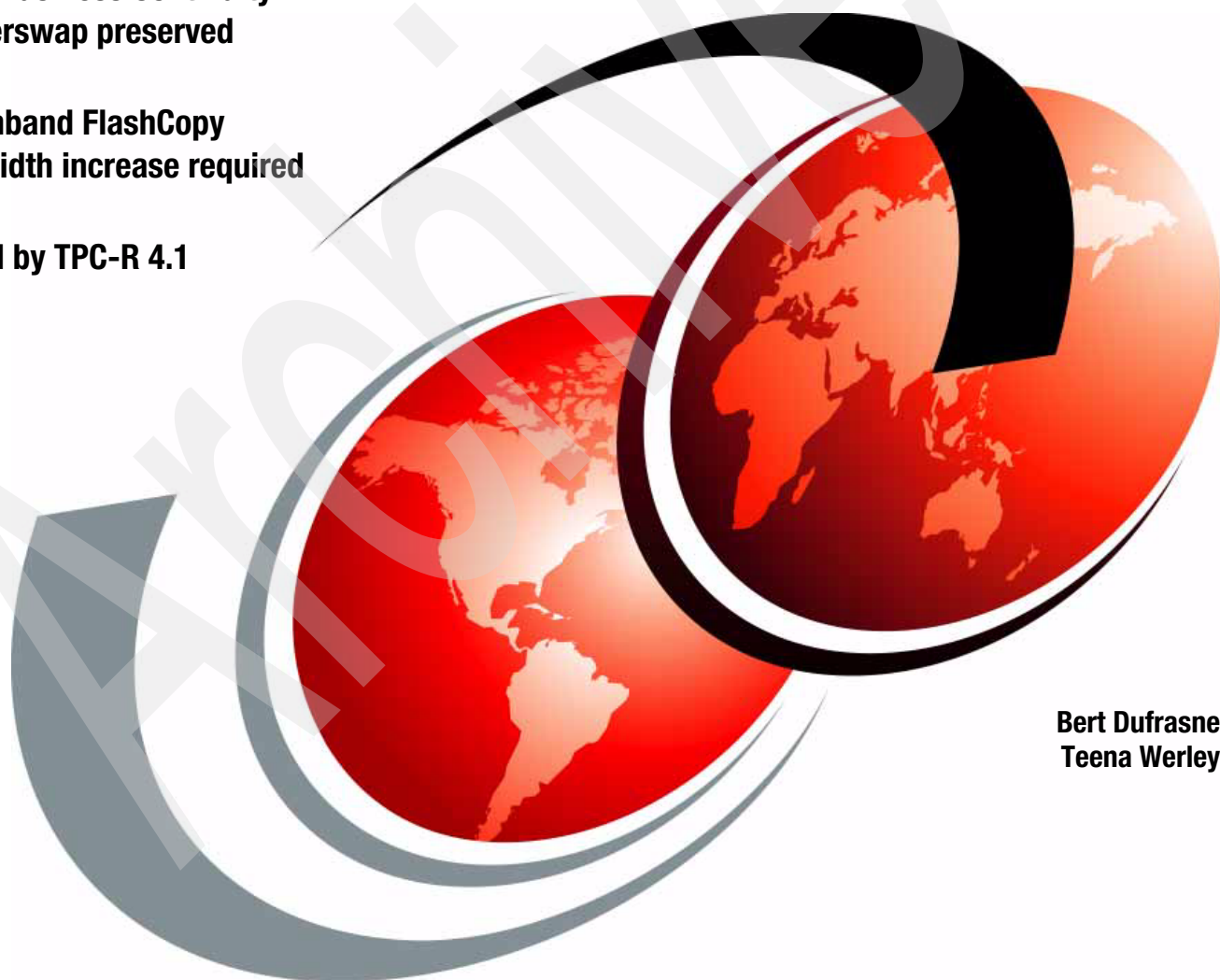


# IBM System Storage DS8000: Remote Pair FlashCopy (Preserve Mirror)

Improves Business Continuity  
z/OS Hyperswap preserved

Exploits inband FlashCopy  
No bandwidth increase required

Supported by TPC-R 4.1



Bert Dufrasne  
Teena Werley





International Technical Support Organization

**IBM System Storage DS8000: Remote Pair FlashCopy  
(Preserve Mirror)**

May 2009

Archived

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

#### **First Edition (May 2009)**

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# Preface

The IBM® DS8000® provides support for a new Copy Services function called Remote Pair FlashCopy®. In the z/OS® environment, this function is referred to as Preserve Mirror.

When a FlashCopy target device is also a Metro Mirror primary device, this function allows a the Metro Mirror pair to more quickly regain synchronization (duplex mode) when a FlashCopy occurs. The Remote Pair FlashCopy provides a solution for data replication, data migration, remote copy, and disaster recovery tasks. It is particularly useful for full volume FlashCopy and dataset level FlashCopy for z/OS.

This IBM Redpaper publication explains the mechanism and operations of the Remote Pair FlashCopy function. It also provides examples and illustrations of how to establish and then withdraw the Remote FlashCopy pair relationship.

## The team that wrote this paper

This IBM Redpaper publication was produced by a team of specialists from around the world working at the International Technical Support Organization, San Jose Center.

**Bert Dufrasne** is an IBM Certified Consulting I/T Specialist and Project Leader for System Storage™ disk products at the International Technical Support Organization, San Jose Center. He has worked at IBM in various I/T areas. Bert has written many IBM Redbooks® publications and has also developed and taught technical workshops. Before joining the ITSO, he worked for IBM Global Services as an Application Architect in retail, banking, telecommunications, and healthcare industries. He holds a Masters degree in Electrical Engineering from the Polytechnic Faculty of Mons (Belgium).

**Teena Werley** is a Staff Software Engineer for the DS8000 Systems Test team in Tucson, Arizona. She has been with IBM for five years as a member of both test and development teams for IBM Systems Storage products including ESS, DS8000, and DS6000™ models. Her responsibilities include testing DS8000 hardware and firmware, large DS8000 configuration and Copy Services, Open Systems and zSeries® attachment, and interoperability between IBM Systems Storage products. Teena holds dual Bachelor of Science degrees in Molecular and Cellular Biology and Computer Science from the University of Arizona.

Thanks to the following people for their contributions to this project:

John Bynum  
IBM US

Lisa Martinez, Robert Brown, Karl Arvizu, Chip Jarvis, Lisa Gundy, Gail Spear, Hank Sautter, Charlie Burger, Leann Vaterlaus, Jeffrey Suarez.  
IBM US

Nick Clayton  
IBM UK

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# Introducing Remote Pair Flashcopy

This chapter explains the concept of Remote Pair FlashCopy. This new IBM DS8000 Copy Services function is also available with z/OS V1.8, or later, using the name FlashCopy Preserve Mirror.

## 1.1 Overview of Remote Pair FlashCopy

An existing Metro Mirror source volume can be used as a FlashCopy target volume. This process allows you to create a point-in-time copy and then make a copy of that data at a remote site.

A Metro Mirror (MM) primary volume can become the target of a FlashCopy relationship. When this occurs, the corresponding Metro Mirror volume pairs go to duplex pending (also called copy pending) status as long as the FlashCopy data is being transferred to the Metro Mirror remote site. This behavior is illustrated in Figure 1-1. The time it takes to complete the copy of the FlashCopy data, until all remote mirror and copy volumes are synchronous again, depends on the amount of data to be transferred and the available bandwidth to the remote site. During this time, the remote site would be inconsistent if a disaster occurs. This inconsistent state can happen frequently when dataset level FlashCopy relationships are frequently established.

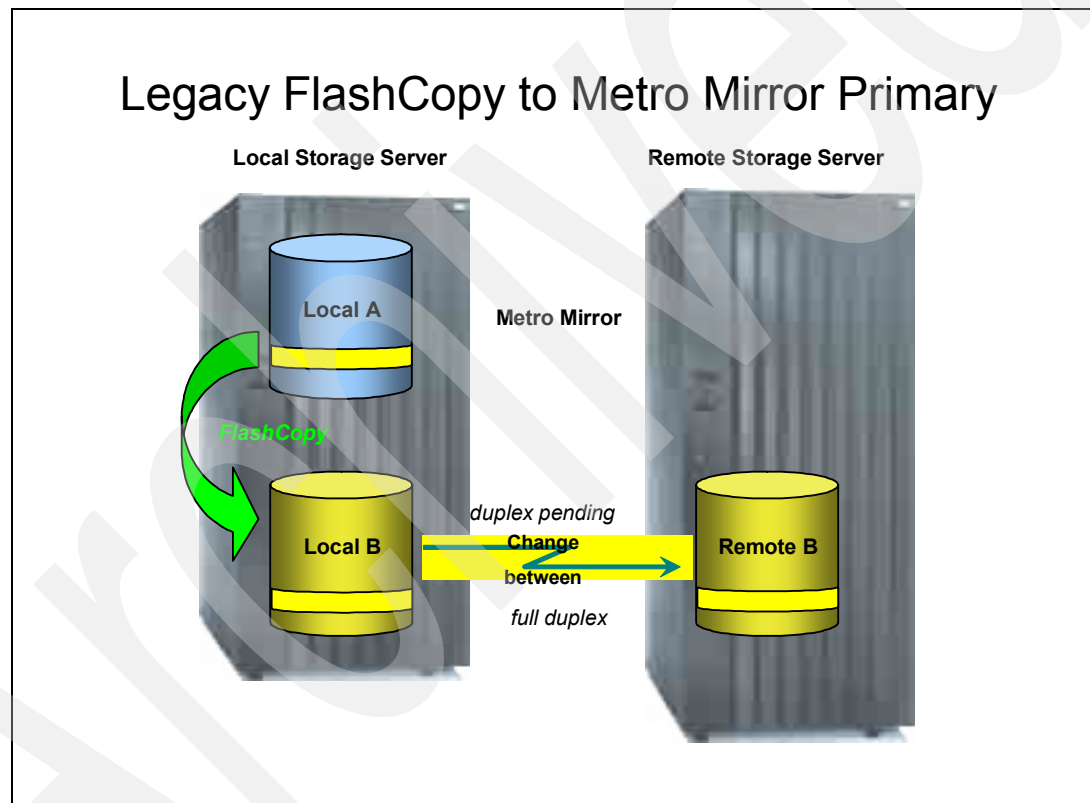


Figure 1-1 Legacy FlashCopy onto Metro Mirror Primary

To solve this problem, a new type of FlashCopy called *IBM Remote Pair FlashCopy* is now supported on IBM DS8000 (starting with LMC 5.4.25.xx).

With this new function, as shown in Figure 1-2, when data is FlashCopied from Local A to Local B, an equivalent operation is also performed from Remote A to Remote B at the remote site. Only the command, not the actual data, is sent from the Local to the Remote site, allowing the Metro Mirror relationship to remain in full duplex state.

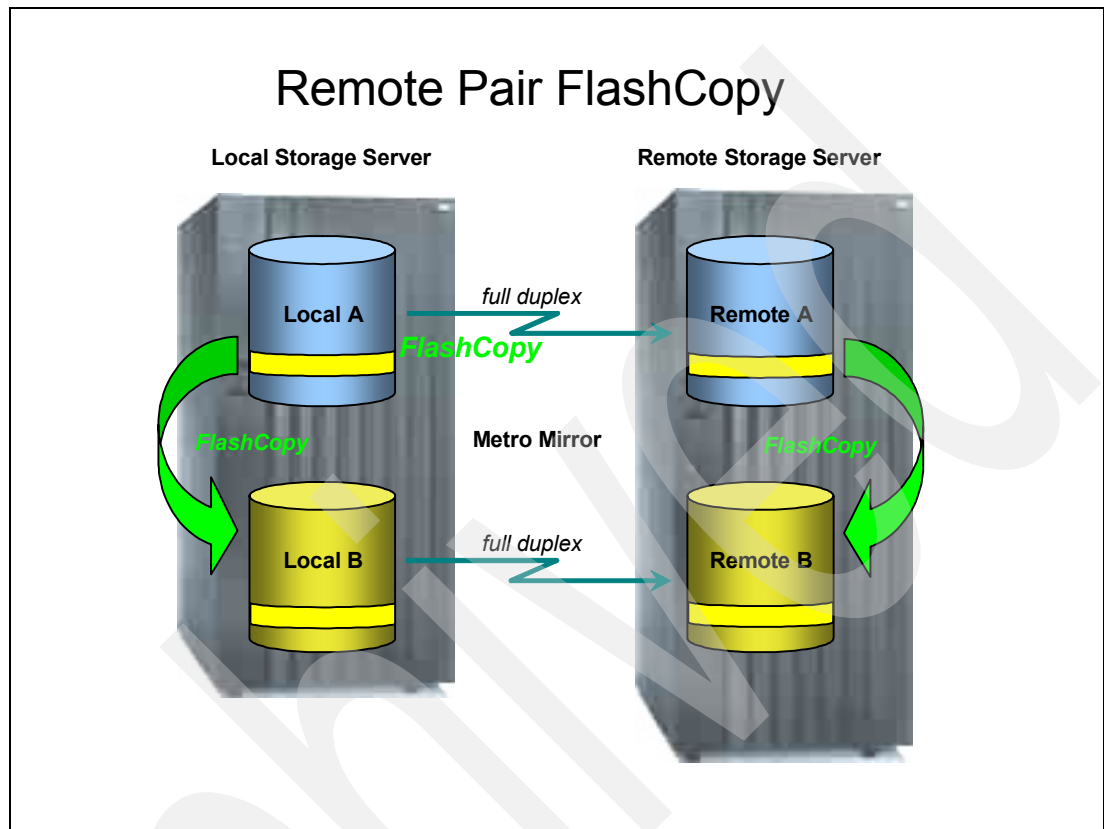


Figure 1-2 Remote Pair FlashCopy

To 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 inband FlashCopy command is generated to trigger a FlashCopy operation on the remote site rather than mirroring the data associated with the operation. In Figure 1-2, when a FlashCopy command is received to FlashCopy from Local A to Local B, a similar command is generated and sent to FlashCopy from Remote A to Remote B.

The following conditions are required to establish Remote Pair FlashCopy:

- ▶ Both the Local A / Remote A and the Local B / Remote B Metro Mirror pairs are in full duplex state.
- ▶ The Remote A and Remote B volumes are in the same Storage Facility Image (SFI).

## 1.2 Using Remote Pair FlashCopy

In the following sections we discuss the benefits, features, and restrictions of Remote Pair FlashCopy, as well as the support available.

## 1.2.1 Benefits of Remote Pair FlashCopy

Remote Pair FlashCopy is especially beneficial for business continuity in z/OS environments with continuous dataset operations.

Dataset operations such as copy, backup, defragmentation, and others happen throughout the day. With System Managed Storage (SMS), data could be placed anywhere on the volume without being manually managed by the user. This allows for increased disk space utilization. Any one volume can contain source datasets mixed in with FlashCopy target datasets for multiple other source volumes (backup, copy, migration, consolidation) or can include target datasets for the source datasets on the same volume such as for defragmentation operations.

To protect against site failure or storage failure, the data on these volumes can also be mirrored using Metro Mirror to a remote site.

It is often the case that most customers would mirror their local backup volumes that contain copies of production data. Because all local backup volumes are Metro Mirror primaries, when they perform their point in time copies using FlashCopy, at either a volume or dataset level, they utilize the FlashCopy onto Metro Mirror primary functionality.

Without Remote pair FC, the Metro Mirror pair goes into a duplex pending state while the tracks associated with the FlashCopy relationship were copied to the Metro Mirror secondary device. And this makes it impractical for many customers requiring continuous dataset FlashCopy operations throughout the day: The Metro Mirror pair goes into duplex pending (copy pending) state and the mirrored copy is inconsistent for much of the day. This also disables the hyperswap feature when any one pair goes duplex pending.

Remote Pair FlashCopy allows for continuous dataset FlashCopy operations while keeping the Metro Mirror pair full duplex and keeping the remote data consistent.

## 1.2.2 Features of Remote Pair FlashCopy

- ▶ Remote Pair FlashCopy operations are supported on both Count Key Data (CKD) and Fixed Block (FB) volumes.
- ▶ Remote Pair FlashCopy operations on CKD can be issued on both full volume or dataset level.
- ▶ Remote Pair FlashCopy maintains Metro Mirror full duplex to preserve hyperswap enabled state and for disaster recovery scenarios.
- ▶ No additional link bandwidth is needed because only the FlashCopy commands are sent to the remote site, not the data to be copied.
- ▶ Remote Pair FlashCopy can be used in combination with the following features:
  - Incremental FlashCopy (as long as the initial establish FlashCopy used Remote Pair FlashCopy)
  - FlashCopy options: copy, nocopy, or nocopy-to-copy
  - FlashCopy Consistency Groups
- ▶ The Geographically Dispersed Parallel Sysplex™ (GDPS®) supports the use of Remote Pair FlashCopy in a GDPS/PPRC or GDPS/HM environment.

### 1.2.3 Restrictions

The following options are not currently supported in conjunction with Remote Pair FlashCopy:

- ▶ Certain FlashCopy options are not supported with Remote Pair FlashCopy:
  - Commit is not supported.
  - Revert is not supported.
  - Fast Reverse Restore is not supported.
  - Local or remote targets cannot be Space Efficient volumes.
- ▶ Remote Pair FlashCopy onto a Global Mirror target is not supported.
- ▶ Remote Pair FlashCopy onto a Global Copy target is not supported.
- ▶ Remote Pair FlashCopy onto a z/OS Global Mirror target is not supported.
- ▶ Remote Pair FlashCopy in conjunction with cascading configurations has the following limitations:
  - Metro/Global Copy:

A Remote Pair FC is allowed with this configuration as long as the configuration requirements for the devices involved in the Metro Mirror relationships are met. The FlashCopy command would be executed from Local A to Local B, and an inband FlashCopy command would be issued to do the FlashCopy from Remote A to Remote B. The tracks in the relationship would then be copied from Remote B to its corresponding PPRC secondary device via the Global Copy copy mechanism.
  - Metro/Global Mirror:

Because the ability to FlashCopy to a primary device that is participating in a Global Mirror session is not allowed, any attempt to do a Remote pair FlashCopy (Preserve Mirror) Required operation would fail. This is because the inband FlashCopy operation would attempt to FlashCopy from Remote A to Remote B, and Remote B would be a PPRC primary that is in a Global Mirror session. In this case, it is necessary to use Preserve Mirror with Preferred or No.
- ▶ Existing copy services restrictions still apply (the remote target cannot be a source, local B cannot be a z/OS Global Mirror primary, and so on.)

### 1.2.4 Software support

Various Copy Services interfaces support the new Remote Pair FlashCopy function. Some interfaces use the term *Preserve Mirror*. Preserve Mirror is the z/OS Software function utilizing IBM's Remote Pair FlashCopy:

- ▶ TSO
- ▶ ICKDSF
- ▶ DFSMSdss
- ▶ ANTRQST
- ▶ ISMF panels for DSS and ICKDSF
- ▶ DFSMSHsm
- ▶ DS8000 DSCLI
- ▶ TPC for Replication 4.1

DFSMS honors the Remote Pair FlashCopy specification when selecting target volumes for logical data set operations.

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## Remote Pair FlashCopy implementation and usage

In this chapter we discuss in more detail the options to establish, monitor, and withdraw IBM Remote Pair FlashCopy.

For examples and illustrations, refer to:

- ▶ Chapter 3, “Using Remote Pair FlashCopy in open systems environments” on page 15
- ▶ Chapter 4, “Using Remote Pair FlashCopy in a z/OS environment” on page 21.

## 2.1 Terminology

We use the following terms to describe configuration details of Remote Pair FlashCopy:

<b>Local A</b>	The device at the local site that is the source of the FlashCopy relationship being requested.
<b>Local B</b>	The device at the local site that is the intended target of the FlashCopy relationship being requested. Local A and Local B can be the same device for a dataset level operation.
<b>Remote A</b>	When Local A is a Metro Mirror primary device, Remote A is the Metro Mirror secondary associated with Local A.
<b>Remote B</b>	When Local B is a Metro Mirror primary device, Remote B is the Metro Mirror secondary associated with Local B. Remote A and Remote B can be the same device for a dataset level operation.
<b>Mirrored FlashCopy relationship or Mirrored relation</b>	This is a FlashCopy relationship established as a Remote Pair FlashCopy operation.
<b>Preserve Mirror</b>	The software terminology used to describe the hardware Remote Pair FlashCopy function.
<b>Local Relationship</b>	The FlashCopy relationship established between Local A and Local B as part of a Remote Pair FlashCopy operation.
<b>Remote Relationship</b>	The FlashCopy relationship established between Remote A and Remote B as part of a Remote Pair FlashCopy operation.

## 2.2 Preparing for Remote Pair FlashCopy

Before Remote Pair FlashCopy can be established, the Metro Mirror relationship(s) between the Local A and B and Remote A and B pairs must be established and synchronized.

### 2.2.1 Creating Metro Mirror relationships

Metro Mirror (previously known as synchronous Peer-to-Peer Remote Copy or PPRC) provides real-time mirroring of logical volumes between two DS8000s that can be located up to 300 km from each other. It is a synchronous copy solution where write operations are completed on both copies (local and remote site) before they are considered to be complete. Metro Mirror is typically used for applications that cannot suffer any data loss in the event of a failure.

Metro Mirror relationships must be established between the local and remote devices in order for Remote Pair FlashCopy to work. This entails planning which devices on both the local and remote sites are to be included, establishing Metro Mirror paths and pairs between the local and remote sites, and allowing time for the relationships to become full duplex. After the Metro Mirror relationships are in full duplex, Remote Pair FlashCopy can be established.

As a reminder, the volumes states can be:

<b>Simplex</b>	The initial state of a volume. A volume pair relationship has not been established between the source and target volumes or a remote mirror and copy relationship has been withdrawn.
----------------	---

<b>Pending</b>	The initial state of a defined volume pair. The remote mirror and copy feature is in the process of copying data from the source volume to the target volume. During the pending period, the volume pair is not synchronized.
<b>Duplex</b>	The state of a volume pair after remote mirror and copy has completed the copy operation of the source volume to the target volume. At this time, the volume pair is synchronized, and all writes have been applied from the source to target volume.
<b>Suspended</b>	The state of the volume pair when the source storage unit cannot complete a write operation to the target storage unit or when the volume pair has been suspended manually.

## 2.2.2 References for Metro Mirror

For more information on how to set up Metro Mirror, refer to one of the following publications:

- ▶ *IBM System Storage DS8000: Copy Services in Open Environments*, SG24-6788
- ▶ *IBM System Storage DS8000: Copy Services with IBM System z*, SG24-6787

## 2.3 Remote Pair FlashCopy establish

This section describes the requirements, options, and error handling when establishing a Remote Pair FlashCopy.

### 2.3.1 Remote Pair FlashCopy requirements

The following configuration requirements must be met before Remote Pair FlashCopy can be established:

- ▶ Both Local A and Local B must be Metro Mirror primary devices in full duplex mode with links established and available.
- ▶ Remote A and Remote B must reside in the same DS8000 Storage Facility Image (SFI).
- ▶ The required microcode level (5.4.25.xx) must be installed in both the local and the remote storage control units.

### 2.3.2 Remote Pair FlashCopy establish options

The FlashCopy establish command has three (new) options that specifies how the Remote Pair FlashCopy copy should be performed:

- Required** Indicates that the installation *cannot* tolerate their Metro Mirror pairs going into a duplex pending state while the Remote B device is being updated with the tracks to be copied. If the Local A device is a Metro Mirror primary device, all configuration requirements for a Remote Pair FlashCopy operation *must* be met so that the FlashCopy command can be mirrored at the remote site, otherwise the request fails. If the Local B device is not a Metro Mirror primary device, then Remote Pair FlashCopy is ignored and the FlashCopy proceeds normally from Local A to B only.

- Preferred** Indicates that the installation *can* tolerate their Metro Mirror pairs going into a duplex pending state while the Remote B device is being updated with the tracks to be copied, but the preference is not to go into duplex pending. If the Local B device specified is a Metro Mirror primary device, and all configuration requirements for a Remote Pair FlashCopy operation are met, the FlashCopy command should be mirrored at the remote site. If the Local B device specified is a Metro Mirror primary device and all configuration requirements for a Remote Pair FlashCopy operation are *not* met, then the legacy function is used. The pair then goes into a duplex pending state while the secondary device is updated. If the Local B device is not a Metro Mirror primary device, then Remote Pair FlashCopy is ignored and the FlashCopy proceeds normally from Local A to B only.
- No** Indicates that a Remote Pair FlashCopy operation should not be done, even if all of the configuration requirements for a Remote Pair FlashCopy operation are met. If the Local B device is a Metro Mirror primary device, then the legacy function is used. The pair then goes into a duplex pending state while the secondary is updated with the tracks to be copied. This option is the default.

**Note:** The *FlashCopy to a PPRC Primary OK* keyword must be specified when the Remote Pair FlashCopy required or preferred option is used. The keyword differs depending on the interface used to establish FlashCopy.

**Note:** If Remote Pair FlashCopy is used in combination with incremental FlashCopy, the use of Preferred or Required when issuing a resync needs to be consistent with the existing relationship. If the existing incremental relationship was established without Remote Pair FlashCopy, a resync cannot be issued with Remote Pair FlashCopy Required, because the remote relationship would not exist.

### 2.3.3 Remote Pair FlashCopy establish error handling

If the Remote Pair FlashCopy establish command completes successfully at the local site but, for some reason, fails to mirror the command at the remote site, the Metro Mirror pair would no longer be considered duplex. Depending on the FlashCopy option used, the Metro Mirror pair state changes as follows:

- Required** Local B / Remote B Metro Mirror pair suspends.
- Preferred** Local B / Remote B Metro Mirror pair goes duplex pending.

Table 2-1 summarizes the behavior of Remote Pair FlashCopy (either as Required or Preferred), for different combinations of the Remote Mirror (Local B / Remote B) pair status

Table 2-1 Remote Pair FlashCopy behavior

Source	Target	Situation	Required	Preferred
Duplex	Duplex	Normal	Remote Pair FC is performed	Remote Pair FC is performed
Duplex	Duplex	Problem with Remote FC detected early	FC failed	Target device duplex pending
Duplex	Duplex	Problem with remote FC detected late	Target device suspends	Target device duplex pending
Suspended	Suspended	Any	FC failed	Set target device Out-Of-Sync (OOS) bitmap
Pending	Pending	Any	FC failed	Set target device OOS bitmap
Duplex	Suspended / Pending	Any	FC failed	Set target device OOS bitmap
Suspended / Pending	Duplex	Any	FC failed	Target device duplex pending
Any	Simplex	Any	FC issued locally	FC issued locally
Simplex	Duplex	Any	FC failed	Target device duplex pending
Simplex	Suspended / Pending	Any	FC failed	Set target device OOS bitmap

## 2.4 Remote Pair FlashCopy Withdraw

When a Remote Pair FlashCopy operation has begun, there is no guarantee that the local and remote DS8000s would perform the background copy for their respective relationships at the same pace. Therefore, a withdraw of the FlashCopy relationship, as might be issued by the host, introduces a situation where Local B and Remote B are not identical, even though the Metro Mirror pair is full duplex.

There are two methods to withdraw Remote Pair FlashCopy relationships. The relationships can be withdrawn after a background copy completes that maintains the Metro Mirror full duplex state, or the relationships can be forced to withdraw immediately.

### 2.4.1 Withdraw with Background Copy

To ensure identical Local B and Remote B data, the local and remote relationships should be terminated only after all source data is copied (destaged) to the target volumes. This can be achieved by a *Start Background Copy and Terminate Withdraw* operation performed on both local and remote relationships. After the background copy is completed, the Metro Mirror primary and secondary volumes would be physically identical.

The following rules apply to Withdraw with Background Copy:

- ▶ FlashCopy Withdraw of a mirrored relationship established with Remote Pair FlashCopy Required or Remote Pair FlashCopy Preferred, without the force indicator, issued to either Local A or Local B, results in a background copy being initiated for both the local and the remote relationships. If the relationship is persistent, the relationship is withdrawn after the background copy completes.
- ▶ Start background copy issued to Local A starts a background copy for both the local and the remote relationships.
- ▶ Start background copy issued to Remote A starts a background copy for the remote relationship only.
- ▶ FlashCopy Withdraw without start Background Copy or Terminate All issued to Remote A is rejected if the background copy has not completed.
- ▶ FlashCopy Withdraw with Terminate All issued to Remote B is rejected if the background copy has not completed.
- ▶ FlashCopy Withdraw with Terminate All (z/OS only), also known as the Deleted Data Space Withdraw (DDSW) option, when issued to the remote FlashCopy source (Remote A), starts a background copy for the remote relationship only.

**Note:** If FlashCopy relationship is established as a Mirrored Relationship, and the Local B to Remote B Metro Mirror relationship is deleted prior to a FlashCopy Withdraw request, then the relationship is no longer treated as a Mirrored Relation, so normal Withdraw processing applies.

## 2.4.2 Force FlashCopy Withdraw

Background Copy on Withdraw might not be suitable for all situations. For example, if another FlashCopy Establish is issued before the previously established relationships finish the background copy, the new FlashCopy operation would fail.

In that scenario, a new *force* option has been added to FlashCopy Withdraw that causes a mirrored relationship to be withdrawn immediately at both the local and the remote sites.

When the *force* option is used, an indicator is set for the target Metro Mirror pair, stating that there might be tracks that are not identical even though the pair is full duplex.

**Note:** When a Remote Pair FlashCopy relationship is withdrawn with the *force* option, it can leave the tracks involved in the relationship in a non-mirrored state between the primary and secondary. However, the data on those tracks is not considered valid by the host, so the Metro Mirror pair is still considered full duplex.

### 2.4.3 FlashCopy Withdraw interface differences

Default handling behavior for FlashCopy Withdraw is different depending on the interface used:

- ▶ ICKDSF:
  - The default initiates Background Copy on withdraw.
  - FORCE option exists.
- ▶ TSO / DFSMSdss / ANTRQST:
  - Force is the default with no other option.
- ▶ DSCSI:
  - No force option
  - The default behavior fails the withdraw.
  - Requires **-cprm** option to initiate Background Copy.

## 2.5 Querying Metro Mirror state

Remote Pair FlashCopy operations can impact the state of the Metro Mirror pair:

- ▶ If a force withdraw is issued against a Remote Pair FlashCopy pair, the Metro Mirror pair still shows as full duplex, but there is also an indication that the pair was a target of a Remote Pair FlashCopy Withdraw.
- ▶ If a Remote Pair FlashCopy Establish Required failed at the remote, the Metro Mirror pair suspends. The Metro Mirror query indicates reason for the suspension is Remote Pair FlashCopy.

Archived



## Using Remote Pair FlashCopy in open systems environments

In this chapter, we illustrate Remote Pair FlashCopy for open systems environments. We provide details about changes that were made to the DSCLI, DSGUI, and TPC-R interfaces to support Remote Pair FlashCopy.

If you are working in a z/OS mainframe environment, refer to Chapter 4, “Using Remote Pair FlashCopy in a z/OS environment” on page 21

## 3.1 DSCLI

DSCLI has been updated to support the new Remote Pair FlashCopy function for full volume FlashCopy operations. These operations can be performed on both FB volumes for open systems or for CKD volumes on z/OS systems.

### 3.1.1 Establish Remote Pair FlashCopy using DSCLI

To establish Remote Pair FlashCopy using DSCLI, use the command **mkflash -tgtpprc** with the new parameter **-pmir**. The **-tgtpprc** parameter must be included (Example 3-1).

The **-pmir** parameter has three options:

`[-pmir no|required|preferred]`

A detailed description of each option is described in 2.3.2, “Remote Pair FlashCopy establish options” on page 9.

*Example 3-1 Establish Remote Pair FlashCopy with DSCLI*

```
dsccli> mkflash -tgtpprc -pmir required c000:c040
Date/Time: March 19, 2009 10:44:39 AM MST IBM DSCLI Version: 5.4.2.296 DS: IBM.2107-1301411
CMUC00137I mkflash: FlashCopy pair C000:C040 successfully created.
```

### 3.1.2 Query Remote Pair FlashCopy Using DSCLI

The **lsflash** command output has been updated with an additional column that shows the type of Remote Pair FlashCopy (Preserve Mirror) established on the pair (Example 3-2).

*Example 3-2 DSCLI lsflash showing Remote Pair FlashCopy (Preserve Mirror) status on local pair*

```
dsccli> lsflash -fmt delim c000:c040
Date/Time: March 19, 2009 10:47:14 AM MST IBM DSCLI Version: 5.4.2.296 DS: IBM.2107-1301411
ID,SrcLSS,SequenceNum,Timeout,ActiveCopy,Recording,Persistent,Revertible,SourceWriteEnabled,TargetWriteEnabled,BackgroundCopy,Pmir
=====
C000:C040,C0,0,120,Enabled,Disabled,Disabled,Disabled,Enabled,Enabled,Enabled,Required
```

The **lsremoteflash** command output has also been updated with the **Pmir** column (Example 3-3).

*Example 3-3 DSCLI lsremoteflash showing Remote Pair FlashCopy status on remote pair*

```
dsccli> lsremoteflash -conduit IBM.2107-1301411/c0 IBM.2107-75HT431/0000:IBM.2107-75HT431/0040
Date/Time: March 19, 2009 11:15:40 AM MST IBM DSCLI Version: 5.4.2.296 DS: IBM.2107-1301411
ID      SrcLSS SequenceNum ActiveCopy Recording Persistent Revertible SourceWriteEnabled TargetWriteEnabled BackgroundCopy Pmir
=====
0000:0040 00      0          Enabled  Disabled Disabled Disabled Enabled Enabled Enabled Enabled Remote
```

### 3.1.3 Withdraw Remote Pair FlashCopy using DSCLI

To withdraw Remote Pair FlashCopy, **rmflash** is used as you would normally on the local FlashCopy pair. The **rmflash** initiates the background copy on the local FlashCopy pair and withdraws the FlashCopy after the background copy completes. The **rmflash** command is also sent to the remote where the remote FlashCopy pair initiates the background copy and withdraws. There is not a force option to withdraw Remote Pair FlashCopy immediately with DSCLI (Example 3-4).

#### Example 3-4 Withdraw Remote Pair FlashCopy with DSClI

```
dsccli> rmflash c000:c040
Date/Time: March 19, 2009 10:44:12 AM MST IBM DSClI Version: 5.4.2.296 DS: IBM.2107-1301411
CMUC00144W rmflash: Are you sure you want to remove the FlashCopy pair c000:c040:? [y/n]:y
CMUC00140I rmflash: FlashCopy pair C000:C040 successfully removed.
```

### Withdraw on the Metro Mirror secondary

Normally, removing the FlashCopy (FLC) relationship on the Metro Mirror Primary volumes automatically removes the remote FLC relationship on the secondary Metro Mirror volume. If there are communications problems, however, the remote FLC relationship on the secondary Metro Mirror volumes cannot be removed.

Normally, using **rmflash** on a FLC relationship with a Remote Pair Copy status of *Remote* fails, leaving the FLC relationship intact.

The **rmflash** command added an optional **-cprm** parameter to solve this problem. Using **rmflash** on a FLC relationship with a Remote Pair Copy status of *Remote* and the new **-cprm** parameter behaves as follows:

- ▶ If specified on a non-persistent FLC, the **-cprm** parameter does the following operations:
  - Copy any remaining tracks from the source volume to the target volume
  - Terminate the FlashCopy relationship
- ▶ If specified on a persistent FLC, the **-cprm** parameter does the following operations:
  - Change the FLC relationship from persistent to non-persistent.
  - Copy any remaining tracks from the source volume to the target volume.
  - Terminate the FlashCopy relationship.

## 3.2 Remote Pair FlashCopy with DSGUI

DSGUI has been updated to support the new Remote Pair FlashCopy function for full volume FlashCopy operations. These operations can be performed on both FB volumes for open systems or for CKD volumes on z/OS systems.

### 3.2.1 Remote Pair FlashCopy Establish with DSGUI

To establish Remote Pair FlashCopy via DSGUI, we take the same steps to set up the FlashCopy relationships in the *Create FlashCopy: Realtime* panels. Additional options are added to the *Select common options* panel to establish Remote Pair FlashCopy.

On the *Select common options* panel, the checkbox for *Establish target on existing Metro Mirror source* must be selected.

One of three radio buttons can be selected: **Preserve Mirror None**, **Preserve Mirror Preferred**, or **Preserve Mirror Required**. Preserve Mirror None is the default. Those options are detailed in 2.3.2, “Remote Pair FlashCopy establish options” on page 9.

**Note:** The term Preserve Mirror is used in the DSGUI options for IBM's Remote Pair FlashCopy.

Figure 3-1 illustrates the options on FlashCopy establish.

The screenshot shows the 'Create FlashCopy: Real-time' window. On the left, a navigation pane lists steps: 'Define relationship type', 'Select source volumes', 'Select target volumes', 'Select common options' (highlighted), and 'Verification'. The main area is titled 'Select common options' and contains the instruction 'Select one or more copy options for the FlashCopy volume pairs and click Next.' Below this are several checkboxes: 'Make relationship(s) persistent' (unchecked), 'Initiate background copy' (checked), 'Enable change recording' (unchecked), 'Permit FlashCopy to occur if target volume is online for host access' (unchecked), 'Establish target on existing Metro Mirror source' (checked), and 'Inhibit writes to target volume' (unchecked). At the bottom of this section are three radio buttons for 'Preserve Mirror': 'None' (selected), 'Preferred' (unchecked), and 'Required' (unchecked). Below the radio buttons is a text field labeled '\*Sequence number' with the value '0'. At the bottom of the window are four buttons: '< Back', 'Next >', 'Finish', and 'Cancel'.

Figure 3-1 DSGUI Select Preserve Mirror options

The same three options are offered on both the resync FlashCopy and reverse FlashCopy DSGUI panels.

### 3.2.2 Query Remote Pair FlashCopy with DSGUI

DSGUI displays the type of Remote Pair FlashCopy relationship in the FlashCopy properties panel as shown in Figure 3-2.

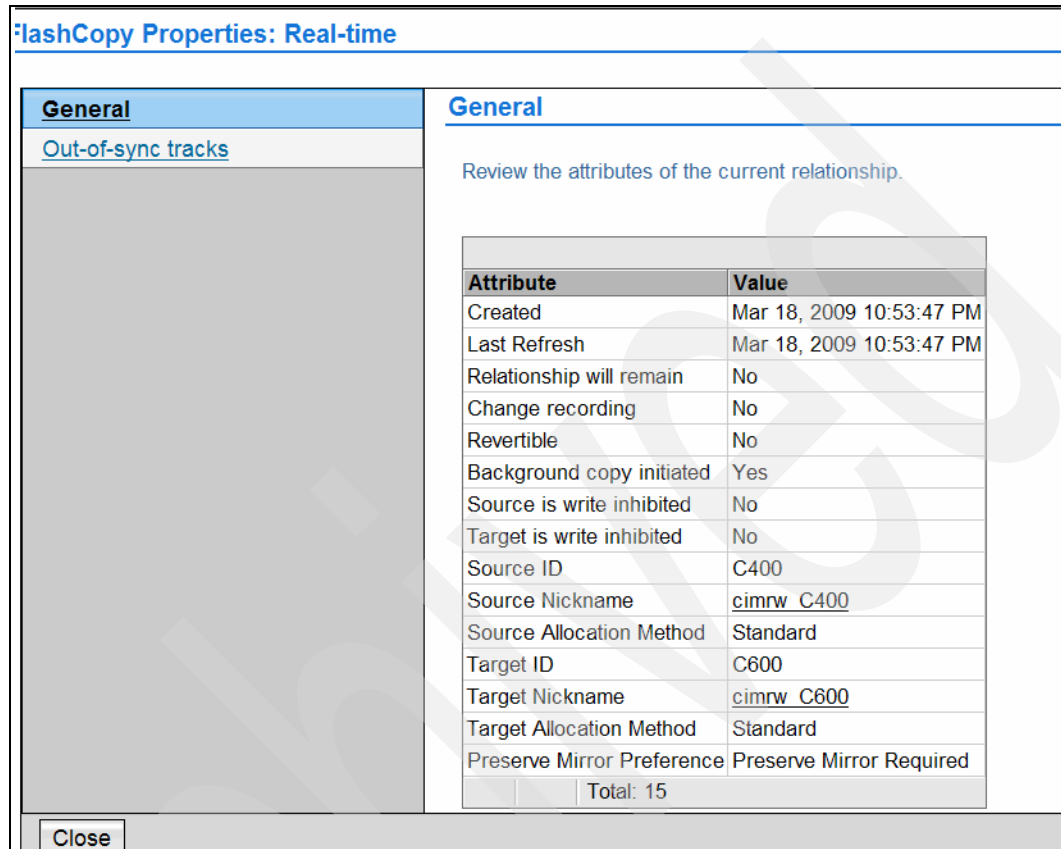


Figure 3-2 DSGUI FlashCopy Query showing Preserve Mirror state

### 3.2.3 Withdraw Remote Pair FlashCopy with DSGUI

To withdraw Remote Pair FlashCopy, select the pairs to be withdrawn as you would normally do via the DSGUI. The withdraw initiates background copy on the local FlashCopy pair and withdraws the FlashCopy after the background copy completes. The withdraw command is also sent to the remote where the remote FlashCopy pair initiates the background copy and withdraws. There is no force withdraw option available via DSGUI.

### 3.3 TPC-Replication

Tivoli® Productivity Center for Replication (TPC-R) 4.1 has been updated to support full volume Remote Pair FlashCopy. These operations can be performed on both FB volumes for open systems or for CKD volumes on z/OS systems.

The steps to create a Remote Pair FlashCopy session are the same as for any other FlashCopy session; however, additional Copy options are available as illustrated in Figure 3-3.

**Copy Options:**  
affect ESS/DS Devices.)

☒ Allow FlashCopy target to be Metro Mirror or Global Copy source

☐ Don't attempt to preserve Metro Mirror consistency.

☒ Attempt to preserve Metro Mirror consistency but allow FlashCopy even if Metro Mirror target consistency can't be preserved. \*

☐ Attempt to preserve Metro Mirror consistency but fail FlashCopy if Metro Mirror target consistency can't be preserved. \*

\* Preserving the consistency of a Metro Mirror target is only available on DS8000 storage devices with the required code levels installed.

Figure 3-3 Remote Pair FlashCopy options in TPC-R 4.1 - Create Session Properties panel

When a FlashCopy Session is created, the following options are provided when selecting the *Allow FlashCopy target to be Metro Mirror or Global Copy source* check box:

- ▶ Do not attempt to preserve Metro Mirror consistency.
- ▶ Attempt to preserve Metro Mirror consistency but allow FlashCopy even if Metro Mirror target consistency cannot be preserved.
- ▶ Attempt to preserve Metro Mirror consistency but fail FlashCopy if Metro Mirror target consistency cannot be preserved

These three options correspond to Remote Pair FlashCopy options *None*, *Preferred*, and *Required* respectively. For more information about these options, refer to 2.3.2, “Remote Pair FlashCopy establish options” on page 9

## Using Remote Pair FlashCopy in a z/OS environment

This chapter illustrates z/OS interfaces available to manage IBM's Remote Pair FlashCopy functions. We discuss the following interfaces:

- ▶ Data Set Services (DFSMSdss)
- ▶ Time Sharing Option (TSO)
- ▶ IBM Device Support Facilities (ICKDSF)
- ▶ ANTRQST macro

DSCLI, DSGUI, and TPC-R are also available to manage z/OS FlashCopy on a full volume basis. Those interfaces are discussed in Chapter 3, "Using Remote Pair FlashCopy in open systems environments" on page 15.

**Note:** The terms Remote Pair FlashCopy and Preserve Mirror are used interchangeably in this chapter. Preserve Mirror is the z/OS software function utilizing IBM Remote Pair FlashCopy.

## 4.1 DFMSdss

Data Set Services (DFSMSDss) is a component of DFSMS (Data Facility Storage Management Subsystem). This dataset management tool that can utilize DS8000 FlashCopy functions for dataset operations. DFSMSDss can also now use the new Remote Pair FlashCopy function in conjunction with the existing FlashCopy-to-PPRC Primary function during COPY, DEFrag, and CONSOLIDATE operations.

For more detailed information on DFSMSdss please refer to IBM publication, *z/OS DFSMS Storage Administration Reference (for DFSMSdftp, DFSMSdss, DFSMShsm)*, SC26-7402.

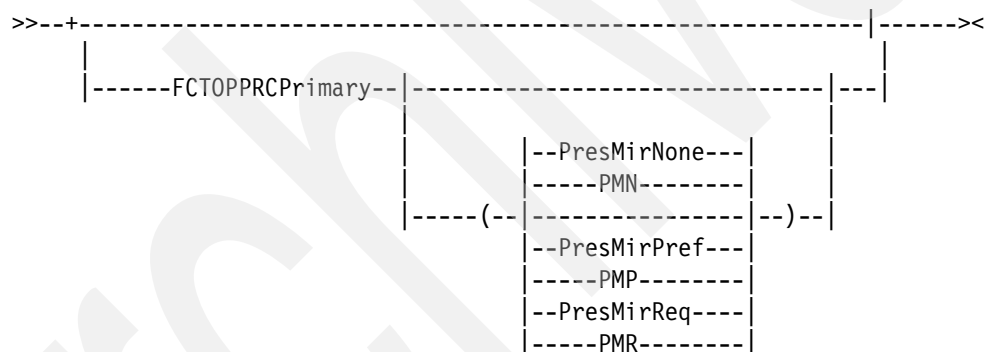
#### 4.1.1 Remote Pair FlashCopy using DFSSdss

DFSMSdss adds three new optional sub keywords to be used as a subparameter with the existing FCTOPPRCPRIARY keyword (see Example 4-1). The sub keywords are:

- ▶ PRESMIRREQ
- ▶ PRESMIRPREF
- ▶ PRESMIRNONE

The default is PRESMIRNONE.

## FCTOPPRCPrimary Keyword Syntax



### Example 4-1 A Preserve Mirror Required DFSMSdss job

```
//COPY01      EXEC  PGM=ADDRSSU
//SYSPRINT    DD  SYSOUT=*
//DASD1       DD    UNIT=3390,VOL=SER=SLC400,DISP=OLD
//DASD2       DD    UNIT=3390,VOL=SER=SLC401,DISP=OLD
COPY DS(INCLUDE(USER.TEST.DATA)) -
  INDDNAME(DASD1) -
  OUTDDNAME(DASD2) -
  FASTREP(REQ) -
  FCTOPPRCP(PMR) -
  DEBUG(FRMSG(DETAILED))
```

The new keywords **PRESMIRREQ**, **PRESMIRPREF**, and **PRESMIRNONE** are detailed in 2.3.2, “Remote Pair FlashCopy establish options” on page 9. **PRESMIRNONE** is the default if no sub keyword is specified.

**Note 1:** To specify FCTOPPRCPPrimary, RACF® authorization might be required.



**Note 2:** Do not use the FCTOPPRCPPRIMARY(PRESMIRREQ) with the FCTOSETGTOK(FAILRELATION) keyword.

## 4.1.2 DUMP FCWITHDRAW

A DFSMSdss DUMP FCWITHDRAW automatically withdraws the FlashCopy relationship immediately. This also causes a bit to be set for the target Metro Mirror pair, indicating that it was previously the target of a preserve mirror relationship that was withdrawn.

Deleting a dataset that is involved in an active Preserve Mirror relationship also sets the bit indicating a withdrawn preserve mirror relation. An immediate FlashCopy Withdraw is performed before the dataset is deleted.

## 4.1.3 DEBUG FRMSG keyword

With Preserve Mirror, there are situations where a Preserve Mirror Preferred or Required operation is requested but cannot be honored, while the Fast Replication request can be honored. There are also situations where a Fast Replication Preferred or Required operation cannot be honored when a Preserve Mirror Required operation cannot be honored. DFSMSdss can issue the new ADR850I that states specific reasons why a Preserve Mirror Preferred request cannot be honored when either DEBUG(FRMSG(SUM I DTL)) is specified.

If DFSMSdss cannot perform the FlashCopy when the target volume is a Metro Mirror Primary and FCTOPPRCPPRIMARY(PMR) is specified, DFSMSdss issues message ADR918I with a new return code X'27' indicating that DFSMSdss could not use Fast Replication to perform the operation without causing one or more Metro Mirror pairs to go into duplex pending status.

If DEBUG(FRMSG(SUM I DTL)) is specified, then DFSMSdss includes reason codes and message text to indicate why Preserve Mirror could not be used.

## 4.2 Remote Pair FlashCopy using TSO

TSO commands are commonly used in z/OS environments to manage various operations, including copy services commands. TSO commands might be generated by REXX or CLIST procedures. They might also be generated out of other software tools.

You can issue the TSO commands from procedures that are similar to the scripting approach in open systems environments.

For a detailed description of TSO commands to manage Copy Services, refer to the IBM publication, *z/OS DFSMS Advanced Copy Services*, SC35-0428.

### 4.2.1 TSO FCESTABL for Remote Pair FlashCopy

The new keyword for the FCESTABL TSO command is:

PRESERVEMIRROR(REQUIRED|PREFERRED|NO)

The sub keywords REQUIRED, PREFERRED, and NO are detailed in 2.3.2, "Remote Pair FlashCopy establish options" on page 9. PRESERVEMIRROR can be abbreviated as PRESMIR.

When PRESREVEMIRROR(PREFERRED) or PRESERVEMIRROR(REQUIRED) is specified, TGTPPRIM(YES) must also be specified.

PRESERVEMIRROR(PREFERRED and PRESERVEMIRROR(REQUIRED) are mutually exclusive with:

- ▶ REMOTE(YES)
- ▶ ACTION(FRR)

An illustration of the command is shown in Example 4-2.

*Example 4-2 TSO FCESTABL command*

---

```
FCESTABL SDEVN(X'uadd') TDEVN(X'uadd') MODE(NOCOPY) PRESERVEMIRROR(PREFERRED)
```

---

## 4.2.2 TSO FCWITHDR for Remote Pair FlashCopy Withdraw

TSO FCWITHDR does an immediate withdraw of a Remote Pair FlashCopy relationship (unless you specify the DDSW option). A bit is set for the target Metro Mirror pair, indicating that it was previously the target of a preserve mirror relationship that was withdrawn. The bit serves as an indicator that there might be tracks that are not identical only on the remote device.

An illustration of the command is shown in Example 4-3.

*Example 4-3 TSO FCWITHDR*

---

```
FCWITHDR SDEVN(X'uadd') TDEVN(X'uadd')
```

---

**Note:** TSO FCWITHDR does not have the *non-force* option to initiate background copy and withdraw the relationship when it completes.

The DDSW option, when used with a FlashCopy Withdraw issued to the remote FlashCopy source (Remote A), starts a background copy for the remote relationship. A FlashCopy Withdraw with DDSW issued to the remote FlashCopy target (Remote B) is then rejected.

## 4.2.3 TSO FCQUERY

TSO FCQUERY SHOWRELS has an added column that shows the type of Preserve Mirror FlashCopy established on the pair. The type shown in the PM column is similar to those outlined in the ICKDSF FlashCopy query in 4.3.3, "ICKDSF FLASHCPY query" on page 27.

An illustration of the command is shown in Example 4-4.

*Example 4-4 TSO FCQUERY SHOWRELS*

---

```
ANTF0421I FCQUERY Relations - 1
DEVN SSID LSS CCA CU      SERIAL      ACT  MAX XC PC CC RV SE  SEQNUM
0000 1111 22 33 AAAA 000000044444 555 666 N N N N NN 77777777
RELATIONSHIP DETAIL STARTING TRACK: aaaaaaaa
DEVICE LONG BUSY FOR CG: bbb WRITE INHIBITED: ccc
-----
PARTNER  SOURCE  TARGET  S F C C P C T S F P
LSS CCA SSID START  START  O V O A R R W E S M
--- --
dd ee ffff gggggggg hhhhhhhh i j k l m n o p q r
```

```

NO. OF TRACKS: ssssssssss TRACKS TO COPY: tttttttttt
ESTABL: yyyy/mm/dd hh:mm:ss LAST INCR: yyyy/mm/dd hh:mm:ss
dd ee ffff gggggggg hhhhhhhh i j k l m n o p q r
NO. OF TRACKS: ssssssssss TRACKS TO COPY: tttttttttt
ESTABL: yyyy/mm/dd hh:mm:ss LAST INCR: N/A
dd ee ffff gggggggg hhhhhhhh i j k l m n o p q r
NO. OF TRACKS: ssssssssss TRACKS TO COPY: tttttttttt
ESTABL: yyyy/mm/dd hh:mm:ss LAST INCR: N/A

```

---

## 4.2.4 TSO CQUERY

TSO CQUERY has two new possible pair states that describes the state where a FlashCopy Establish with Preserve Mirror Required was requested and the inband FlashCopy Establish sent from the local control unit failed, resulting in the Local B to Remote B Metro Mirror pair being suspended. This new state value is: SUSPEND.PM.

An illustration of the command is shown in Example 4-5.

*Example 4-5 TSO CQUERY showing SUSPEND.PM*

---

```

***** PPRC REMOTE COPY CQUERY - VOLUME *****
*                                     (PRIMARY) (SECONDARY) *
*                                     SSID CCA LSS SSID CCA LSS*
*DEVICE  LEVEL  STATE  PATH STATUS  SERIAL#  SERIAL#  *
*-----  -----  -----  -----  -----  -----  *
* BD00  PRIMARY.. SUSPEND.PM  ACTIVE..  2BE0 00 E0  0123 18 03 *
*          CRIT(NO)..... CGRPLB(NO). 0000000BHYR1 000000027449*
*          INCRES(NO).    AUTORESYNC(NO)

```

---

If a Metro Mirror pair was previously the target of a preserve mirror relationship that was withdrawn (FORCE withdraw) without background copy being initiated, a diagnostic bit is set for this pair, indicating this status (see Example 4-6).

For TSO CQUERY, if this diagnostic bit is on, the following status line is added:

\*PAIR WAS THE TARGET OF A WITHDRAWN PRESERVE MIRROR RELATION\*

If the pair is subsequently suspended and resynchronized or terminated, this diagnostic bit is turned off.

*Example 4-6 TSO CQUERY showing Metro Mirror pair after PM FlashCopy Withdraw with FORCE*

---

```

***** PPRC REMOTE COPY CQUERY - VOLUME *****
*                                     (PRIMARY) (SECONDARY) *
*                                     SSID CCA LSS SSID CCA LSS*
*DEVICE  LEVEL  STATE  PATH STATUS  SERIAL#  SERIAL#  *
*-----  -----  -----  -----  -----  -----  *
* BD00  PRIMARY.. DUPLEX..  ACTIVE..  2BE0 00 E0  0123 18 03 *
*          CRIT(NO)..... CGRPLB(NO). 0000000BHYR1 000000027449*
*          INCRES(NO).    AUTORESYNC(NO)
*PAIR WAS THE TARGET OF A WITHDRAWN PRESERVE MIRROR RELATION *

```

---

## 4.3 ICKDSF

The System z® ICKDSF utility offers a means of control for Copy Services functions. ICKDSF typically runs as a batch program, and so can be automatically run from batch scheduling products (for example, Tivoli Workload Scheduler).

More information on ICKDSF can be found in the *Device Support Facilities User's Guide and Reference*, GC35-0033.

### 4.3.1 ICKDSF FLASHCPY ESTABLISH for Remote Pair FlashCopy

ICKDSF FLASHCPY ESTABLISH can tell the control unit that if the target is a Metro Mirror primary volume, a Remote Pair FlashCopy operation is required, preferred, or not desired. The default is to disallow a Remote Pair FlashCopy operation (see Example 4-7).

The new keyword for the FLASHCPY ESTABLISH is:

PRESERVEMIRROR(REQUIRED|PREFERRED|NO)

This keyword indicates the handling of the request based on whether the specified target is a Metro Mirror primary device. This keyword can be abbreviated as PRESMIR.

The sub keywords, REQUIRED, PREFERRED, and NO are detailed in 2.3.2, “Remote Pair FlashCopy establish options” on page 9.

*Example 4-7 FLASHCPY ESTABLISH - Preserve Mirror preferred*

---

```
FLASHCPY ESTABLISH DDNAME(ddname) TARGETVOL(1ss,cca,uuu) TGTOKASPPRCPRIM(YES)
PRESERVEMIRROR(PREFERRED)
```

---

**Restrictions:** The REQUIRED and PREFERRED keywords are not valid if the FASTREVERSERESTORE parameter is specified. If REQUIRED or PREFERRED is specified then TGTOKASPPRCPRIM(YES) must be specified.

### 4.3.2 ICKDSF FLASHCPY WITHDRAW for Remote Pair FlashCopy

ICKDSF has a new keyword on the FLASHCPY WITHDRAW request that indicates whether a background copy should be initiated or if both the local and remote relationships should be immediately withdrawn (see Example 4-8).

The new keyword for the FLASHCPY WITHDRAW is:

FORCE(NO|YES)

NO indicates that a background copy should be done. This is the default.

YES indicates that a background copy should not be done. The FlashCopy pair is immediately withdrawn and a bit is set to indicate that the Metro Mirror pair was the target of a withdrawn Preserve Mirror relationship.

*Example 4-8 ICKDSF FLASHCPY WITHDRAW with FORCE*

---

```
FLASHCPY WITHDRAW DDNAME(ddname) TARGETVOL(1ss,cca,uuu) FORCE(YES)
```

---

### 4.3.3 ICKDSF FLASHCPY query

The ICKDSF FLASHCPY RELATIONS INFORMATION TABLE contains a new column giving the Preserve Mirror status. The new column heading is 'PM' for Preserve Mirror status. Example 4-9 shows an example ICKDSF FLASHCPY RELATIONS for a Preserve Mirror Required relationship.

The Preserve Mirror status can be one of the following values:

- N** The relationship was not established as a Preserve Mirror operation because Preserve Mirror was not requested or Preserve Mirror Preferred was specified but could not be accomplished.
- P** The relationship was established as a Preserve Mirror operation due to a Preserve Mirror Preferred request.
- R** The relationship was established as a Preserve Mirror operation due to a Preserve Mirror Required request.
- S** This is the remote relationship established between two Metro Mirror secondary devices due to a Preserve Mirror operation or the PM relationship type cannot be determined because of a conflict in the source and/or target Metro Mirror copy status.
- U** The Preserve Mirror relationship type cannot be determined because of a conflict in the source and/or target Metro Mirror copy status.

Example 4-9 ICKDSF FLASHCPY RELATIONS

FLASHCOPY RELATIONS INFORMATION TABLE																								
ADDRESSED VOLUME CU SERIAL NUMBER: 0000001711																								
ADDRESSED VOLUME INFORMATION																					PARTNER VOLUME INFO			
FLASHCPY														START OF EXTENT	# CONTIG	# TRACKS								
SEQUENCE														-----	TRKS IN	YET TO								
NUMBER	R/T	R	FV	BCE	BCP	CRA	VR	SWI	TWP	P	SEVI	PM	SOURCE	TARGET	EXTENT	BE COPIED	SSID	LSS	CCA	SSID	LSS	CCA		
00000000	SRC	F	T	T	F	F	F	F	F	F	FFFF	R	00000000	00000000	50085	50085	BF62	19	21	BF99	1A	28		
LEGEND																								
PM = PRESERVE MIRROR RELATIONSHIP INFORMATION LEGEND:																								
N = NOT A MIRRORRED RELATIONSHIP																								
P = MIRRORRED RELATIONSHIP, PREFERRED SPECIFIED																								
R = MIRRORRED RELATIONSHIP, REQUIRED SPECIFIED																								
S = REMOTE MIRRORRED RELATIONSHIP AT PPRC SECONDARY																								
U = MIRRORRED RELATIONSHIP UNDETERMINED																								

### 4.3.4 ICKDSF PPRC query

ICKDSF also provides additional information in the PPRCOPY QUERY when the volume being queried is involved with a Preserve Mirror relationship.

A new possible volume/pair state has been added that describes the state where a FlashCopy Establish with Preserve Mirror Required was requested and the inband FlashCopy Establish sent from the local control unit failed, resulting in the Local B to Remote B Metro Mirror pair being suspended. PPRCOPY QUERY indicates Peer-to-Peer Remote Copy Suspended (see Example 4-10).

**Example 4-10 ICKDSF PPRC Query - Failed Preserve Mirror request at the Secondary**

```
PPRCOPY QUERY DDNAME(TGT02)
ICK00700I DEVICE INFORMATION FOR CDC5 IS CURRENTLY AS FOLLOWS:
    PHYSICAL DEVICE = 3390
    STORAGE CONTROLLER = 2107
    STORAGE CONTROL DESCRIPTOR = E8
    DEVICE DESCRIPTOR = 0C
    ADDITIONAL DEVICE INFORMATION = 4800003C
    TRKS/CYL = 15, # PRIMARY CYLS = 10017
ICKDSF - MVS/ESA    DEVICE SUPPORT FACILITIES 17.0
ICK04030I DEVICE IS A PEER TO PEER REMOTE COPY VOLUME
ICK03091I EXISTING VOLUME SERIAL READ = SLCDC5
```

TIME: 15:11:19

QUERY REMOTE COPY - VOLUME

DEVICE	LEVEL	STATE	PATH STATUS	(PRIMARY)		(SECONDARY)		AUTORESINC
				SSID	CCA	SSID	CCA	
-----	-----	-----	-----	SER #	LSS	SER #	LSS	-----
CDC5	PRIMARY	SUSPEND(C) XDP	ACTIVE	CD80	45	9D80	45	DISABLE
				HT431	3B	01411	BB	

If a Metro Mirror pair was previously the target of a Preserve Mirror FlashCopy relationship that was withdrawn, a diagnostic bit is set for this pair. PPRCOPY QUERY shows a new message indicating that the previous FlashCopy Withdraw had been done with the force parameter (see Example 4-11):

```
ICK04034I THIS PAIR WAS THE TARGET OF A WITHDRAWN PRESERVE MIRROR RELATION
```

If the pair is subsequently suspended and resynchronized or terminated, this diagnostic bit is turned off.

**Example 4-11 PPRCOPY QUERY after Preserve Mirror Force Withdraw**

```
PPRCOPY QUERY DDNAME(TGT01)
ICK00700I DEVICE INFORMATION FOR C685 IS CURRENTLY AS FOLLOWS:
    PHYSICAL DEVICE = 3390
    STORAGE CONTROLLER = 2107
    STORAGE CONTROL DESCRIPTOR = E8
    DEVICE DESCRIPTOR = 0C
    ADDITIONAL DEVICE INFORMATION = 4800003C
    TRKS/CYL = 15, # PRIMARY CYLS = 10017
ICK04030I DEVICE IS A PEER TO PEER REMOTE COPY VOLUME
ICK03091I EXISTING VOLUME SERIAL READ = SLC685
ICK04034I THIS PAIR WAS THE TARGET OF A WITHDRAWN PRESERVE MIRROR RELATION
```

QUERY REMOTE COPY - VOLUME

				(PRIMARY)		(SECONDARY)		AUTORESINC
				SSID	CCA	SSID	CCA	
DEVICE	LEVEL	STATE	PATH STATUS	SER #	LSS	SER #	LSS	-----
C685	PRIMARY	DUPLEX	ACTIVE	C680	05	9680	05	DISABLE
				HT431	2D	01411	AD	

## 4.4 ANTRQST

The ANTRQST macro provides an application program call to the z/OS system data mover's (SDM) application programming interface (API). This macro allows you to call Metro Mirror, z/OS Global Mirror and FlashCopy functions from an application program.

For detailed information, see the IBM publication, *z/OS DFSMS Advanced Copy Services*, SC35-0428.

### 4.4.1 Using ANTRQST for Remote Pair FlashCopy

The ANTRQST macro has been updated to add a new keyword to the FCESTABLISH request.

The new keyword to establish Preserve Mirror FlashCopy for the ANTRQST REQUEST=FCESTABLISH is:

PRESMIR=REQ|PREF|NO

NO is the default. The new sub keywords REQ, PREF, and NO are detailed in 2.3.2, "Remote Pair FlashCopy establish options" on page 9

### 4.4.2 Using ANTRQST to query Remote Pair FlashCopy

The ANTRQST macro has also been changed to add a new keyword to the QFRVOLS request. The value specified in the new keyword indicates whether capability checking should consider the eligibility as a Preserve Mirror operation.

The new keyword for the ANTRQST REQUEST=QFRVOLS is:

PRESMIR=NO|PREF|REQ

- |             |   |
|-------------|---|
| <b>NO</b>   | Indicates that preserve mirror checking is not needed.  |
| <b>PREF</b> | Indicates that preserve mirror checking needs to be done, and target volumes are eligible, even if a preserve mirror operation cannot be done, as long as the device is FlashCopy eligible. |
| <b>REQ</b>  | Indicates that preserve mirror checking needs to be done, and if the device is not preserve mirror eligible, the device is not eligible.  |

## 4.5 Remote Pair FlashCopy and SMS volume selection

The following situations are handled as described:

- ▶ If the volume is not Fast Replication (FR) capable, the volume selection is handled as before:
  - If FAST REPLICATION was REQUIRED, then this volume is rejected.
  - If FAST REPLICATION was PREFERRED, then this volume is ranked lower than a FR capable volume. The associated message text in the volume entry can be externalized in the IGD17268I or IGD17279I message.

- ▶ If the volume is FR capable:
  - PRESERVE MIRROR was either not specified or specified as NO. This case is handled as before. The volume is eligible for volume selection and is ranked higher than a similar non-FR capable volume.
  - PRESERVE MIRROR was specified as PREFERRED. This case is also handled as before. The “preserve mirror” capability of this volume is IGNORED. The volume is eligible for volume selection and is ranked higher than a similar non-FR capable volume.
  - PRESERVE MIRROR was specified as REQUIRED. This volume is considered eligible for volume selection if any one of the following conditions is met:
    - The volume is marked PRESERVE MIRROR capable.
    - The volume is marked NOT PRESERVE MIRROR capable because it is not a PPRC volume.
    - The volume is marked NOT PRESERVE MIRROR capable because it does not have the new feature installed.



## FlashCopy review

In this appendix, we review the DS8000 FlashCopy function and describe the different features (copy and nocopy, incremental, multiple targets). In parallel, we also point out what is changing or different in the context of Remote Pair FlashCopy.

This information is provided here for the convenience of readers who need to refresh their knowledge of the DS8000 FlashCopy function.

In this appendix, we discuss:

- ▶ What FlashCopy is
- ▶ Background COPY and NOCOPY
- ▶ Reads and writes during FlashCopy relationship
- ▶ FlashCopy options

For additional information on FlashCopy or IBM DS8000 Copy Services in general, refer to:

- ▶ *IBM System Storage DS8000: Copy Services in Open Environments*, SG24-6788
- ▶ *IBM System Storage DS8000: Copy Services with IBM System z*, SG24-6787

# Overview of FlashCopy

FlashCopy creates an instant copy of a volume at a specific point-in-time, which is why it is often referred to as Point-in-Time Copy, instantaneous copy, or time zero (t0) copy. FlashCopy is a system storage driven function that the software invokes.

By doing a FlashCopy, a relationship is established between a *source* and a *target*. Both are considered to form a FlashCopy *pair*.

After you issue a FlashCopy command, a FlashCopy relationship is created between the source and target volumes and they become available for processing with full read/write access. Typically, large applications, such as databases, have their data spread across several volumes, and all of their volumes with dependent data should be FlashCopied at exactly the same point-in-time or FlashCopied while maintaining the order of their dependent writes. FlashCopy offers *Consistency Groups*, which allows you to FlashCopy multiple volumes while maintaining the order of the volumes' dependent writes. It takes only a few seconds to establish relationships for tens to hundred or more volume pairs.

Two variations of FlashCopy are available:

- ▶ **Standard FlashCopy:**

Standard FlashCopy uses a normal volume as target volume. This target volume has to have the same size (or larger) as the source volume, and that space is allocated in the storage subsystem.

- ▶ **IBM FlashCopy SE:**

IBM FlashCopy SE uses space efficient volumes as FlashCopy target volumes. A space efficient volume has a virtual size that is equal to the source volume size. However, space is not allocated for this volume at the beginning when the volume is created and the FlashCopy is initiated; instead, space is allocated in the repository when a first update is made to original tracks on the source volumes and those tracks are copied to the FlashCopy SE target volume. Writes to the SE target also consume repository space.

**Restriction:** Remember that for Remote Pair FlashCopy, local or remote targets might not be Space Efficient volumes.

FlashCopy and FlashCopy SE are optional and distinct licensed features of the IBM DS8000. Both features can coexist on a DS8000.

FlashCopy can be invoked by:

- ▶ DS CLI
- ▶ DS Storage Manager GUI
- ▶ TPC for Replication
- ▶ DFSMSdss
- ▶ TSO
- ▶ ICKDSF
- ▶ z/OS API

Some of the reasons for using FlashCopy to make copies of data are:

- ▶ Backup processing
- ▶ Data mining
- ▶ Creating an environment for testing or development
- ▶ Creating data for reporting
- ▶ Archiving

## Basic concepts

Here we describe the basic characteristics of the FlashCopy operation.

### Establishing the FlashCopy relationship

When you start FlashCopy, the relationship between source and target is established by creating a pointer table, including a bitmap for the target. This process is completed very quickly and makes the copy appear to be instantaneous.

While the FlashCopy relationship is being created, the DS8000 holds off I/O activity to the volume by putting the source volume in a SCSI *queue full* state (open systems) during which, any new I/Os that are issued receive a queue full error and are automatically reissued by the host bus adapter. For z/OS, the system is placed in an *extended long busy* condition, where no user disruption or intervention is required. I/O activity resumes when the FlashCopy is established.

If all bits for the bitmap of the target are set to their initial values, this means that no data block was copied so far. The data in the target is not modified during bitmap set up. At this first step, the bitmap and the data look as illustrated in Figure A-1.

The target volume in Figure A-1 and Figure A-2 can be a normal volume or a space efficient volume. In both cases the logic is the same.

The difference between standard FlashCopy and FlashCopy SE is where the physical storage resides. For standard FlashCopy it is a normal volume, for IBM FlashCopy it is a repository (see Figure A-5 on page 36).

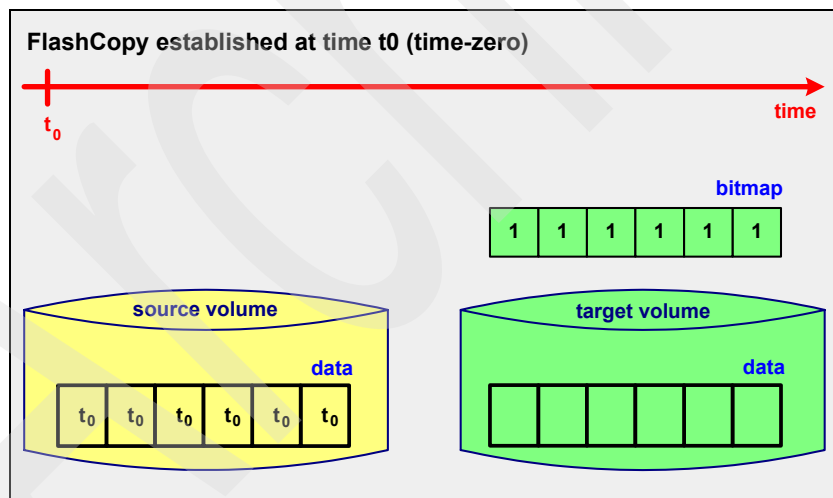


Figure A-1 FlashCopy at time  $t_0$

### Background COPY and NOCOPY

As result of the FlashCopy, either all physical blocks from the source volume are copied (full copy), or — when using the *nocopy* option — only those parts that are changing in the source data since the FlashCopy was established are copied.

The specification of background copy or nocopy has no effect upon when the target volume is used for reads or writes.

With the standard FlashCopy, background copy is the default, while nocopy is now enforced with FlashCopy SE.

## Background copy

When you invoke the *copy* option, and the establish process completes, a background process is started that copies all data from the source to the target. After this process is finished, and if there were no updates on the target, the picture we get is similar to Figure A-2.

If not explicitly defined as *persistent*, the FlashCopy relationship ends as soon as all data is copied. If you specified the *persistent* FlashCopy option, the FlashCopy relationship must be withdrawn explicitly.

Only the standard FlashCopy allows a full background copy. FlashCopy SE has no such function, but remember that both features can coexist.

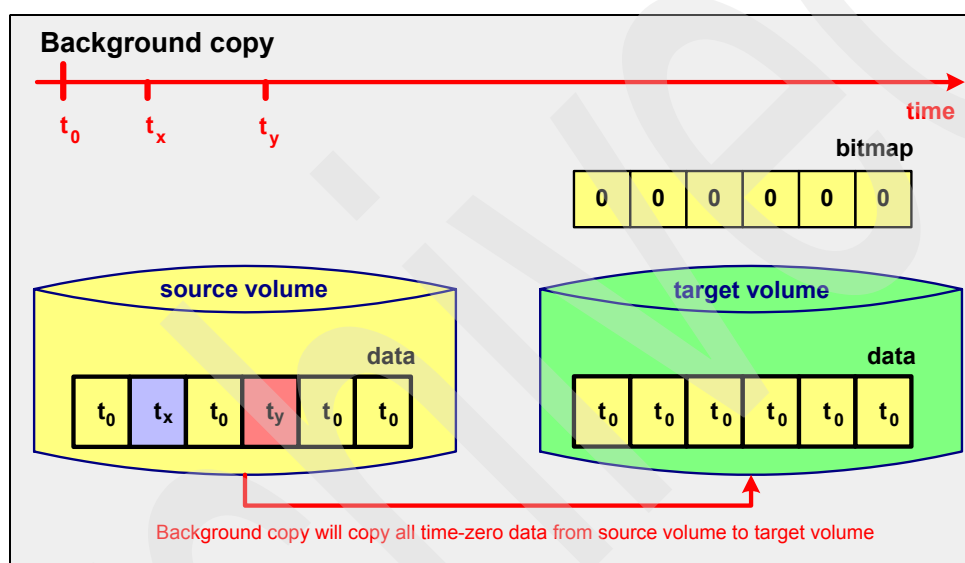


Figure A-2 Target volume after full volume FlashCopy relationship finished

If there are writes to the target, then the picture we get is similar to Figure A-3.

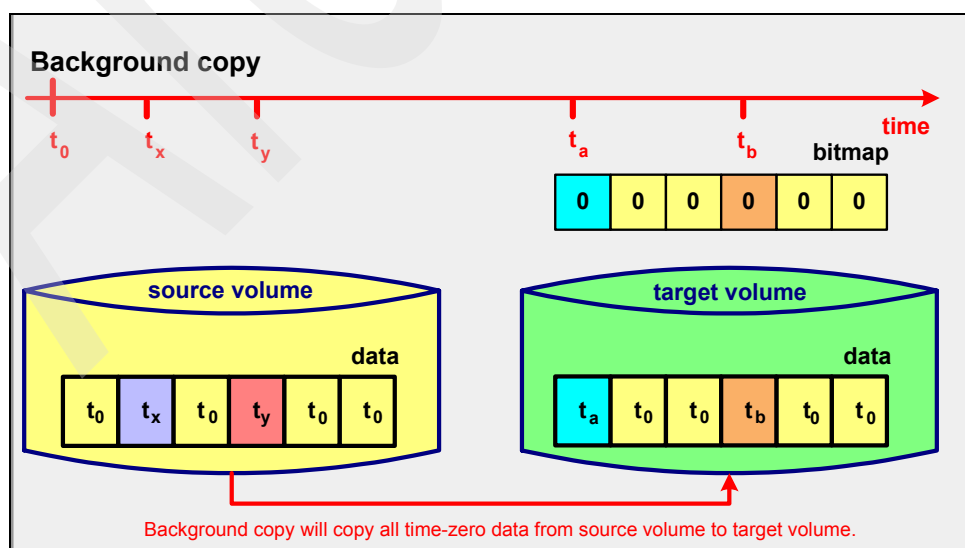


Figure A-3 FlashCopy after updates to the target volume

## Nocopy option

If FlashCopy is established using the *nocopy* option, the result is as shown in Figure A-4 here and Figure A-6 on page 37. The relationship lasts until it is explicitly withdrawn or until all data in the source volume is modified. Blocks for which no write occurred on the source or on the target stays as they were at the time when the FlashCopy was established.

The *nocopy* option is default for FlashCopy SE when using the DSCLI (for DFSMSdss you have to specify FCNOCOPY or MODE(NOCOPY) for TSO). The FlashCopy is a set of tracks that can consist of an entire volume or just a selected set of tracks. Attempts to read/write data already copied proceed as normal while attempts to process data not yet copied is intercepted and “Copy on Demand” or read from source is performed as needed. All of this processing creates the effect of an instant copy.

**Note:** FlashCopy SE must always be a *nocopy* relationship.

## Reads and writes during the FlashCopy relationship

After the relationship is established, it is possible to perform read and write I/Os on both the source and the target. Assuming that the target is used for reads only while production is ongoing, things would look as illustrated in Figure A-4.

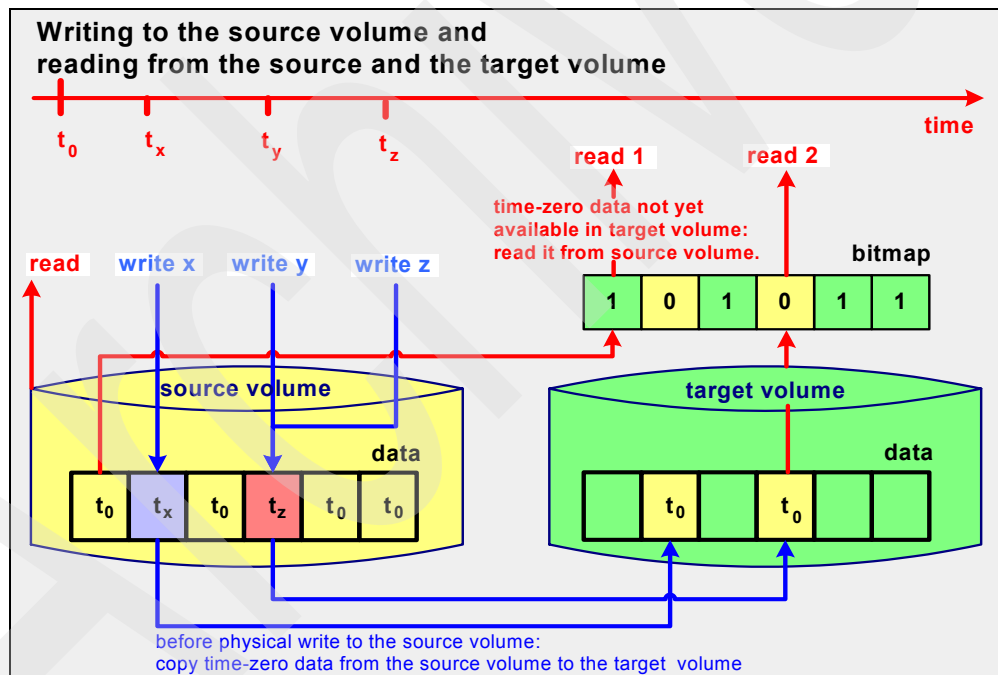


Figure A-4 Reads from source and target volumes and writes to source volume

- Reading from the source:

The data is read immediately. See Figure A-4 and Figure A-5.

- Writing to the source:

Whenever data is written to the source volume while the FlashCopy relationship exists, the storage subsystem makes sure that the time-zero-data is copied to the target volume prior to overwriting it in the source volume. When the target volume is a space efficient volume, the data is actually written to a repository (Figure A-5).

To determine if the data of the physical track on the source volume needs to be copied to the target volume, the bitmap is analyzed. If the bitmap identifies that the time-zero data is not available on the target volume, the data is copied from source to target. If it states that the time-zero data was already copied to the target volume, no further action is taken. See Figure A-4 on page 35 and Figure A-5 here.

It is possible to use the target volume immediately, for reading data and also for writing data. Figure A-5 shows reads and writes for FlashCopy SE.

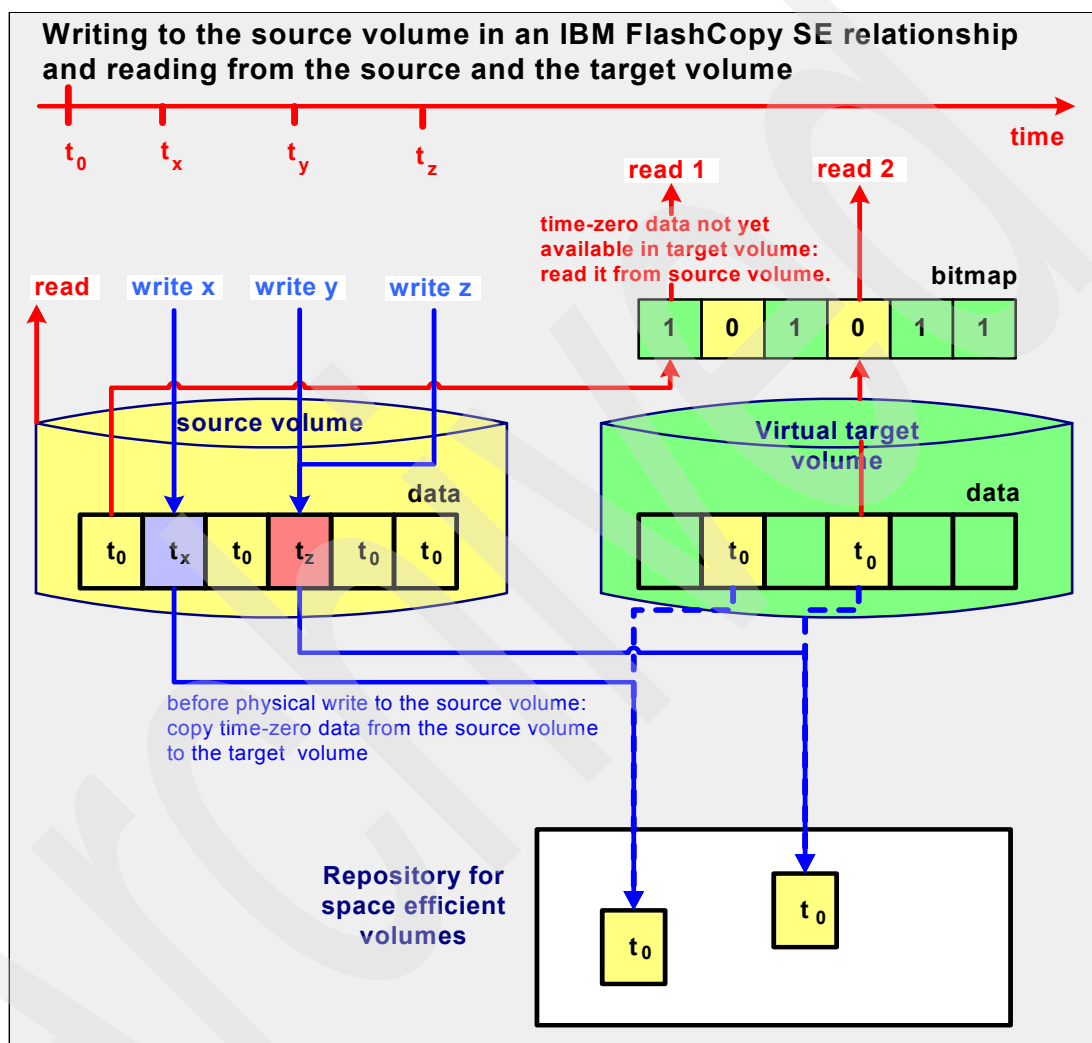


Figure A-5 Reads from source and target volumes and writes to source volume for FlashCopy SE relations

Next we explain the various reads and writes to and from the source and the target:

► Reading from the target:

Whenever a read-request goes to the target while the FlashCopy relationship exists, the bitmap identifies if the data must be retrieved from the source or from the target. If the bitmap states that the time-zero data has not yet been copied to the target, then the physical read is directed to the source. If the time-zero data was already copied to the target, then the read is performed immediately against the target. See Figure A-4 on page 35 and Figure A-5 here.

- Writing to the target:

When data is written to the target volume while the FlashCopy relationship exists, the storage subsystem makes sure that the bitmap is updated, which ensures that the time-zero data from the source volume never overwrites updates that were done directly to the target volume. Figure A-6 illustrates writing to the target volume.

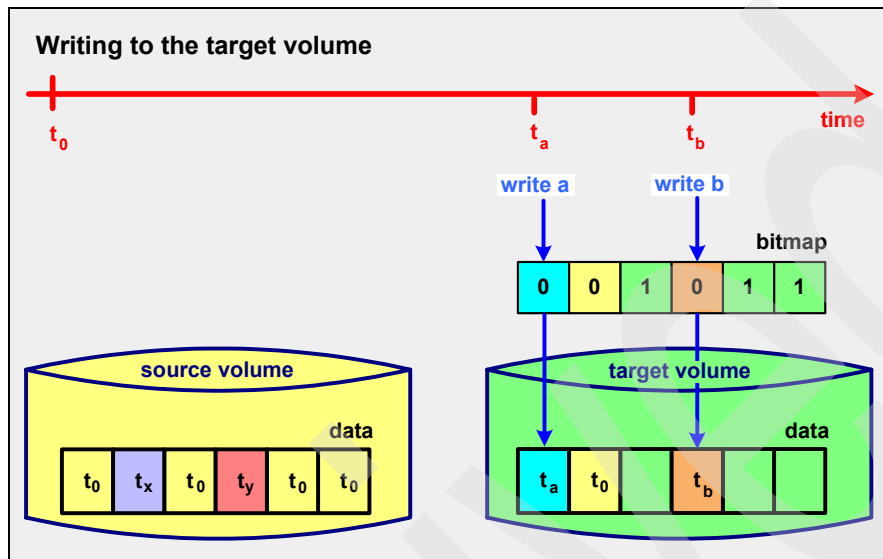


Figure A-6 Writes to target volume

- Terminating the FlashCopy relationship:

The FlashCopy relationship is *automatically ended* when all tracks are copied from the source volume to the target volume. The relationship can also be *explicitly withdrawn* by issuing the corresponding commands. If the *persistent* FlashCopy option or nocopy was specified, then the FlashCopy relationship must be withdrawn explicitly.

A FlashCopy SE relationship ends when it is withdrawn. When the relationship is withdrawn, there is an option to release the allocated space of the space efficient volume.

## FlashCopy options

You can perform a FlashCopy at the volume level, on a data set (z/OS and z/VSE™ only) or on a selected set of tracks.

We also explained that you can specify FlashCopy with either background copy or nocopy. There are additional options available when invoking FlashCopy:

- Switching from nocopy to background copy
- Persistent relationship
- Multiple relationships
- Incremental FlashCopy
- Consistency group FlashCopy
- Inband FlashCopy
- Fast Reverse Restore enabled FlashCopy
- Performing Fast Reverse Restore

## Nocopy to background copy

If you have a FlashCopy relationship that was invoked with nocopy, or if a background copy has not yet completed, the target volume becomes unusable if the relationship is withdrawn before all of the source tracks are copied to the target. If you want to have the target volume usable after the relationship is withdrawn, you can convert the nocopy to background copy. After the background copy completes, the relationship is withdrawn and the target volume is usable. You might want to do this, for example, if you wanted to FlashCopy the target volume (a FlashCopy target cannot be a FlashCopy source at the same time).

## Persistent FlashCopy

If you have a background copy and the background copy is completed, the relationship is withdrawn. There is no way to query the source volume to see what the last FlashCopy target was if the relationship is withdrawn.

If you specify that the FlashCopy is persistent, the relationship is maintained even after the background copy completes. The relationship is then manually withdrawn.

You might want to consider using persistent FlashCopy if you have procedures where you FlashCopy a source volume to a target one night and then FlashCopy it to a different target the following night. With persistent FlashCopy, you can query the source to see where it was last flashed, withdraw the relationship, and then flash to a different target, which lessens the chance of accidentally flashing to the wrong target.

**Remote Pair FlashCopy:** Remote Pair FlashCopy supports the persistent option.

## Multiple relationships

A single source volume can have up to 12 targets of which only one can be incremental.

**Remote Pair FlashCopy:** Remote Pair FlashCopy supports Multiple FlashCopy relationships.

## Incremental FlashCopy

Incremental FlashCopy provides the capability to only background copy those tracks that changed since the last increment was taken, which reduces the amount of data to process in background copy and thus the amount of time it takes for the background copy to complete. When the FlashCopy relationship is established, the change data recording (which also turns on the persistent flag), and background copy parameters are used. An incremental flash can be performed in either direction.

A bitmap is used to track changes to both the source and target volumes. After the initial incremental FlashCopy is established, which does a background copy on the entire source on the first FlashCopy, the next increment only background copies those tracks that were updated since the last increment. It also background copies those tracks that were updated on the target and need to be overlaid. To maintain the incremental relationship, specify change recording with each increment. If you do not specify change recording, the relationship is withdrawn after the incremental background copy completes.



If you did an incremental FlashCopy A > B, you do not have to wait for the background copy to complete before you issue another increment A > B. However, if you did an increment A > B and now want to do an increment B > A, you must wait until the A > B background copy completes.

**Remote Pair FlashCopy:** Incremental FlashCopy and Remote Pair FlashCopy are supported unless the request is attempting to take an increment using Remote Pair FlashCopy on a relationship that was established without Remote Pair FlashCopy.

## Consistency Group FlashCopy

FlashCopy is often used to make copies of data that crosses the volume boundary. In cases where the data is dependent upon each other, the data that crosses boundaries needs to be consistent. That is, the order of the dependent writes must be maintained. *FlashCopy Consistency Group* provides a mechanism for achieving a consistent data copy across multiple volumes without requiring that the application I/O be quiesced.

In the case of production data, application impact must be minimized. Prior to Consistency Group FlashCopy, you have to first quiesce the application, or in the case of DB2®, use the **SET LOG** commands, establish their FlashCopy relationships, and then restart the application. This process is disruptive and causes application outages or data unavailability for an unacceptable period of time.

You can specify Consistency Group for FlashCopy by using the **freeze** option, which holds off initiation and completion of write I/O to the source volumes until a **thaw** command is issued or, by default, when two minutes have passed.

The FlashCopy command and FlashCopy **freeze** is on a volume basis, but the **thaw** command is at the LSS level, which means that if there were more than one set of volumes using consistency, the **thaw** command would affect all of the Consistency Groups.

The target of each source volume is within one physical disk subsystem, but source volumes within a Consistency Group can span physical disk subsystems.

**Remote Pair FlashCopy:** Consistency Group FlashCopy and Remote Pair FlashCopy is supported.

## Inband FlashCopy

*Inband FlashCopy* allows FlashCopy requests to be issued remotely through an existing PPRC link. Inband FlashCopy is useful if the host at the recovery site is not online. The Inband option eliminates the need for a host connection from the local site to the remote subsystem for FlashCopy backup.

The FlashCopy request must be issued at a host processor that is connected to the PPRC primary volume, with the PPRC secondary volume specified as the FlashCopy source.

You can issue all supported full-volume FlashCopy commands with the Inband option, except the **thaw** portion of Consistency Group processing.

Fast Reverse Restore is also not supported with Inband because you need to issue the command to the remote FlashCopy target volume (not the remote FlashCopy source).

**Remote Pair FlashCopy:** An Inband FlashCopy is performed when a Remote Pair FlashCopy command is issued.

## Fast Reverse Restore Enabled FlashCopy

A *Fast Reverse Restore Enabled FlashCopy* is a FlashCopy relationship that is established with attributes that allow a Fast Reverse Restore to be performed upon the FlashCopy pair. The attributes are:

- ▶ Change Recording
- ▶ Persistent (Change Recording invokes persistent automatically)
- ▶ Background nocopy

A Fast Reverse Restore Enabled FlashCopy relationship is most often found in Global Mirror environments, although Global Mirror is not required for Fast Reverse Restore.

**Remote Pair FlashCopy:** Fast Reverse Restore and Remote Pair FlashCopy is not supported.

## Fast Reverse Restore

A *Fast Reverse Restore* is performed upon a FlashCopy pair that is established as Fast Reverse Restore Enabled. The Fast Reverse Restore copies the target back to the source and physically copies from the target to the source those tracks that were previously physically copied to the target while the Fast Reverse Restore relationship was enabled.

A Fast Reverse Restore FlashCopy is most often done when you create consistent data after a planned or unplanned outage in a Global Mirror environment.

**Remote Pair FlashCopy:** Fast Reverse Restore and Remote Pair FlashCopy is not supported.

The Fast Reverse Restore capability was enhanced with R3 microcode. In R3, you no longer need to have Change Recording specified on the relationship in order to do Fast Reverse Restore. It is possible to have multiple targets and use Fast Reverse Restore to restore any ONE of them. The one consideration for using Fast Reverse Restore on one of the relationships is that prior to the Fast Reverse Restore, all other targets must be removed. Therefore, you need to be careful about picking the correct relationship for the Fast Reverse Restore.

# Related publications

The publications listed in this section are considered particularly suitable for a more detailed discussion of the topics covered in this paper.

## IBM Redbooks publications

For information about ordering these publications, see “How to get IBM Redbooks publications” on page 41. Note that some of the documents referenced here might be available in softcopy only.

- ▶ *IBM System Storage DS8000: Copy Copy Services in Open Environments*, SG24-6788
- ▶ *IBM System Storage DS8000: Copy Services with IBM System z*, SG24-6787

## Other publications

These publications are also relevant as further information sources:

- ▶ *z/OS DFSMS Storage Administration Reference (for DFSMSdfp, DFSMSdss, DFSMSHsm)*, SC26-7402
- ▶ *Device Support Facilities User's Guide and Reference*, GC35-0033
- ▶ *z/OS DFSMS Advanced Copy Services*, SC35-0428

## Online resources

These Web sites are also relevant as further information sources:

- ▶ DS8000 Series Web site:  
<http://www.ibm.com/systems/storage/disk/ds8000/index.html>
- ▶ DFSMS Web site:  
<http://www.ibm.com/systems/storage/software/sms/index.html>

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# IBM System Storage DS8000: Remote Pair FlashCopy (Preserve Mirror)



**Improves Business  
Continuity  
z/OS Hyperswap  
preserved**

**Exploits inband  
FlashCopy  
No bandwidth  
increase required**

**Supported by TPC-R  
4.1**

The IBM DS8000 provides support for a new Copy Services function called Remote Pair FlashCopy. In the z/OS environment, this function is referred to as Preserve Mirror.

This function allows a significant reduction of the recoverability time when a FlashCopy target device is also a Metro Mirror primary device. The Remote Pair FlashCopy provides a solution for data replication, data migration, remote copy, and disaster recovery tasks. It is particularly useful for full volume FlashCopy and dataset level FlashCopy for z/OS.

This IBM Redpaper publication explains the mechanism and operations of the Remote Pair FlashCopy function. It also provides examples and illustrations of how to establish and then withdraw the Remote FlashCopy pair relationship.

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