changed are copied in the background. This option requires one dedicated target volume for each source volume.

## Fast replication overview (3 of 4)

- When FlashCopy is used, the following options are supported (*continued*):
  - Preserve Mirror operation (also known as Remote Pair FlashCopy)
    - When FlashCopy is issued on the local Metro Mirror site, an inband FlashCopy command is generated to trigger a FlashCopy operation on the remote site, therefore, maintaining the Metro Mirror pair in a full-duplex state
    - Specify Preserve Mirror preference for the copy pool as one of the following options:
      - PR – Preserve Mirror Required,
      - PP – Preserve Mirror Preferred,
      - PN – Preserve Mirror No. **Allow FlashCopy to PPRC Primary**, but Preserve Mirror is not desired, or
      - NO - FlashCopy to PPRC Primary not allowed (*default*)

When the Preserve Mirror Required or Preferred option is used, an inband FlashCopy command is generated to trigger a FlashCopy operation on the Metro Mirror remote site, therefore maintaining the Metro Mirror pair in a full-duplex state when the Preserve Mirror configuration requirements are met.

“Preserve Mirror Required” specifies when the Preserve Mirror Configuration requirements are not met, FlashCopy should not be used. “Preserve Mirror Preferred” specifies when the Preserve Mirror Configuration requirements are not met, FlashCopy to PPRC primary volumes should still be allowed and the PPRC pair may go into a duplex-pending state. “Preserve Mirror No” specifies FlashCopy to PPRC primary volumes is allowed, but Preserve Mirror operation is not desired. “NO” means FlashCopy to PPRC primary volumes is not allowed. The default is “NO”. The Preserve Mirror option can be specified for the copy pool on the FRBACKUP command in V1R9 and V1R10, and in the DFSMS copy pool construct on V1R11 and later.

## Fast replication overview (4 of 4)

- When FlashCopy is used, the following options are supported (*continued*):
  - Space Efficient FlashCopy (V1R9 OA30816)
    - Requires DS8000® FlashCopy SE licensed feature installed
    - Full-volume level
    - NOCOPY mode only
    - Flash back was not supported before V1R12

A space efficient (SE) volume is a logical volume that does not consume physical space until writes take place. Space efficient volumes can only be created when the FlashCopy SE licensed feature is installed on the DS8000. Space efficient volumes are seen by servers just like normal volumes.

Space efficient FlashCopy refers to a FlashCopy relationship for which the target volume is a space efficient volume. With space efficient FlashCopy, the amount of physical space consumed by the target volume is limited to the minimum amount of space required to maintain the copy. Space efficient FlashCopy is supported at full-volume level (including free space), in NOCOPY mode only, and cannot be used in combination with the Preserve Mirror operation. Before V1R12, DFSMSHsm did not support disk recovery from a space efficient volume.

## Introduction to fast reverse restore (1 of 2)

- Before V1R12
  - Disk recovery could not be performed until the physical background copy was complete
  - Disk recovery from a NOCOPY version was not supported
  - Disk recovery from a space efficient backup version was not supported
- V1R12 fast reverse restore
  - Exploits DS8000 fast reverse restore function
  - Requires minimal DS8000 LMC level
  - Enables DFSMSHsm to flash back for recovery even though the physical background copy has not completed
  - Enables fast replication disk recovery from a NOCOPY version
  - Enables fast replication disk recovery from a space efficient backup version
  - Reduces fast replication recovery time

FlashCopy is a two-phase backup. The first phase is the initialization phase where the storage controller establishes a source-to-target relationship. After the initialization completes, control is returned to the initiator. Updates to the source volume can begin immediately. The second phase is the copy phase where the storage controller performs a background copy of the tracks from the source to the target volume. If a track on the source volume is updated before that track has been copied to the target, then storage controller will immediately copy that track to the target volume before actually writing the update to the track. NOCOPY option only copy the tracks that are updated on the source volume.

Before V1R12, disk recovery could not be performed until the physical background copy has completed. Disk recovery from a NOCOPY version or space efficient version was also not supported. A NOCOPY disk version was created for the purpose of dumping to tape. DFSMSHsm would withdraw the disk version automatically after the tape version has been created successfully. Recovery from a NOCOPY version must be performed from a dump tape version.

In V1R12, DFSMSHsm exploits the Fast Reverse Restore function of the IBM System Storage® DS8000 series and allows recovery to be performed from an existing FlashCopy target volume to its source volume without having to wait for the background copy to finish. In a DFSMSHsm NOCOPY environment enabled for fast reverse restore, the DASD backup version can be kept until explicitly withdrawn, deleted, or when a new version is created. Disk recovery from a NOCOPY version is performed using the fast reverse restore function.

To use fast reverse restore, ensure the following **minimum** Licensed Machine Code (LMC) is installed on the DS8000 series storage server:

<b>If your LMC version is...</b>	<b>Then the required minimum LMC level is...</b>
5.3.1.xx	5.3.1.450
5.4.21.xx	5.4.21.540
5.4.30.xx	5.4.30.253
6.5.0.xx	6.5.0.220

## Introduction to fast reverse restore (2 of 2)

- Restrictions
  - Since the background copy does not complete, the backup version is invalidated and backup volumes are initialized as part of the recovery
  - Only supported for recovery of an entire copy pool
  - Source volumes cannot be in any other FlashCopy relationships
    - Fast reverse restore fails when existing FlashCopy source has multiple FlashCopy targets
  - Not supported in combination with Preserve Mirror operation
  - Other FlashCopy restrictions remain
- Resume after failure
  - If one or more volumes fail, similar to recovery from tape, just reissue the command and only the set of previously failed volumes is retried

Fast reverse restore provides the capability to 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. Once a fast reverse restore has completed, the contents of the backup volume (the original FlashCopy target) become invalid. DFSMSHsm automatically initializes the backup volume following successful fast reverse restore of the volume and invalidates the copy pool backup version following successful recovery of the entire copy pool.

DFSMSHsm supports fast reverse restore of a copy pool in both COPY and NOCOPY modes. However, fast reverse restore cannot be used in combination with the Preserve Mirror operation. Fast reverse restore is not supported for individual volume or data set level recoveries. If any source volumes have multiple FlashCopy targets, the additional targets must be removed before attempting fast reverse restore. You can use the DFSMSHsm QUERY COPYPOOL(cpname) command to determine the FlashCopy state of your fast replication volumes before attempting fast reverse restore.

If one or more volumes within the copy pool failed, similar to recovery from tape, just reissue the command and only the set of previously failed volumes is retried.



## Using fast reverse restore (1 of 4)

- New SMS copy pool setting for “Allow Fast Reverse Restore Y/N”
  - Yes indicates that it is acceptable to recover a version before the background copy is complete and for the backup version to become invalidated

```

COPY POOL DEFINE                               Page 2 of 5
Command ==>

SCDS Name . . : DFSMS.FRSMS.SCDS
Copy Pool Name : CP1

To DEFINE Copy Pool, Specify:
  Catalog Name ==>
                ==>
                ==>
                ==>
                ==>
                ==>
                ==>
                ==>
                ==>
                ==>

Capture Catalog Information for Data Set Recovery . . . N (R, P or N)
Allow Fast Reverse Restore . . . . . Y (Y or N)
  
```

You can specify whether fast reverse restore is allowed by changing the value in the **Allow Fast Reverse Restore** field in the SMS copy pool construct. If you enter Y (yes), recovery of a FlashCopy source from the FlashCopy target can occur without waiting for the background copy to complete. Entering N (no) disables fast reverse restore and requires you to wait for the original FlashCopy operation to complete before starting recovery, this is the default.

## Using fast reverse restore (2 of 4)

- The copy pool setting is stored for each backup version at the time of the backup
  - FRBACKUP CP(CP1)
- Recovery of the copy pool uses fast reverse restore if the backup version is fast reverse restore enabled and flash back is possible
  - FRRECOV CP(CP1)
  - Standard FlashCopy is used if fast reverse restore cannot be used
- Specify FORCE on the FRRECOV command if the disk copy is currently being dumped to tape
  - FRRECOV CP(CP1) FORCE
  - Incomplete dump volumes will be discarded and no further dumps will be created

The copy pool fast reverse restore setting is saved at the time of the fast replication backup. During fast replication recovery, the use of fast reverse restore is based on the disk backup version setting and the state of the current FlashCopy relationships. DFSMSHsm will use standard FlashCopy if the background copy has completed and the volume pair is no longer in a FlashCopy relationship.

If one or more volumes are recovered using fast reverse restore, the copy pool backup version will be invalidated.

Fast reverse restore will fail if any of the backup volumes are being dumped to tape. Specify FORCE on the FRRECOV command if you want to proceed with the recovery when the disk copy is currently being dumped to tape. Incomplete dump volumes will be discarded and no further dumps will be created.

## Using fast reverse restore (3 of 4)

- QUERY COPYPOOL(cpname) indicates percent complete
  - Determine if you should just wait for background copy to complete

```
ARC1820I THE FOLLOWING VOLUMES IN COPY POOL CP1, VERSION  
001, HAVE AN ACTIVE FLASHCOPY BACKGROUND COPY
```

ARC1820I (CONT.)	SGNAME	FR-PRIMARY	FR-BACKUP	PCT-COMP
ARC1820I (CONT.)	SGRP1	SRC01B	TGT01B	011
ARC1820I (CONT.)	SGRP1	SRC02B	TGT02B	009

Because fast reverse restore will invalidate the entire disk backup version following a successful recovery, you can use the percent-complete information to determine how far along the background copy is and decide whether fast reverse restore should be used for recovery. The example shows background copy from SRC01B to TGT01B is 11% complete, and background copy from SRC02B to TGT02B is 9% complete.

## Using fast reverse restore (4 of 4)

- LIST COPYPOOL output displays new information
  - New value for fast replication state of disk backup: Fast Reverse Restore incomplete
  - Backup version enabled for Fast Reverse Restore: Y/N
  - Recovery of the backup version (from disk or tape) is incomplete: Y/N

```

VERSION VTOCENQ  DATE          TIME          FASTREPLICATIONSTATE  DUMPSTATE
   001      Y    2010/02/05  16:55:17  FCFRRINCOMPLETE      ALLCOMPLETE

TOTAL NUM OF
VOLUMES=00007, INCREMENTAL=N, CATINFO=N, FCFRR=Y, RECOVERYINCOMPLETE=Y

```

- New LIST CP SELECT parameters to filter copy pool output
  - SELECT(FRSTATE(**FCFRRINCOMPLETE**))
  - SELECT(**INCOMPLETERECOVERY**)

The LIST COPYPOOL output has been updated with new information. A new fast replication state “FCFRRINCOMPLETE” has been added indicating fast reverse restore is incomplete for the disk backup version. New field “FCFRR=Y/N” indicates whether the copy pool backup version is allowed to use fast reverse restore. New field “RECOVERYINCOMPLETE=Y/N” indicates whether the recovery of the disk or tape backup version is incomplete.

New parameter FCFRRINCOMPLETE has been added to the SELECT(FRSTATE) keyword on the LIST COPYPOOL command. SELECT(FRSTATE) requests information about the FRBACKUP disk copy. FRSTATE(FCFRRINCOMPLETE) indicates that the copy pool has a disk version that was not completely recovered successfully using fast reverse restore. Some volumes have been recovered while other volumes have remained unrecovered. This state refers to recovery using fast reverse restore.

New parameter INCOMPLETERECOVERY is added to the SELECT keyword on the LIST COPYPOOL command. SELECT(INCOMPLETERECOVERY) requests information about copy pool FRBACKUP versions that have not been recovered completely. This refers to either disk recovery using fast reverse restore or recovery from tape.

## Publications

- *z/OS DFSMSHsm Storage Administration (SC35-0421)*
- *z/OS DFSMS Advanced Copy Services (SC35-0428)*
- *IEA – DFSMSHsm fast replication*

For additional information about DFSMSHsm fast replication, see the z/OS DFSMS Storage Administration (SC35-0421). For information about FlashCopy, see the z/OS DFSMS Advanced Copy Services (SC35-0428).

For an overview on DFSMSHsm fast replication, see the IBM Education Assistant presentation for DFSMSHsm fast replication.



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