z/OS
2.5

Cascading FlashCopy

Note

Before using this information and the product it supports, read the information in “Notices” on page 45.

This edition applies to Version 2 Release 5 of z/OS® (5650-ZOS) and to all subsequent releases and modifications until otherwise indicated in new editions.

Last updated: 2021-09-30

© Copyright International Business Machines Corporation 2017, 2021.
US Government Users Restricted Rights – Use, duplication or disclosure restricted by GSA ADP Schedule Contract with IBM Corp.

Contents

Figures v

Tables vii

About this content ix

How to send your comments to IBM xi
If you have a technical problem xi

Chapter 1. What Is Cascading FlashCopy? 1

Chapter 2. Getting started with Cascading FlashCopy 3
Requirements for Cascading FlashCopy 3
Cascading FlashCopy and fast replication recovery 3
Cascading FlashCopy and fast reverse restore 3
Scenarios for using Cascading FlashCopy 3

Chapter 3. Overview of FlashCopy 5
Understanding how FlashCopy works 5
Cascading FlashCopy 9

Chapter 4. System data mover API 13
ANTQFRVL macro 13
ANTQFRVL header return and reason codes 13
Volume capability and reason codes 13

Chapter 5. DFSMShsm and Cascading FlashCopy 19
Combining fast replication options in DFSMShsm 19
Recovering from a copy pool incremental version 21
Recovering a copy pool using fast reverse restore 21
Considerations for the FRRECOV command 22
FRRECOV command: Requesting a fast replication recovery 24
Syntax of the FRRECOV command 25

Chapter 6. DFSMSdss COPY command with Cascading FlashCopy 29
COPY FULL and COPY TRACKS syntax 30
FCFASTREVERSERESTORE 34

Chapter 7. Messages 35
DFSMS system data mover (SDM) messages 35
ICKDSF messages affected by Cascading FlashCopy 36

Appendix A. Accessibility 41
Accessibility features 41
Consult assistive technologies 41
Keyboard navigation of the user interface 41
Dotted decimal syntax diagrams 41

Notices.....45
Terms and conditions for product documentation..... 46
IBM Online Privacy Statement..... 47
Policy for unsupported hardware..... 47
Minimum supported hardware..... 47
Trademarks..... 48

Index..... 49

Figures

1. A full-volume copy, only one FlashCopy relationship active on a volume..... 7

2. Multiple FlashCopy relationships active on a volume..... 8

3. Initial FlashCopy relationship..... 9

4. Forward Cascading FlashCopy relationship.....9

5. Initial FlashCopy relationship..... 10

6. Backward Cascading FlashCopy relationship.....10

7. Cyclic Cascaded FlashCopy relationship..... 11

Tables

1. Summary of Differences Between Non-Cascading FlashCopy and Cascading FlashCopy..... 1

2. Allowable combinations of fast replication options..... 20

About this content

This content supports z/OS (5650-ZOS) and contains information about Data Facility Storage Management Subsystem (DFSMS).

Purpose of this information

This is a collection of all of the information that you need to understand and use Cascading FlashCopy®, one of the IBM® Advanced Copy Services, which provide backup and recovery of data should a disaster occur to your data center. Some of this information also appears elsewhere in the z/OS library.

Who should read this information

To use this information effectively, you should be familiar with current disaster recovery and workload migration procedures at your location.

© Copyright IBM Corp. 2017, 2021

How to send your comments to IBM

We invite you to submit comments about the z/OS product documentation. Your valuable feedback helps to ensure accurate and high-quality information.

Important: If your comment regards a technical question or problem, see instead “If you have a technical problem” on page xi.

Submit your feedback by using the appropriate method for your type of comment or question:

Feedback on z/OS function
If your comment or question is about z/OS itself, submit a request through the IBM RFE Community (www.ibm.com/developerworks/rfe/).

Feedback on IBM Documentation function
If your comment or question is about the IBM Documentation functionality, for example search capabilities or how to arrange the browser view, send a detailed email to IBM Documentation Support at ibmdocs@us.ibm.com.

Feedback on the z/OS product documentation and content
If your comment is about the information that is provided in the z/OS product documentation library, send a detailed email to mhvrcfs@us.ibm.com. We welcome any feedback that you have, including comments on the clarity, accuracy, or completeness of the information.

To help us better process your submission, include the following information:

- Your name, company/university/institution name, and email address
- The section title of the specific information to which your comment relates
- The comprehensive content collection title: Cascading FlashCopy
- The text of your comment.

When you send comments to IBM, you grant IBM a nonexclusive authority to use or distribute the comments in any way appropriate without incurring any obligation to you.

IBM or any other organizations use the personal information that you supply to contact you only about the issues that you submit.

If you have a technical problem

If you have a technical problem or question, do not use the feedback methods that are provided for sending documentation comments. Instead, take one or more of the following actions:

- Go to the IBM Support Portal (support.ibm.com).
- Contact your IBM service representative.
- Call IBM technical support.

© Copyright IBM Corp. 2017, 2021

Chapter 1. What Is Cascading FlashCopy?

Cascading FlashCopy is a form of FlashCopy, one of the Advanced Copy Services that provide solutions to the complex challenges of disaster recover, data migration, data duplication, and business continuance. For more information about Advanced Copy Services, see *z/OS DFSMS Advanced Copy Services*. The introduction to FlashCopy from that book has been included here. See Overview of FlashCopy.

The benefits of Cascading FlashCopy are summarized in Table 1 on page 1.

Table 1. Summary of Differences Between Non-Cascading FlashCopy and Cascading FlashCopy

Non-Cascading FlashCopy	Cascading FlashCopy
A volume or track can be a source or a target at a given time, but not both.	A track, set of tracks, or volume can be both a source and target of a FlashCopy relationship.
A source can have up to 12 targets.	A source can have up to 12 relationships.
Restoring a source from a target, with Fast Reverse Restore, requires you to remove other FlashCopy relationships.	You can restore a source from a target without having to withdraw other target relationships.

With Cascading FlashCopy, a track, set of tracks, or volume can be both a source and target of a FlashCopy relationship. One of those relationships may be a target relationship and the remaining may be source relationships, up to the maximum of 12 relationships. So, when a track, set of tracks, or a volume is involved in a cascading FlashCopy configuration, up to 11 targets are allowed. A source may have 12 targets only if it is not also a target itself.

Without Cascading FlashCopy, if you attempt to FlashCopy to a target that is a source of an existing FlashCopy relationship, the request fails due to the FlashCopy contention. Similarly, if you attempt to FlashCopy from a source that is the target of an existing relationship, the request fails due to the FlashCopy contention. As a result, you might have to remove relationships or wait for the background copy to complete in order to avoid the FlashCopy contention. Cascading FlashCopy eliminates the need to remove relationships or wait for a background copy to complete.

Cascading FlashCopy also provides the ability to restore a source from a target without having to withdraw other target relationships that the FlashCopy source has. You can accomplish this by creating a reverse relationship between the FlashCopy target and the FlashCopy source. Without Cascading FlashCopy, reversing the direction of the FlashCopy, which you can perform using Fast Reverse Restore, requires that you remove other relationships, which prevents other point in time copies from being preserved.

For more information about Cascading FlashCopy, see “Cascading FlashCopy” on page 9.

© Copyright IBM Corp. 2017, 2021

Chapter 2. Getting started with Cascading FlashCopy

This topics describes requirements for Cascading FlashCopy, and introduces the function.

Requirements for Cascading FlashCopy

DFSMS supports Cascading FlashCopy on the D/T2107 storage subsystem. Exploitation of Cascading FlashCopy on the D/T2107 storage subsystem requires a PTF and a microcode (LMC) upgrade. For minimum microcode levels and current maintenance required to exploit Cascading FlashCopy, refer to the Technical Information section of announcement letter ENUS117-061 at IBM Offering Information website (www.ibm.com/common/ssi).

Supply the following:

- Type of content: Announcement Letter
- Keywords: ENUS117-061

Or, you can contact IBM Hardware support for the current D/T2107 LMC.

To enable Cascading FlashCopy, you must install the PTFs for enabling APAR OA52391.

Cascading FlashCopy and fast replication recovery

With support for Cascading FlashCopy, DFSMShsm lifts some restrictions that previously existed related to FlashCopy and fast replication recovery.

DFSMShsm's support for cascaded FlashCopy:

- Allows fast replication recovery using fast reverse restore or reverse restore without requiring the additional FlashCopy targets be removed.
- By creating cyclic relationships, allows fast replication recovery without waiting for the background copy of a previous point-in-time copy pool backup to complete.
- By creating cyclic relationships, allows fast replication service to perform a new point-in-time copy pool backup without waiting for the background copy from a previous fast replication recovery to complete.

For more information, see Chapter 5, “DFSMShsm and Cascading FlashCopy,” on page 19.

Cascading FlashCopy and fast reverse restore

With support for Cascading FlashCopy, DFSMSdss lifts a restriction on the COPY command related to fast reverse restore.

Prior to Cascading FlashCopy, if the target volume of a COPY command is the source volume of other FlashCopy relationships, then those copies must be withdrawn prior to requesting fast reverse restore with the FCFASTREVERSERESTORE parameter. With Cascading FlashCopy, you can use FCFASTREVERSERESTORE without first withdrawing the copies.

For more information, see Chapter 5, “DFSMShsm and Cascading FlashCopy,” on page 19.

Scenarios for using Cascading FlashCopy

This topic describes some scenarios for using Cascading FlashCopy.

Retaining multiple FlashCopy backups during recovery

Without Cascading FlashCopy, prior to restoring a point-in-time copy, you must remove FlashCopy relationships from other point-in-time copies, due to the restriction that an existing FlashCopy source

© Copyright IBM Corp. 2017, 2021

cannot become a target. With Cascading FlashCopy, you can retain multiple point-in-time copies during recovery, by either reversing the direction of a FlashCopy or restoring a specific point-in-time copy by creating a cyclic relationship. Preserving multiple point-in-time copies allows you to choose the point-in-time copy that has the necessary data for recovery.

Mirror recovery with test copy

When performing a recovery in a mirrored environment without Cascading FlashCopy, you must ensure that the secondary devices are not in existing FlashCopy relationships. For example, in a Global Mirror environment that has test copies from the secondary's, prior to performing the FlashCopy of the Global Mirror journal, you must first remove the FlashCopy relationships that were created for test copies, then perform the FlashCopy for Global Mirror journal volumes. Once those steps complete, regulations might require you to take a safety copy to preserve the D/R copy using FlashCopy, in case the recovery fails. This means you must wait for the background copy of the Global Mirror journal to complete. Cascading FlashCopy eliminates both the requirement to remove test copy relationships and the need to wait for the background copy to complete prior to initiating a safety copy.

Backup and object recovery

When performing a system level backup, you might require the recovery of specific objects that reside in the backup. Without Cascading FlashCopy, you must wait for the background copy to complete if you choose to retain the original point-in-time copy, or use Fast Reverse Restore, which prevents you from retaining the point-in-time copy of the original backup. With Cascading FlashCopy, you can FlashCopy specific objects (that is, data sets) from system level backups while preserving point-in-time copies, by creating cyclic Cascading FlashCopyrelationships.

Preventing FlashCopy contention

Without Cascading FlashCopy, you can encounter situations where you unknowingly attempt to perform a FlashCopy from an existing track that is the target of a FlashCopy, or select a target that is the source of an existing relationship. You might encounter this situation, for example, when you attempt to defrag volumes or consolidate data set extents, which both involve relocating extents within a single volume. Often when an extent is relocated from a particular track range that is now free space, that same free space is chosen to move other tracks into. If FlashCopy was used to relocate extents from an area that is now free space, FlashCopy cannot relocate extents into the newly created free space if the background copy has not completed. With Cascading FlashCopy, contentions no longer inhibit the use of FlashCopy, and so FlashCopy can be used to relocate the extents.

Creating point-in-time copies from remote backups

Without Cascading FlashCopy, you must carefully plan FlashCopy processes that are performed on remote devices in order to prevent the impact on FlashCopies that are performed on local devices. For example, with Remote Pair FlashCopy, when FlashCopies are performed on primary devices, those FlashCopies are mirrored on corresponding secondary devices. If FlashCopies are being performed from secondary devices independent of the Remote Pair FlashCopy process, they can create conflicts and prevent the use of FlashCopy on the primary volume, disrupting mirroring. With Cascading FlashCopy, you can to perform FlashCopies more often from secondary volumes, with less planning related to FlashCopies that are occurring on the primary volumes that are being mirrored.

Chapter 3. Overview of FlashCopy

FlashCopy enables you to make copies of a set of tracks, with the copies immediately available for read or write access. This set of tracks can consist of an entire volume, a data set, or just a selected set of tracks.

FlashCopy provides both source volume to target volumes support, which came with FlashCopy Version 1, and source data set level to target data set level support, which comes with FlashCopy Version 2. FlashCopy can be used in combination with XRC, synchronous PPRC, and PPRC-XD.

The primary objective of FlashCopy is to create a copy of a source volume on the target volume. This copy is called a point-in-time copy. Access to the point-in-time copy of the data on the source volume is through reading the data from the target volume. The actual point-in-time data that is read from the target volume might or might not be physically stored on the target volume. As soon as a FlashCopy relationship is established (more specifically, as soon as the initialization process for a FlashCopy establish, initiated with the FCESTABL command, is complete), the point-in-time data is available for reading from the target volume. However, if data is written to a track that is a target track in a FlashCopy relationship and the updated target track is read afterwards, the data that is returned is user-updated data, and not the point-in-time source track data. Target tracks are withdrawn from a FlashCopy relationship as soon as any application writes to these tracks.

FlashCopy V1 requires the entire source volume and target volume to be involved in a FlashCopy relationship, even if selected tracks were specified on the FCESTABL command. FlashCopy V1 relationships do not allow any other FlashCopy relationships to exist on either the source or target volume.

ESS FlashCopy Version 2 enhances the FlashCopy function by providing an alternative method to copying an entire source volume to a target volume. This enhancement includes the following features:

- Multiple FlashCopy relationships are allowed on a volume.
- Track relocation is possible because for tracks to be copied, the target tracks do not need to be in the same location on the target volume as on the source volume.
- A FlashCopy target and source volume need not be in the same logical subsystem (LSS) in an ESS. However, FlashCopy must be processed in the same ESS.
- Extent level (data set level) FlashCopy.
- Incremental/Persistent Flashcopy.
- NOCOPY to COPY conversion.

Guidelines: Do not use the TSO or the API FlashCopy functions to copy data sets that you intend to access from the target volume. With FlashCopy, TSO or API usage does not provide any data management services, such as allocation or cataloging. Data sets that are copied using these functions are not accessible from the target volume without the user manually performing these data management tasks. You can use a data set copy program that provides these data management services as part of the copy process, such as DFSMSdss.

Understanding how FlashCopy works

When a FCESTABL command is processed, an attempt is made to create a relationship between tracks on a source device and tracks on a target device. A track extent contains a beginning track, an ending track, and all the tracks between the beginning track and the ending track. For FlashCopy V2, a source track extent and a target track extent are required to describe a track set. A contiguous set of source tracks related to a contiguous set of target tracks is called a track set. Each track set makes up a FlashCopy relationship.

You can request a FlashCopy relationship using:

- TSO/E commands

© Copyright IBM Corp. 2017, 2021

- An application programming interface (API) macro (ANTRQST) using the REQUEST=FCESTABLISH command..
- A REXX exec that calls program ANTTREXX. ANTTREXX uses the ANTRQST API. .
- A Web-browser interface called “IBM TotalStorage™ Enterprise Storage Server® Copy Services.” This Web-enabled interface is part of the ESS storage subsystem.
- DFSMSdss
- ICKDSF

A FlashCopy relationship can be established in:

- COPY mode, which runs a background copy process. This is the default.
- NOCOPY mode, which suppresses the background copy.

A FlashCopy relationship begins when the FlashCopy relationship is initiated and ends when the background copy completes or when you withdraw it, which you can do with the FCWITHDR command. When you use the FCESTABL command with the NOCOPY parameter to establish the FlashCopy relationship, you must explicitly withdraw the FlashCopy relationship when it is no longer required. You can specify one or more track sets using the FCWITHDR command, but each track set must have a source extent and a target extent.

You are not informed when the background copy is complete. To monitor when the copy completes, issue the FCQUERY command. A non-persistent FlashCopy relationship is terminated and this inactivity is reflected in the FCQUERY output. However, an incremental relationship, which is persistent, continues to appear as active in the FlashCopy report.

How long the actual physical copy takes depends on:

- The amount of data being copied
- The number of background copy processes that are occurring
- The other activities on the ESS.

When the FCESTABL command includes the MODE(COPY) parameter, the ESS copies all specified source tracks to specified target tracks. Figure 1 on page 7 illustrates a full-volume copy, where the source tracks are copied to the target volume in the same track locations as the source tracks.

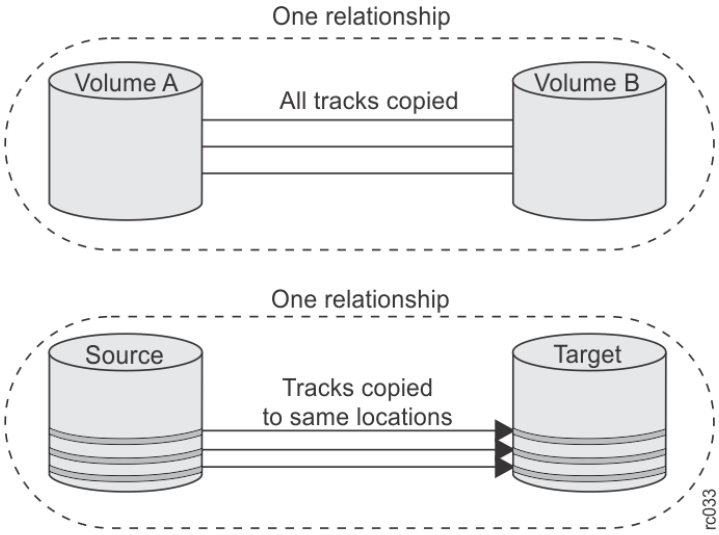


Figure 1. A full-volume copy, only one FlashCopy relationship active on a volume

You can copy the same source volume track to different tracks on one or more target volumes or even copy to a track on the source volume as a target, up to twelve times. Figure 2 on page 8 illustrates this concept.

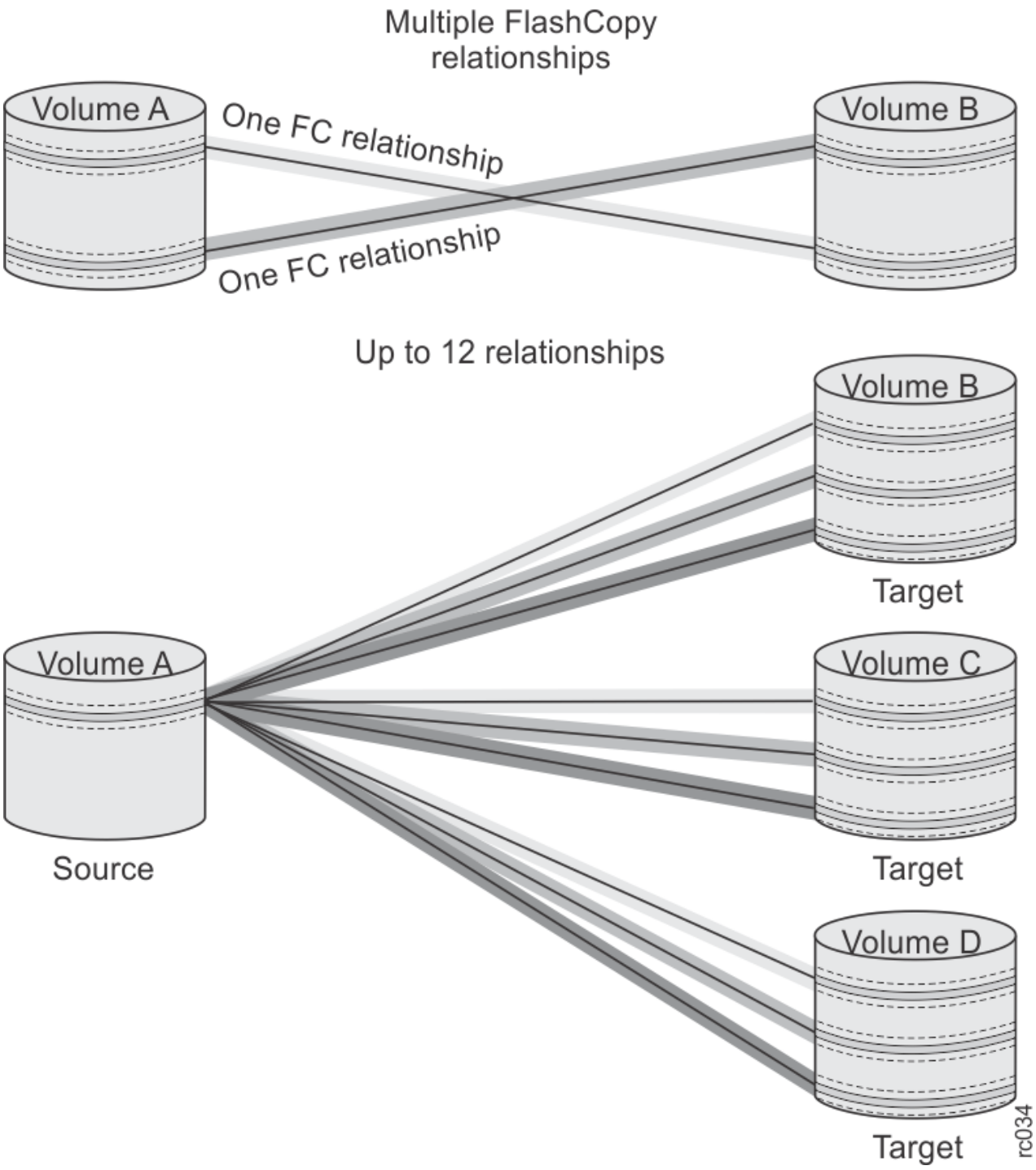


Figure 2. Multiple FlashCopy relationships active on a volume

Note: As long as a track on a volume is not a source or target track of an existing FlashCopy relationship, it can become the target track in a new FlashCopy relationship. The only restriction is that you cannot exceed the total number of active FlashCopy relationships per volume. Use the FCQUERY command to determine what that number is.

There might be circumstances that require you to withdraw a FlashCopy relationship. For example, you might not want to wait for the copy to complete or there might no longer be a need for the FlashCopy relationship. For either case, you can use the FCWITHDR command.

Cascading FlashCopy

Cascading FlashCopy:

- Allows a track, set of tracks, or volume to be both a source and target of a FlashCopy relationship
- Provides the ability to restore using Fast Reverse Restore to the original FlashCopy source from a FlashCopy target without having to withdraw other FlashCopy target relationships that the FlashCopy source may have.

Cascading FlashCopy is created when an existing FlashCopy target becomes the source of a new FlashCopy relationship (a forward cascaded relationship), or an existing FlashCopy source becomes the target of a new FlashCopy relationship.

For example, we have established a FlashCopy relationship with volume A as the source and volume B as the target, as shown in Figure 3 on page 9.

Figure 3. Initial FlashCopy relationship

Now we initiate a FlashCopy with volume B as the source and volume C as the target. This creates a forward cascaded relationship. See Figure 4 on page 9.

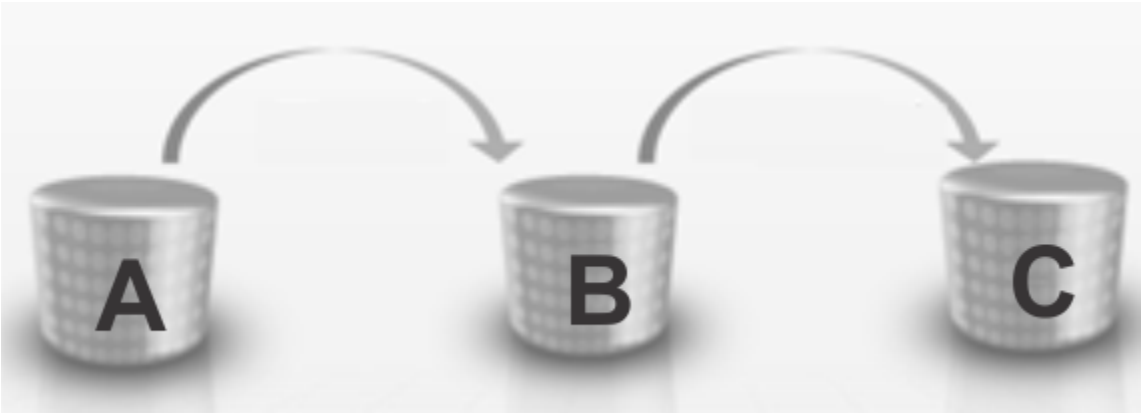


Figure 4. Forward Cascading FlashCopy relationship

Creating a backward Cascading FlashCopy relationship might occur as follows:

1. The initial relationship is volume B as the source and volume C as the target.

Figure 5. Initial FlashCopy relationship

2. You add a new FlashCopy relationship, with volume A as the source and volume B as the target.

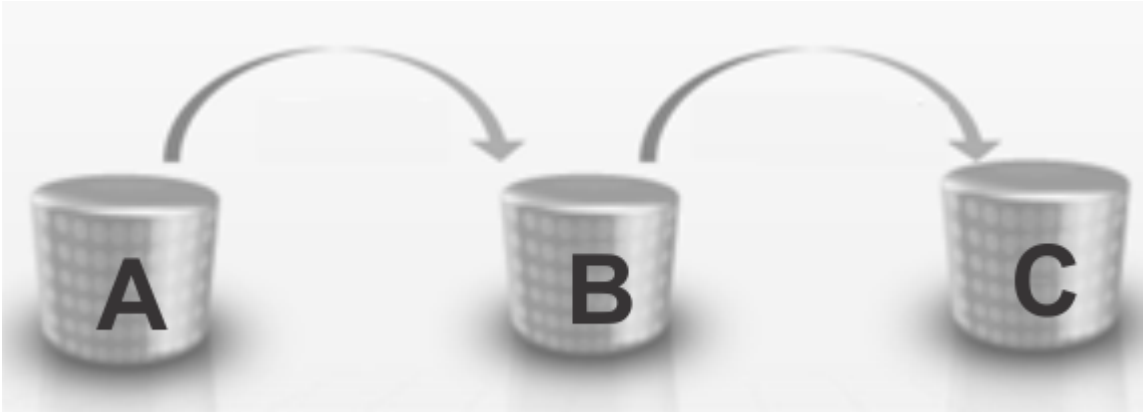


Figure 6. Backward Cascading FlashCopy relationship

Cyclic cascaded relationship

When you create a relationship from an existing target to its existing source, without using restore or Fast Reverse Restore, a new relationship is created, resulting in a cyclic cascading relationship. The number of FlashCopy relationships must not exceed 12 otherwise creating additional relationships as part of a cyclic will fail.

For example, we have established a FlashCopy relationship with volume A as the source and volume B as the target, as shown in Figure 3 on page 9.

While the relationship still exists between volumes A and B, we establish a new relationship between B and A, as shown in Figure 7 on page 11.

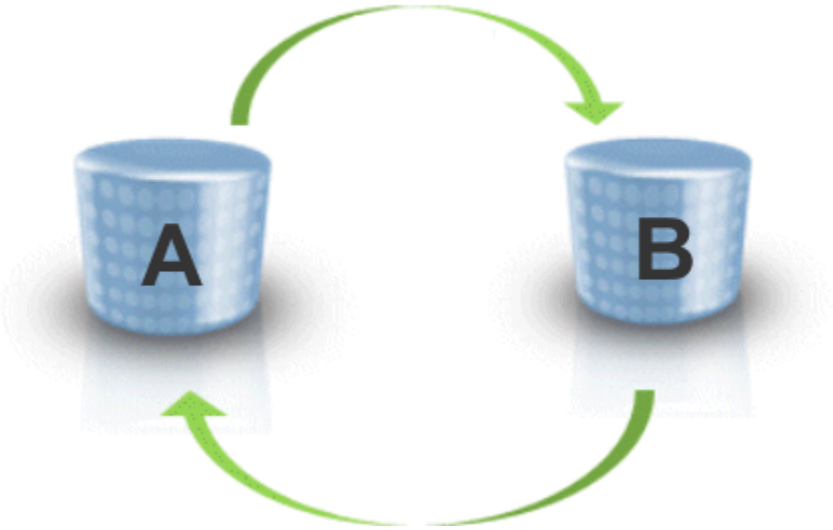


Figure 7. Cyclic Cascaded FlashCopy relationship

A cyclic Cascading FlashCopy relationship differs from a Fast Reverse Restore scenario because the point-in-time copy is preserved on both volumes A and B. With a Fast Reverse Restore operation, that point-in-time copy would not be preserved. In addition, Fast Reverse Restore can be performed only on full volume relationships, while cyclic relationships can be at a track or data set level.

Incremental FlashCopy with cascading relationships

You cannot cascade relationships from incremental FlashCopy target volumes until after the background copy is complete.

In addition, you cannot cascade different Incremental FlashCopy types (for example, Type-1 and Type-2), and you cannot create cyclic relationships of incremental relationships.

Chapter 4. System data mover API

This section describes how Cascading FlashCopy affects the ANTQFRVL macro of the z/OS System Data Mover (SDM) application programming interface (API). See changes marked with revision bars.

ANTQFRVL macro

This macro maps the input and output fields in the parameter area pointed to by the VOLLIST keyword in the ANTRQST Query Fast Replication Volumes request.

The ANTRQST REQUEST=QFRVOLS VOLLIST parameter has the name of an area mapped by the ANTQFRVL macro. This area is required for the QFRVOLS request of ANTRQST.

The header area must be filled in by the caller. This includes setting QFRVLEYE to ANTQFRVL, setting QFRVLVRL to the value of the QFRVRLC symbol and setting QFRVLLEN to the total length, in bytes, of the parameter area.

The caller sets the number of volume entries, supplies the volume or device information for them and sets all other volume entry areas to binary zero.

ANTQFRVL header return and reason codes

When ANTRQST returns to the caller, and the RETINFO return and reason code are zero, the ANTQFRVL header return code and reason code have the following values:

Return Code	Reason Code	Description
0	0 (X'00')	The control volume and VOLLIST have been processed. All volumes are eligible.
0	1 (X'01')	The control volume and VOLLIST volumes have been processed. One or more VOLLIST volumes are ineligible.
4	1 (X'01')	No volumes have been processed. The control volume does not support and version of FlashCopy.
4	2 (X'02')	No volumes have been processed. The control volume could not be accessed to determine FlashCopy support status.
8	x	Input parameters or VOLLIST extent parameters invalid. This is an IBM internal error.
12	x	QFRVOLS abend or other serious error. This is an IBM internal error.

Volume capability and reason codes

When ANTRQST returns to the caller, and the RETINFO return and reason code are zero, and the ANTQFRVL header return code is zero, each volume entry has one of the following values:

Volume Capable	Volume Reason	Description
1	0 (X'00')	The volume is source capable.
2	0 (X'00')	The volume is target capable.
0	.	The volume is not currently Fast Replication capable. The volume reason will have a non-zero value indicating the current cause for being incapable.

© Copyright IBM Corp. 2017, 2021

Volume Capable	Volume Reason	Description
0	1 (X'01')	The maximum number of FlashCopy relationships are active on the volume.
0	2 (X'02')	The volume is a PPRC Primary volume.
0	3 (X'03')	The volume is a PPRC Secondary volume
0	4 (X'04')	The volume is a Concurrent Copy source.
0	5 (X'05')	The volume is extended Remote Copy source.
0	6 (X'06')	The volume is currently inhibited from starting any FlashCopy operations.
0	7 (X'07')	A volume level (phase 1) FlashCopy relationship is active on this volume.
0	8 (X'08')	The maximum number of FlashCopy relationships for the Enterprise Storage Server (ESS) are active.
0	9 (X'09')	The volume is currently inaccessible.
0	10 (X'0A')	Asynchronous PPRC Primary target active for volume.
0	11 (X'0B')	Full volume target relation exists on the volume.
0	12 (X'0C')	Full volume source relation exists on the volume.
0	13 (X'0D')	Maximum full volume relations exist on the volume.
0	14 (X'0E')	Volume is space efficient, target capability requested and SETGTOK=YES was not specified, or Preserve Mirror was specified.
0	15 (X'0F')	The volume is in the process of a PPRC cascading failover/failback recovery operation or the PPRC volume was established with incremental resynchronization started, and target capability checking was requested.
0	16 (X'10')	The volume is a cascaded PPRC volume.
0	17 (X'11')	The volume is not capable of data set level FlashCopy operations. (Space efficient volumes are not eligible for data set level FlashCopy operations.)
0	18 (X'12')	The volume is not capable of inhibiting writes to the source.
0	19 (X'13')	Reserved
0	20 (X'14')	Reserved
0	21 (X'15')	Device is in a Soft Fenced state
0	23 (X'17')	The specified volume is a target volume of an incremental relationship, source checking was requested, and the copy is not complete for the incremental relationship.
0	24 (X'18')	The maximum number of full volume relations exists and target capability was requested.
0	25 (X'19')	Volume is in an incremental FlashCopy relationship and is not eligible for new incremental FlashCopy relationship of the requested change recording version.
0	26-27 (X'1A-1B')	Reserved for common incapable reason codes FlashCopy incapable, PPRC Remote Pair FlashCopy incapable, and XRC Remote Pair FlashCopy incapable
0	28 (X'1C')	FlashCopy onto a Global Mirror target cannot be performed because a Global Mirror force Consistency Group is in progress.

Volume Capable	Volume Reason	Description
0	29-63 (X'1D-3F')	Reserved for common incapable reason codes FlashCopy incapable, PPRC Remote Pair FlashCopy incapable, and XRC Remote Pair FlashCopy incapable
0	64-95 (X'40-5F')	Reserved for XRC Remote Pair FlashCopy
0	96-127 (X'60-7F')	Reserved
0	128-159 (X'80-9F')	Reserved for PPRC Remote Pair FlashCopy
0	160-191 (X'A0-BF')	Reserved
0	200 (X'C8')	The volume cannot be found.
0	201 (X'C9')	The volume does not support FlashCopy.
0	202 (X'CA')	The volume and the control volume are not in the same subsystem.
0	203 (X'CB')	An I/O error was detected when obtaining FlashCopy status of the volume. To obtain a diagnostic ABEND dump from the ANTMAIN address space that will provide additional information about the error, issue system command F ANTAS000,CTFLG ABEND_LIC ON, and resubmit the failing request. Once the dump has been obtained, issue system command F ANTAS000,CTFLG ABEND_LIC OFF.
0	204 (X'CC')	The volume does not have the same track geometry as the control volume.
0	205 (X'CD')	A VM formatted MVS minidisk.
0	206 (X'CE')	An I/O timeout was detected when obtaining FlashCopy status of the volume.
0	207 (X'CF')	The specified extent is outside the volume's capability.

Preserve Mirror reason codes for volume capability

When ANTRQST returns to the caller, and the RETINFO return and reason code are zero, and the ANTQFRVL header return code is zero, and Version 2 or later is specified, each volume entry has one of the values that are described in the following table.

Preserve Mirror Capable	Preserve Mirror Reason	Description
1	0 (X'00')	The volume is Preserve Mirror Capable.
2	0 (X'00')	Preserve Mirror checking not requested.
3	0 (X'00')	Preserve Mirror checking was not done because the volume is not FlashCopy capable.

Preserve Mirror Capable	Preserve Mirror Reason	Description
0	.	The volume is not currently Preserve Mirror capable. The volume reason will have a nonzero value indicating the current cause for being incapable.
0	1 (X'01')	The maximum number of FlashCopy relations are active on the volume.
0	2 (X'02')	Reserved
0	3 (X'03')	Reserved
0	4 (X'04')	The volume's secondary is a Concurrent Copy source.
0	5 (X'05')	The volume's secondary is an XRC primary.
0	6 (X'06')	The volume's secondary currently is inhibited from starting any FlashCopy operations.
0	7 (X'07')	A Volume Level (Phase 1) FlashCopy relation is active on this volume's secondary.
0	8 (X'08')	The maximum number of FlashCopy relations for the volume's secondary volume's SFI.
0	9 (X'09')	The volume's secondary is inaccessible.
0	10 (X'0A')	The volume's secondary is a Global Mirror primary.
0	11 (X'0B')	A full volume target relationship already exists in the volume's secondary.
0	12 (X'0C')	A full volume source relationship already exists on the volume's secondary and target capability was requested.
0	13 (X'0D')	The maximum number of full volume source relationships exist on the volume's secondary and source capability was requested.
0	14 (X'0E')	The volume's secondary is space efficient.

Preserve Mirror Capable	Preserve Mirror Reason	Description
0	15 (X'0F')	The volume's secondary is in the process of a PPRC cascading failover/failback recovery or the PPRC volume was established with incremental resync. Target capability is required.
0	16 (X'10')	The volume's secondary is a cascaded PPRC volume.
0	17 (X'11')	The volume's secondary is not capable of data set-evel FlashCopy operations,
0	18 (X'12')	The volume's secondary is not capable of inhibiting writes to the source.
0	21 (X'15')	Device is in a Soft Fenced state
0	23 (X'17')	The specified volume is a target volume of an incremental relationship, source checking was requested, and the copy is not complete for the incremental relationship.
0	24 (X'18')	The maximum number of full volume relations exists and target capability was requested.
0	25 (X'19')	Volume is in an incremental FlashCopy relationship and is not eligible for new incremental FlashCopy relationship of the requested change recording version.
0	26-27 (X'1A-1B')	Reserved for common incapable reason codes FlashCopy incapable, PPRC Remote Pair FlashCopy incapable, and XRC Remote Pair FlashCopy incapable
0	28 (X'1C')	FlashCopy onto a Global Mirror target cannot be performed because a Global Mirror force Consistency Group is in progress.
0	29-63 (X'1D-3F')	Reserved for common incapable reason codes FlashCopy incapable, PPRC Remote Pair FlashCopy incapable, and XRC Remote Pair FlashCopy incapable
0	64-95 (X'40-5F')	Reserved for XRC Remote Pair FlashCopy
0	96-127 (X'60-7F')	Reserved

Preserve Mirror Capable	Preserve Mirror Reason	Description
0	128 (X'80')	The volume is not a PPRC primary device. For target checking, software can treat this as capable.
0	129 (X'81')	The volume's secondary and the control volume's secondary are not in the same SFI.
0	130 (X'82')	The volume's PPRC relationship is not full duplex.
0	131 (X'83')	The volume's secondary's SFI does not have the microcode installed that supports IBM Remote Pair FlashCopy (Preserve Mirror).
0	136 (X'88')	Volume has PPRC Multi-Target relationships and PSETCHAR is not configured correctly. USEFORPM is set for either none or more than one of the target volumes.
0	132 (X'84')	The control volume is not a PPRC primary.
0	133 (X'85')	The command was received while the subsystem was installing a new microcode load and the level of one or both CECs does not support IBM Remote Pair FlashCopy (Preserve Mirror).
0	134 (X'86')	An error was detected when sending the command to the volume's secondary.
0	135 (X'87')	The volume is space efficient and target capability was requested. Space efficient volumes are not allowed as the target of a Preserve Mirror operation.
0	208 (X'D0')	The volume is a PPRC primary and the Preserve Mirror feature is not enabled.
0	209 (X'D1')	PPRC Primary not Full Duplex or Preserve Mirror version 2 not installed.
0	256 (X'100')	The controller does not have the Preserve Mirror feature enabled.

Chapter 5. DFSMShsm and Cascading FlashCopy

With support for Cascading FlashCopy, DFSMShsm lifts some restrictions that previously existed related to FlashCopy and fast replication recovery. See changes marked with revision bars.

Fast replication is a function that uses volume-level fast replication to create backup versions for sets of storage groups. You define a set of storage groups with the SMS "copy pool" construct. Fast replication target volumes contain the fast replication backup copies of DFSMShsm-managed volumes. Fast replication target volumes are defined with the SMS "copy pool backup" storage group type. The fast replication backup versions on DASD can then be dumped to tape using either the FRBACKUP command or with Automatic Dump.

Recovery from the fast replication backup versions can be performed at the data set, volume, or copy pool level. The entire copy pool, individual volumes and data sets within a copy pool, can be recovered from the fast replication backup versions on DASD or tape. Individual data sets are recovered to the volume or volumes that they existed on at the time of backup.

The fast replication function enables the backup and recovery of a large set of volumes to occur within a small time frame. The fast replication function supports the FlashCopy and SnapShot functions.

Impacts to FlashCopy functions supported by DFSMShsm

Cascading FlashCopy impacts support for Incremental FlashCopy, specifically, recovering from a copy pool incremental version, and fast reverse restore, as described below.

Incremental FlashCopy

Incremental FlashCopy provides the capability to refresh a volume in a FlashCopy relationship by copying the changed data only. It reduces background copy time when only a subset of data has changed. An incremental FlashCopy relationship persists until it is withdrawn. DFSMShsm supports incremental FlashCopy in COPY mode.

For more information, see “Recovering from a copy pool incremental version” on page 21.

Fast reverse restore

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. When using fast reverse restore, it is best to keep dump tape copies in addition to DASD copies.

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. When the storage subsystem supports cascaded FlashCopy function, the additional FlashCopy targets will not need to be removed prior to attempting fast reverse restore. Ensure the correct backup version is specified on the command you intend to use for fast reverse restore.

For more information, see “Recovering a copy pool using fast reverse restore” on page 21.

Combining fast replication options in DFSMShsm

“Combining fast replication options in DFSMShsm” on page 19 shows the current allowable fast replication options in the DFSMShsm environment. Note, however, that IBM System Storage® DS8000® series might permit different combinations of FlashCopy options.

© Copyright IBM Corp. 2017, 2021

Table 2. Allowable combinations of fast replication options

Can FR option → be used with an FR operation or option ↓?	Multiple (up to 12) FlashCopy targets	COPY mode (Copy pool VERSIONS = 1 to 85)	NOCOPY mode (Copy Pool VERSIONS = 0)	Incremental FlashCopy	Preserve Mirror	FlashCopy SE	Fast reverse restore	FlashCopy consistency group
FRBACKUP COPYPOOL	Yes	Yes	Yes	Yes	Yes	Yes	Yes (1)	Yes
FRRECOV COPYPOOL	No	Yes	Yes/No (2)	Yes	Yes	Yes (2)	Yes	No
FRRECOV TOVOLUME	No	Yes	No (4)	Yes	Yes	No (4)	No	No
FRRECOV DSNAME	Yes	Yes	No (4)	No (5)	Yes	No (4)	No	No
Multiple (up to 12) FlashCopy targets	–	Yes	Yes (3)	Yes (6)	Yes	Yes (3)	Yes (7)	Yes
COPY mode	Yes	–	No	Yes	Yes	No	Yes	Yes
NOCOPY mode	Yes (3)	No	–	No	Yes	Yes	Yes	Yes
Incremental FlashCopy	Yes (6)	Yes	No	–	Yes	No	Yes	Yes
Preserve Mirror	Yes	Yes	Yes	Yes	–	No	No	Yes
FlashCopy SE	Yes (3)	No	Yes	No	No	–	Yes	Yes
Fast reverse restore	Yes (7)	Yes	Yes	Yes	No	Yes	–	Yes (8)
FlashCopy consistency group	Yes	Yes	Yes	Yes	Yes	Yes	Yes (8)	–

Notes:

1. When a copy pool is defined to allow for fast reverse restore, its copy pool backup versions will be created with fast reverse restore capability.
2. DFSMShsm FR copy pool recovery from NOCOPY or space efficient backup volumes can only be used with fast reverse restore. When the NOCOPY version is defined without fast reverse restore capability, the FRRECOV copy pool operation can be performed from dump tapes.
3. A DASD backup version created in NOCOPY mode without fast reverse restore capability is withdrawn when the dump tape has been created. A NOCOPY DASD backup version with fast reverse restore capability can be used for recovery and is kept until it is withdrawn, deleted, or replaced.
4. FRRECOV in VERSIONS=0 environment can be performed FROMDUMP.
5. If there is an existing incremental or persistent relationship, the FRRECOV data set recovery command can be performed using standard I/O. The FASTREPLICATION (PREFERRED | NONE)) parameter can be specified to override the SETSYS FASTREPLICATION(DATASETRECOVERY) specification. You can also specify FROMDUMP to recover from dump tapes.
6. When the software and microcode requirements are met, Incremental FlashCopy requests result in Incremental FlashCopy Version 2 (V2), which allows a volume to have more than one incremental relationship. With Incremental FlashCopy Version 1 (V1), a FlashCopy source can have only one incremental target.
7. Multiple backup copies with fast reverse restore capability can be created. When the storage subsystem supports cascaded FlashCopy function, additional FlashCopy targets do not need to be removed before using fast reverse restore. Otherwise, only one relationship can exist when fast reverse restore is used; all additional relationships must be removed before fast reverse restore is initiated or the FRR operation will fail.

8. A copy pool can be defined with either or both the FlashCopy consistency group option and fast reverse restore capability. In the case where both FlashCopy consistency group = Yes and fast reverse restore = Yes are designated, the copy pool will be backed up using the FlashCopy consistency group option; the copy pool backup DASD version will have fast reverse restore capability. When FRRECOV COPYPOOL FROMDASD is performed, fast reverse restore will be used. Consistency groups will not be used in any FRRECOV operation.

Recovering from a copy pool incremental version

There are no additional keywords to recover from a DASD copy pool incremental version. When a volume from an incremental version or a copy pool incremental version is recovered, only the tracks that have changed since the time the backup version was created are copied back to the source volumes. After the background copy for the recovery is complete, the persistent incremental relationships are withdrawn. The copy pool still remains incremental, and the incremental relationships are re-established once the new incremental version is created. When the new backup copy is created for the incremental version, the FlashCopy incremental relationship is re-established by creating a full copy of each volume.

The following restrictions apply to recovering from an incremental version:

- The FlashCopy incremental relationship must be the only relationship when the storage subsystem does not support cascaded FlashCopy.
- To use reverse restore, the background copy must have completed.
- To use fast reverse restore, the background copy must be in progress.

When recovering from an incremental copy pool version, the FlashCopy incremental relationship must be the only relationship when cascaded FlashCopy is not supported by the storage subsystem. When unsupported, if there are multiple incremental FlashCopy relationships, the unwanted FlashCopy targets (backup versions) must be removed prior to attempting recovery. The FRBACKUP WITHDRAW or FRDELETE commands can be used to remove DFSMShsm managed backups.

In a configuration where the storage subsystems do not support cascaded FlashCopy, when a non-incremental copy pool version is recovered while an incremental version exists, the FlashCopy incremental volume relationships are withdrawn if the background copies of the incremental volume relationships have completed. The incremental version remains recoverable. If the FlashCopy incremental background copies are still active at the time the non-incremental version recovery is requested, the request fails. If the FlashCopy incremental relationships for the incremental version are persistent, individual volume recovery using the TOVOLUME keyword from a non-incremental copy pool version fails regardless of completion of the background copy.

Recovering a copy pool using fast reverse restore

You can use the FRRECOV COPYPOOL(*cpname*) command to recover all volumes associated with the named copy pool defined with fast reverse restore capability. DFSMShsm saves the copy pool fast reverse restore capability setting at the time of the fast replication backup. There are no additional keywords to specify to recover from a DASD copy pool fast reverse restore eligible version. If the state of the FlashCopy relationships meet the fast reverse restore requirements, DFSMShsm uses fast reverse restore to recover the copy pool. Otherwise, DFSMShsm will use regular FlashCopy if the background copy has completed.

Following a successful fast reverse restore, the contents of the DASD backup volume become invalid. DFSMShsm invalidates and initializes the individual DASD backup volume so it is ready to be reused. When the entire copy pool has been successfully recovered, DFSMShsm invalidates the DASD copy pool backup version.

If some of the volumes fail to recover, the FASTREPLICATIONSTATE of the DASD version becomes FCFRRINCOMPLETE. You can issue the FRRECOV COPYPOOL(*cpname*) command again after you have addressed the reason for the failure. DFSMShsm will try to recover the remaining volumes again using fast reverse restore.

Using fast reverse restore does not require the removal of all other FlashCopy targets when cascaded FlashCopy is supported by the storage subsystems. For a successful fast reverse restore when multiple targets are not supported, verify there are not multiple FlashCopy targets before issuing the FRRECOV COPYPOOL(*cpname*) command.

To determine if a copy pool is defined to allow fast reverse restore and select a fast reverse restore eligible backup version, issue LIST COPYPOOL (*cpname*). If the copy pool is defined allowing fast reverse restore at time of backup, the output displays the backup version with: FCFRR=Y. Otherwise, the output contains: FCFRR=N.

Example: LIST COPYPOOL(CP1) will list information about the copy pool named CP1, which is defined to allow fast reverse restore.

```
LIST COPYPOOL(CP1) OUTDATASET

-- DFSMShsm CONTROL DATASET --COPY POOL--LISTING -- AT 09:25:44 ON 09/03/07 FOR SYSTEM=1234

COPYPOOL=CP1
ALLOWPPRCP FRB=PN FRR=PN

VERSION  VTOCENQ     DATE           TIME     FASTREPLICATIONSTATE  DUMPSTATE
  002       Y      2009/03/06      16:35:24   RECOVERABLE           ALLCOMPLETE
TOKEN(C)=C''
TOKEN(H)=X''
TOTAL NUM OF VOLUMES=00002,INCREMENTAL=N,CATINFO=N,FCFRR=Y,RECOVERYINCOMPLETE=N
```

To determine if fast reverse restore can be used for a copy pool version, issue the QUERY COPYPOOL command. When fast reverse restore can be used, the QUERY COPYPOOL command output will display "background copy percent-complete" (PCT-COMP) information other than "***". Percent-complete information (a percentage) is available for full-volume FlashCopy pairs with an incomplete background copy only. A full-volume FlashCopy relationship is established when the FlashCopy technique (such as fast reverse restore or incremental) designates it, or when SETSYS FASTREPLICATION(FCRELATION(FULL)) has been specified.

Because fast reverse restore will invalidate the entire DASD backup version following a successful recovery, you can use the PCT-COMP percentage to determine how far along the background copy is and decide whether fast reverse restore should be used for recovery.

Note:

1. A DASD backup version can be used for fast reverse restore only once because the process invalidates the data on the backup volume. Keep dump tape copies in addition to DASD backup copies when you plan to use the fast reverse restore function.
2. VERIFY(N) cannot be specified when the copy pool is defined allowing fast reverse restore unless a previous FRRECOV COPYPOOL operation has determined the copy pool backup version is no longer eligible to use fast reverse restore. Regular fast replication recovery can be used instead.
3. When a recovery operation such as fast reverse restore from a DASD backup will invalidate an existing DASD copy that has an incomplete dump copy, the recovery operation fails. To force the use of a DASD copy with an incomplete dump copy, specify the FORCE parameter on the FRRECOV command.
4. The preserve mirror operation cannot be used in combination with fast reverse restore. Do not specify PMPREF or PMREQ in the **FRBACKUP to PPRC Primary Volumes allowed** or **FRRECOV to PPRC Primary Volumes allowed** fields for a copy pool defined allowing fast reverse restore.
5. Do not use the TOVOLUME operation to recover individual volumes in a copy pool defined with fast reverse restore capability.

Considerations for the FRRECOV command

The following topics are related to your use of the FRRECOV command:

- **Before processing an FRRECOV COPYPOOL command:** DFSMSdss restores a volume only if the volume is not allocated to another job. If the volume contains a catalog, the catalog address space in a DFSMSdfp environment may have the catalog (and the volume) allocated. If the copy pool catalog

names are specified in the SMS copy pool definition, DFSMShsm attempts to unallocate the catalogs prior to recovery. If the catalog names are not specified in the copy pool definition or the unallocation fails, follow these steps:

1. Issue the F CATALOG,OPEN(*volser*) command to determine which catalogs on the target volume are allocated.
2. For each catalog that is open, issue the F CATALOG,UNALLOCATE (*catalogname*) to cause the catalog address space to close the catalog and deallocate it. When the last catalog on the volume is deallocated, the target volume is also deallocated by the catalog address space.
3. Issue a D U,,,addr,1 command to ensure that the volume is not allocated by another user.
4. If the volume is not marked as allocated, issue the FRRECOV command to DFSMShsm.

- **Modifying FRRECOV wait time for unallocating catalogs:** In a Common Recover Queue SYSPLEX environment, FRRECOV will issue the catalog unallocate command for each catalog name specified in the copy pool definition at the time of the FRRECOV. Wait time applies to all catalogs in the copy pool definition, it is not per catalog.

  The wait time allows users to modify the amount of time FRRECOV will wait for the catalog to be unallocated prior to continuing with the recover process. The wait time is only utilized if operating in a CVQ environment or environment where the FRGCBF_ROUTEALL_UNALLOC bit has been patched on in the FRGCB.

  The FRGCBF_ROUTEALL_UNALLOC bit defaults to ON in release V2R3 and later.

  The default time is 3 seconds, a wait of 3 seconds = 300 one- hundredths of a second. This wait time can be adjusted with a patch to the FRGCB. For example, to change from 3 seconds to 6 seconds:

  ```
  PATCH .FRGCB.+84 X'00000258' VERIFY(.FRGCB.+84 X'0000012C')
  ```

  The field name being patched is FRGCB_CAT_UNALLOC_WTIME. If you do not want a wait time to be used, then patch the FRGCB_CAT_UNALLOC_WTIME field to X'00000000'.

- **Processing an FRRECOV command:** When SnapShot is used as the fast replication utility, a recovery can be performed immediately after the DFSMShsm FRBACKUP command completes.

  When FlashCopy is used as the fast replication utility, a recovery from a fast replication backup cannot be performed if any of the volumes are in an existing FlashCopy relationship unless fast reverse restore is to be used. If fast reverse restore is not intended, do not attempt to recover the copy pool until all of the background copies have completed from an invocation of the FRBACKUP command. You can use the QUERY COPYPOOL command to determine if any of the source volumes for a copy pool are in a FlashCopy relationship.

  When a copy pool is defined without fast reverse restore capability, you can use the FRRECOV command with the VERIFY keyword to prevent the initiation of a recovery of a copy pool for which all of the background copies from the backup have not yet completed. When you specify VERIFY(Y), before initiating any volume recoveries, DFSMShsm first determines if any of the volumes are in an existing FlashCopy relationship. If so, the recover fails. If you need an immediate recovery, you have two options:

  1. Wait until all of the background copies have completed. Then the latest backup version can be used for the recovery.
  2. For FlashCopy version 1, withdraw the outstanding FlashCopy relationships using the FRBACKUP COPYPOOL(*cpname*) WITHDRAW command. Doing this invalidates the latest version of the backup and enables an immediate recovery from the prior version. This process only works for FlashCopy version 2 when the generation 1 background copies are complete.

     Attention: Use the LIST COPYPOOL command or the ARCXTRCT macro to ensure that you do not invalidate the only valid fast replication backup version.

  When a copy pool is defined with fast reverse restore capability, the VERIFY(Y) keyword allows DFSMShsm to determine whether fast reverse restore or regular FlashCopy can be used. For more information, see “Recovering a copy pool using fast reverse restore” on page 21.

- **TSO usage considerations:** When you use commands that specify WAIT or NOWAIT, the results sent back to the user depend on whether the WAIT parameter is specified and the success or failure of one or more volumes:
  - If WAIT is specified and all volumes process successfully, a return code of zero is returned.
  - If WAIT is specified and one or more volumes fail, a nonzero return code and associated messages are returned.
  - If WAIT is not specified, control is returned to the system after the command has been accepted and verified. All messages continue to be issued, but you are not notified when the command completes.
- **Trying a copy pool recovery again:** During recovery of a copy pool, one or more volumes might fail to be recovered. In order to complete the recovery, you must identify and correct the cause of the failures. After correcting the cause of the failures, your options for completing recovery depend on the source of the recovery (DASD or tape) and if fast reverse restore was used.
  - When the copy pool was recovered from DASD without using fast reverse restore (that is, the background copy completed before the recovery began), you can try to recover the individual volumes that failed, or try to recover the entire copy pool again.
    - If a small number of volumes failed recovery, issue a FRRECOV COPYPOOL(*cpname*) TOVOLUME(*volser*) command for each volume to try recovery of that volume again.
    - If FlashCopy version 2 or SnapShot is your fast replication utility, you can immediately try to recover the entire copy pool again.
    - If FlashCopy version 1 is your fast replication utility, you must wait for the FlashCopy relationships that were successfully established during the prior recovery to complete before you can try to recover the copy pool again.
  - When the copy pool was recovered from DASD using fast reverse restore or the recovery was from tape, the recovery can be resumed. This is possible because the recovery status of each volume in the copy pool is tracked in the CDS records. The LIST COPYPOOL(*cpname*) command can be used to determine if a copy pool version previously failed recovery. If the recovery of a copy pool version failed, the LIST COPYPOOL output will indicate "RECOVERYINCOMPLETE=Y" and, if fast reverse restore was used, the fast replication state will be FCFRRINCOMPLETE. To resume recovery of the copy pool, issue a FRRECOV COPYPOOL(*cpname*) command specifying the same token, version, date, or generation as the failed command. The volumes that failed during the prior recovery are determined and a recovery is attempted for only those volumes that failed.

Note:

1. If the initial copy pool recovery was from a DASD version using fast reverse restore (the FASTREPLICATIONSTATE is FCFRRINCOMPLETE) and the recovery is resumed from a dump version, the default is to resume recovery of the remaining volumes. You can specify RESUME(NO) to perform a full recovery from tape. The copy pool DASD backup version will be invalidated when the copy pool recovery is completed successfully.
2. If the initial copy pool recovery was from a dump tape version and you are now trying to recover from the DASD version, a full recovery is performed.
3. The VTOC and the volume serial on the target volume may have changed as a result of the command. Before the volume can be accessed on any remote system, the UCB must be refreshed. The refresh occurs automatically if the volume is online and the device manager REFUCB function is enabled. You enable the REFUCB function through PARMLIB member DEVSUP*xx* or the MODIFY DEVMAN command. For more information, refer to the description of the REFUCB keyword in *z/OS MVS Initialization and Tuning Reference* or *z/OS MVS System Commands*.

FRRECOV command: Requesting a fast replication recovery

The FRRECOV command can be used to recover a copy pool or individual volumes and data sets from the managed copy pool copies. The backup copy to be recovered can reside on either DASD or tape. If the backup copy resides on both DASD and tape, the default is to use the DASD backup copy.

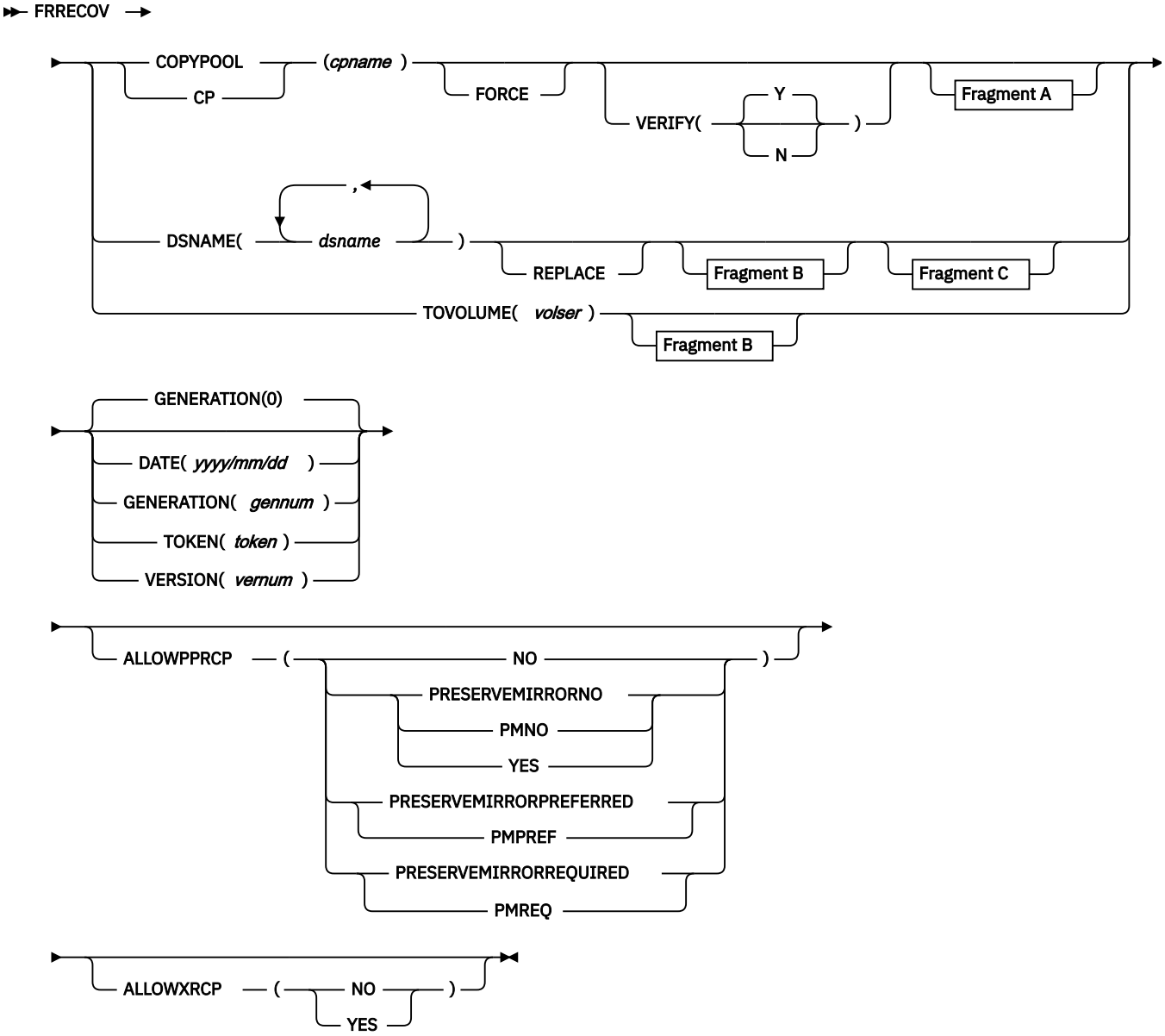
To restrict the recovery to only backup copy versions residing on DASD or tape, use the FROMDASD or FROMDUMP options, respectively. If the backup copy version is not found on either DASD or tape, the recovery request will fail.

When DATE, GENERATION, TOKEN, or VERSION is specified, the corresponding backup copy will be recovered. If no specific backup copy is specified, an attempt to recover generation zero will occur. If no valid backup copy (either the indicated or implicit) is found, on DASD or tape, the recovery request will fail.

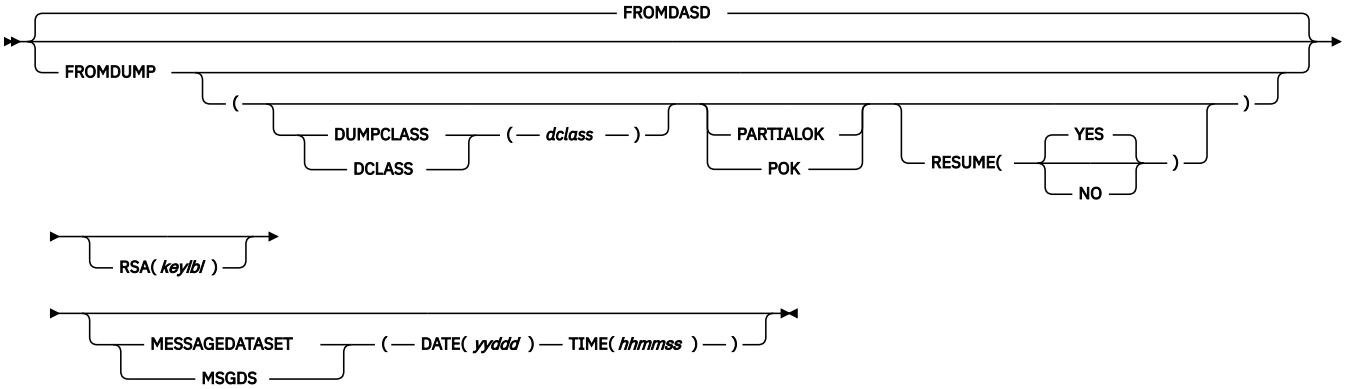
A specific dump class to recover the version from can be specified when recovering from a dump copy on tape. When recovery is performed at the copy pool level, and the dump copy to recover is a partial dump, the recovery request will fail unless the PARTIALOK option is specified.

Cascading FlashCopy affects the TOVOLUME and VERIFY parameters.

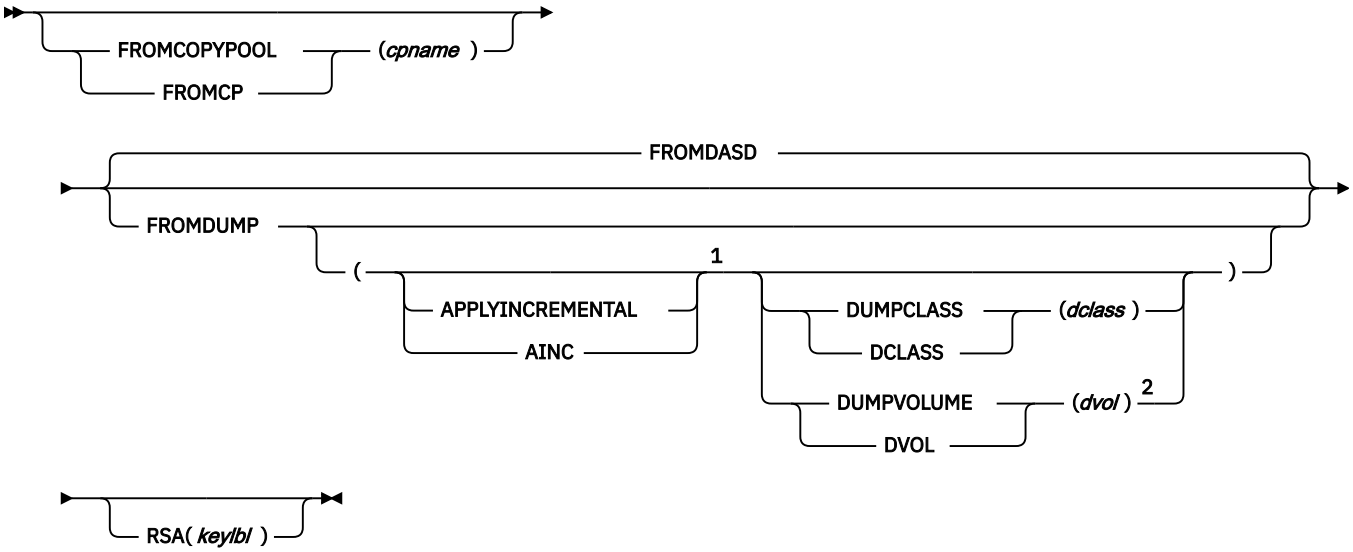
Syntax of the FRRECOV command



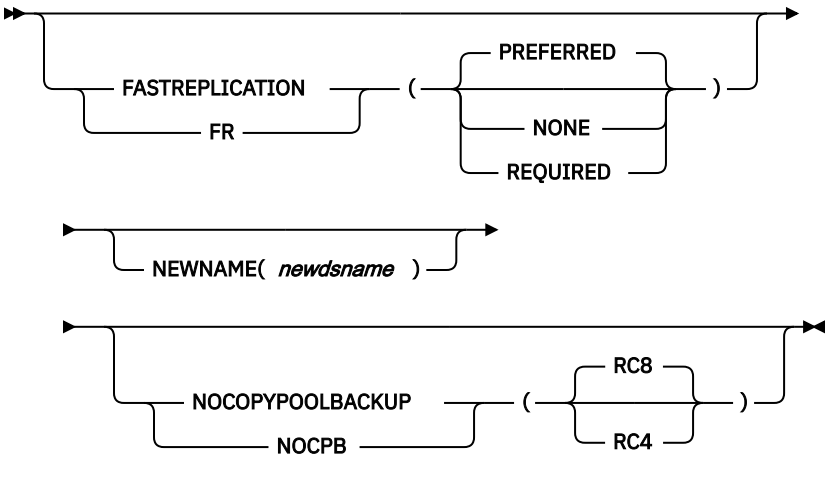
A: COPYPOOL and TOVOLUME optional parameters



B: DSNAME and TOVOLUME optional parameters



C: DSNAME only optional parameters



Notes:

[1] APPLYINCREMENTAL is valid only with the TOVOLUME keyword and is applicable only when the recovery is from a dump volume.

[2] FROMDUMP(DUMPVOLUME(*dvol*)) is mutually exclusive with the DATE, GENERATION, TOKEN, and VERSION parameters.

TOVOLUME: Specifying a single volume within a copy pool to recover

Explanation: TOVOLUME is a required parameter that is mutually exclusive with the DSNAME and COPYPOOL parameters. The TOVOLUME parameter indicates to DFSMShsm to recover a single volume within a copy pool.

For *volser*, specify the name of the source volume to be recovered. If you specify a source volume that is contained within a storage group that is defined within multiple copy pools, then you must also specify FROMCOPYPOOL(*cpname*).

You can use the LIST PRIMARYVOLUME BCDS command to determine which copy pools a volume is contained within. You can then use the LIST COPYPOOL(*cpname*) command to determine which of those copy pools contains the version that you want recovered.

Note: Do not use the TOVOLUME operation to recover individual volumes in a copy pool that are defined with fast reverse restore capability.

Defaults: None.

VERIFY: Verifying that no unexpected FlashCopy relationship exists for a volume in a copy pool

Explanation: VERIFY is an optional parameter that specifies whether verification, of conditions which might prevent a successful fast replication recovery, is performed *before* starting a fast replication recovery operation. Performing verification reduces the risk of a fast replication recovery failure. The following condition is verified:

1. The copy pool is defined allowing fast reverse restore, but one or more DASD are in the process of being dumped to tape.

The following conditions are verified when the devices do not support cascaded FlashCopy:

1. The copy pool is not defined allowing fast reverse restore, but one or more volumes are in an existing FlashCopy relationship.
2. The copy pool is defined allowing fast reverse restore, but there are multiple FlashCopy targets, including non-DFSMShsm managed targets, associated with a source volume in the copy pool. Additional FlashCopy targets need to be removed before attempting fast reverse restore when cascaded FlashCopy is not supported.
3. There are multiple FlashCopy Incremental FlashCopy targets associated with a source volume in the copy pool.

The following options can be used with the VERIFY parameter:

Y
specifies that source volumes require verification. This option is the default.

N
specifies that source volumes do not require verification. Use VERIFY(N) only when all volumes are SnapShot capable, or if the QUERY COPYPOOL command has been issued to verify that there are not any unexpected FlashCopy relationships.

Note:

1. VERIFY(N) cannot be specified when a copy pool is defined allowing fast reverse restore unless a previous FRRECOV COPYPOOL operation has determined the copy pool backup version is no longer eligible for fast reverse restore and regular fast replication recovery can be used.

Defaults: If you do not specify the VERIFY parameter, the default is Y (verification is performed).

Chapter 6. DFSMSdss COPY command with Cascading FlashCopy

Cascading FlashCopy affects the requirement to withdraw copies prior to using FASTREVERSERESTORE. See changes marked with revision bars.

The DFSMSdss COPY command performs data set movement, volume movement, and track movement from one DASD volume to another.

You can copy data sets to another volume of either like or unlike device types. Like devices have the same track capacity (3390 Model 2 and 3390 Model 3), while unlike devices have different track capacities (3380 Model K and 3390 Model 3).

However, the DASD must be of *like* device type if you copy a full volume, range of tracks, or physically copy a data set. The user must specify the source volumes and the target volumes. DFSMSdss only allows one source volume and one target volume.

DFSMSdss offers two ways to process COPY commands as follows:

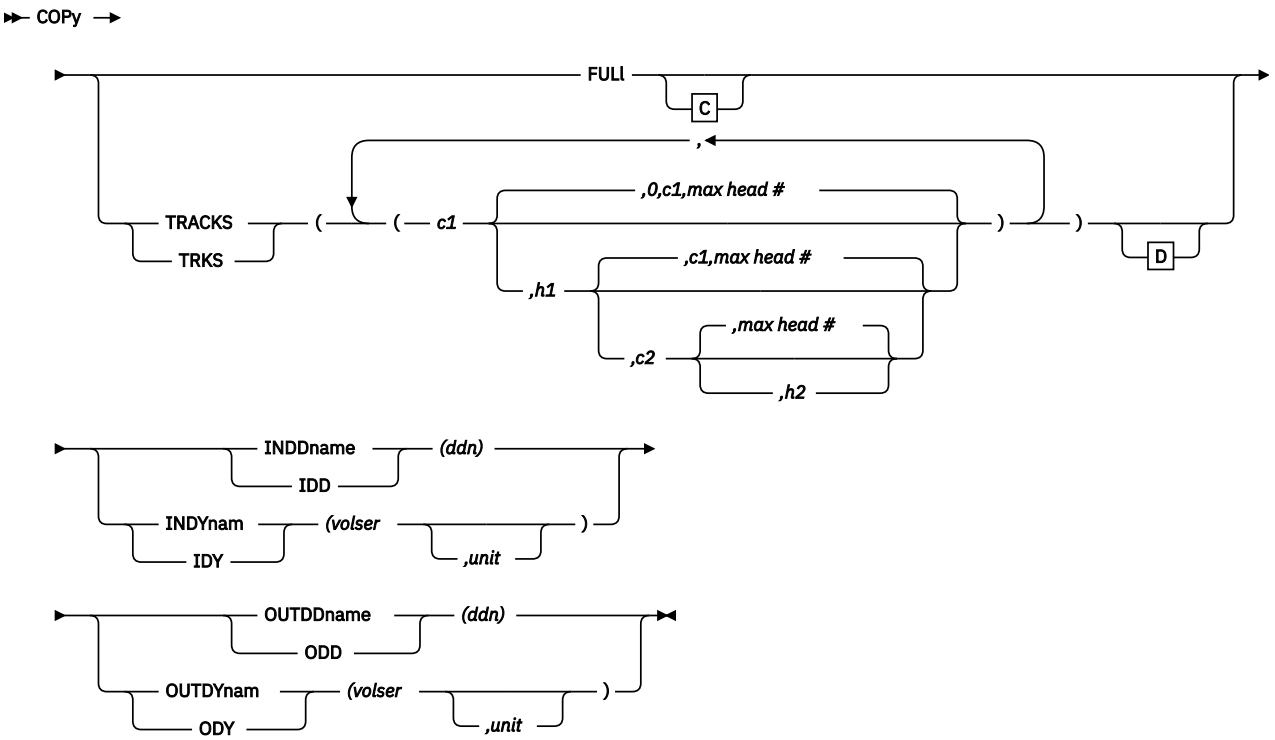
- *Logical processing* is data set-oriented, which means that it operates against data sets and volumes independently of physical device format.
- *Physical processing* can operate against data sets, volumes, and tracks, but is oriented toward moving data at the track-image level. The processing method is determined by the keywords specified on the command.

Integrated catalog facility catalogs should not have a high-level qualifier of SYSCTLG because this causes DFSMSdss to treat them as control volumes.

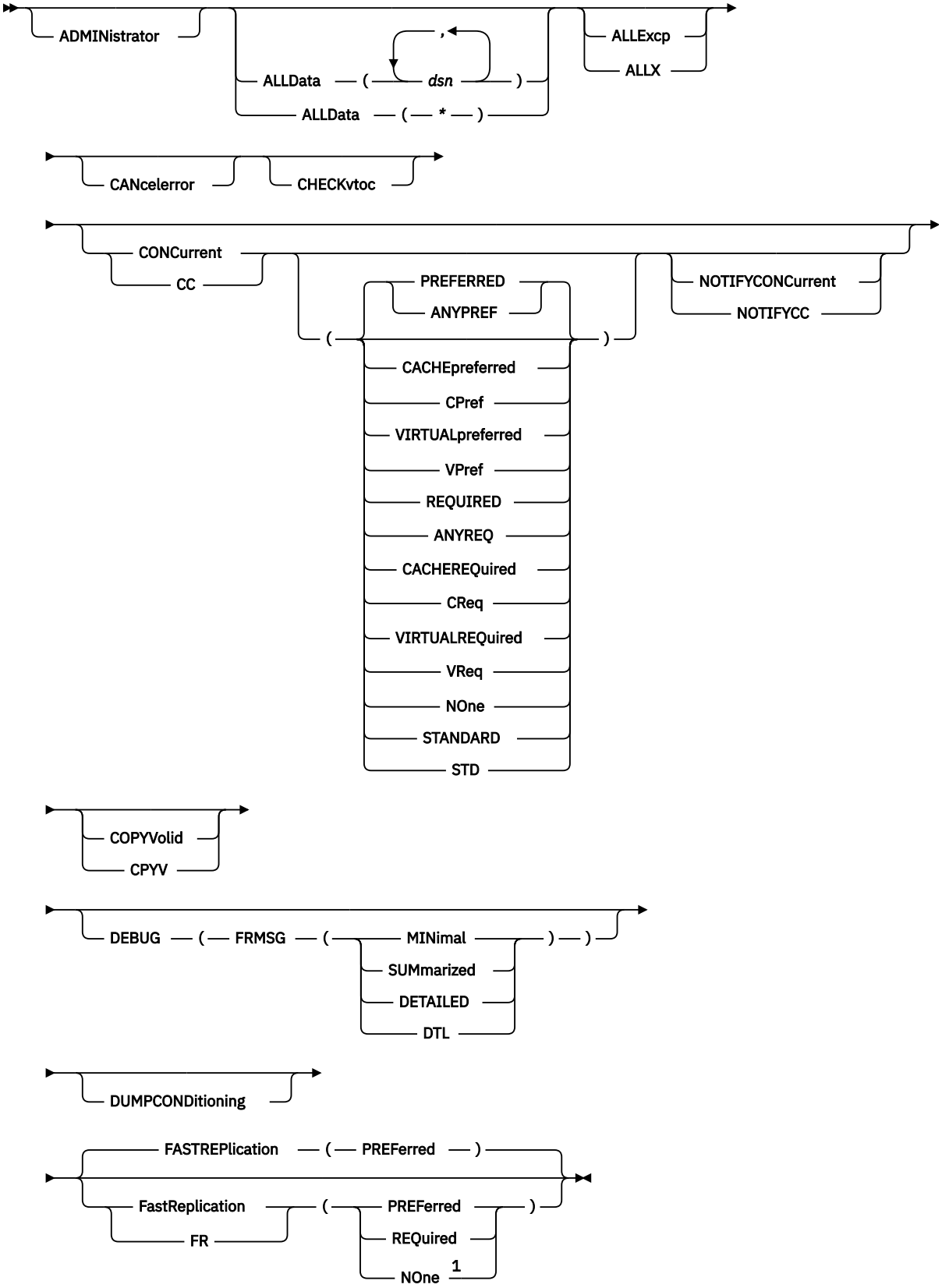
DFSMSdss COPY will always preserve data set encryption attributes of the source data set. Therefore, new allocations will be defined with the source encryption attribute. If a pre-allocated target data set is encountered, it must also be encrypted to be considered a usable target data set. The usable pre-allocated target will be overwritten with the source encryption attributes (which includes the key label).

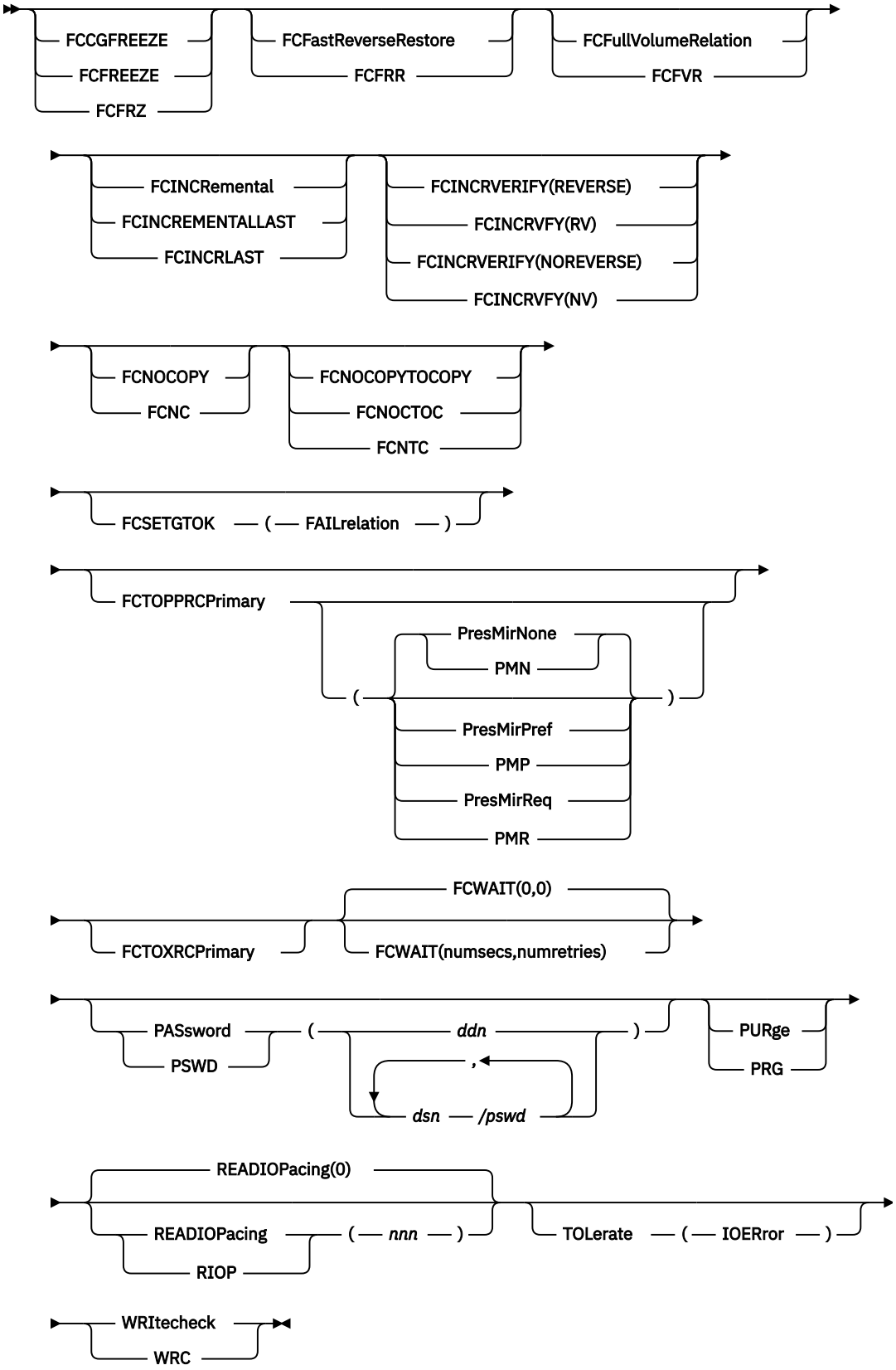
© Copyright IBM Corp. 2017, 2021

COPY FULL and COPY TRACKS syntax

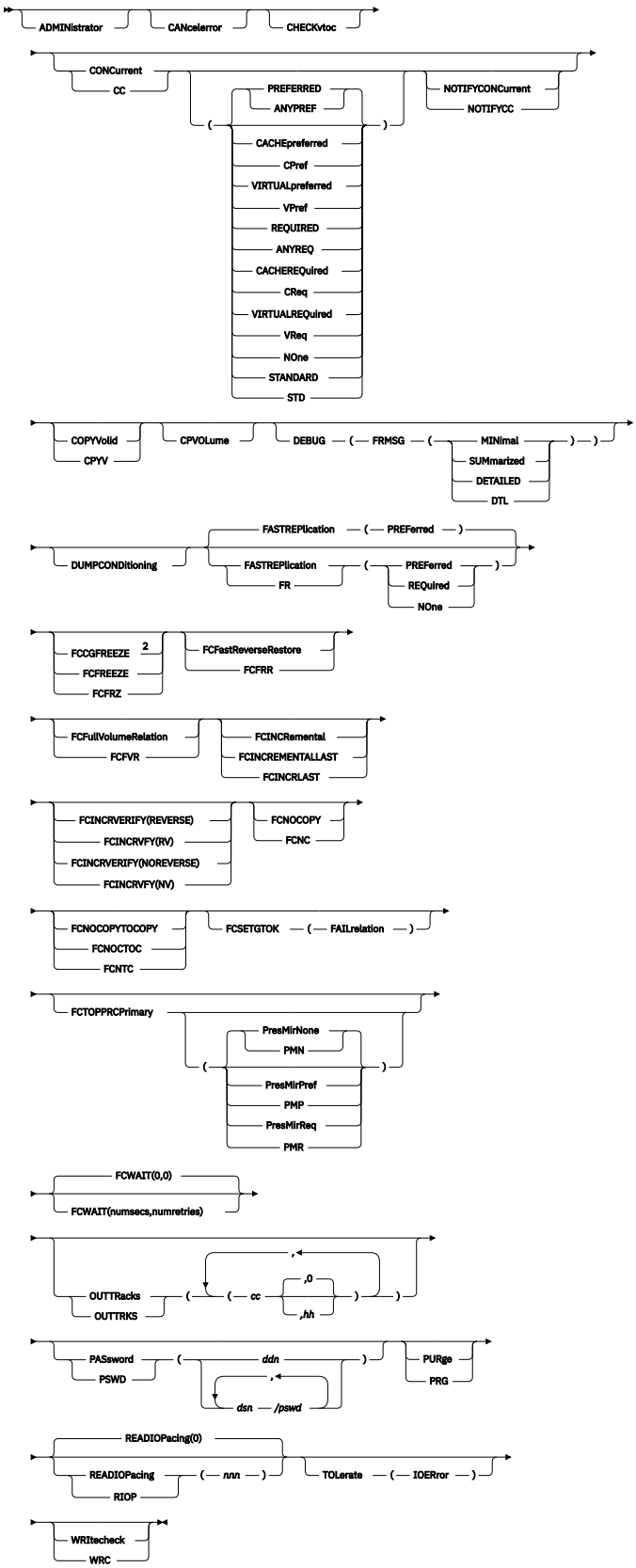


C: Optional Keywords with COPY FULL


ADMINistrator
ALLData (dsn ,)
ALLData (*)
ALLExcp
ALLX
CANcelerror
CHECKvtoc
CONCurrent
CC
(PREFERRED
ANYPREF
CACHEpreferred
CPref
VIRTUALpreferred
VPref
REQUIRED
ANYREQ
CACHEREQuired
CReq
VIRTUALREQuired
VReq
NOne
STANDARD
STD)
NOTIFYCONCurrent
NOTIFYCC
COPYVolid
CPYV
DEBUG (FRMSG (MINimal
SUMmarized
DETAILED
DTL))
DUMPCONDitioning
FASTREPlication (PREFerred)
FastReplication
FR
(PREFerred
REQuired
NOne 1)



D: Optional Keywords with COPY TRACKS



Notes:

[1] Do not use the FASTREPLICATION (NONE) keyword with the FCFULLVOLUMERELATION, FCNOCOPY, FCSETGTOK, or FCTOPPRCPRIMARY keywords.

[2] For COPY TRACKS operations, the FCCGFREEZE, FCINCREMENTAL, and FCINCREMENTALLAST keywords require that the CPVOLUME keyword be specified, too. For more information, see the keyword descriptions.

FCFASTREVERSERESTORE

FCFASTREVERSERESTORE specifies that the use of fast reverse restore is required. Fast reverse restore gives the option to restore a FlashCopy source from its FlashCopy target without having to wait for completion of the background copy operation.

A FlashCopy relationship must exist between the source and the target and must be a single FlashCopy relationship that covers the entire volume (from track 0 through the last track on the volume). The relationship can be an incremental FlashCopy relationship.

The existence of a FlashCopy relationship will be verified. If a relationship does not exist between the source and the target, the fast reverse restore request will fail. Verification can be bypassed using ADRUFO, however, it will be difficult to determine the cause of a request failure.

The contents of the source volume, which is the original target of a FlashCopy operation, are unpredictable after the fast reverse restore operation is complete and should not be used.

Note:

1. Do not specify FCFASTREVERSERESTORE with any of the following keywords:
   - FCTOPPRCPRIMARY (PRESMIRPREF | PRESMIRREQ)
   - FASTREPLICATION (PREFERRED | NONE)
   - CONCURRENT, FCFREEZE, FCINCREMENTAL, FCINCREMENTALLAST, FCINCRVERIFY, FCNOCOPYTOCOPY, FCWAIT
   - FCTOXRCPRIMARY
2. The source and target device capacity must be the same.
3. If the target volume specified is the source volume of other FlashCopy relationships, and the storage subsystem does not support Cascaded FlashCopy relationships, then those copies must be withdrawn prior to using FCFASTREVERSERESTORE. Otherwise the request will fail.
4. ADRUFO can be configured to retry a failed FlashCopy recovery without the use of fast reverse restore. If the subsequent attempt is successful, a new FlashCopy relationship between the specified source and target volumes will be created.

Chapter 7. Messages

This topic includes the messages that are new or changed for Cascading FlashCopy. These are marked with revision bars.

DFSMS system data mover (SDM) messages

This topic describes the DFSMS system data mover (SDM) messages that are affected by Cascading FlashCopy.

ANTF0447E **FLASHCOPY ESTABLISH DEVICE *device-number* IS IN AN INVALID STATE**

Explanation

The FlashCopy establish request issued to device number *device-number* failed because the current state of the existing FlashCopy relationship does not allow the establish to complete.

The following hexadecimal RSN codes xx will give a general indication of what caused the error:

RSN code
Explanation

00
Reason not specified see below for possible reasons the request could not be completed

01
Establish FlashCopy specified starting a new changerecording relation and a change recording relation alreadyexists between the two specified volumes.

02
Establish FlashCopy specified Start/Continue Change Recording Type 1, Restore and Change Recording Type 1 was NOT active for the specified source and target.

03
Establish FlashCopy specified Start/Continue Change Recording Type 2, Restore (and Change Recording Type 2 was NOT active for the specified source and target.

04
For Establish FlashCopy, no relationship was found for the restore, FlashCopy increment, or the fast reverse restore request.

05
Establish FlashCopy change recording type mismatch. Establish FlashCopy specified Start/Continue Change Recording Type 1 and a Change Recording Type 2 relationship exists for the specified source and target volume OR Establish FlashCopy specified Start/Continue Change Recording Type 2 and a Change Recording Type 1 relationship exists for the specified source and target volume.

06
Establish FlashCopy specified Revertible and the relationship was already in a revertible state and its sequence number is NOT equal to the sequence number specified.

07
Establish FlashCopy specified Revertible and the specified source and target volumes will reverse the original relationship.

08
Establish FlashCopy specified Fast Reverse Restore and the relationship is NOT reversed by the specified parameters.

09
Establish FlashCopy specified Restore and not Fast Reverse Restore or specified Revertible AND a previous Establish FlashCopy specified Fast Reverse Restore for the relationship.

© Copyright IBM Corp. 2017, 2021

0A
Establish FlashCopy specified Restore or Revertible AND the relationship is in a failed state due to out of space condition on a space efficient target volume or the volume is fenced.

0E
An error has occurred on the Remote Peer-to-Peer Remote Copy Control Unit or Global Mirror Subordinated Control Unit.

0F
The Establish FlashCopy specified target volume is a Peer-to-Peer Remote Copy Primary Volume and the volume is waiting to release space.

11
Establish FlashCopy specified a source or target volume that is in an existing relationship and that relationship is in a revertible state.

12
Establish FlashCopy specified a source volume that is the target of an existing incremental relationship and the incremental copy has not completed for the other relationship.

14
Establish FlashCopy specified a source volume that is the target volume of an existing relationship and the existing relationship for the volume is in the failed state

26
A FlashCopy Establish command was not successful because Global Mirror is forcing a consistency group which prevents the use of FlashCopy.

If the RSN insert is not present or is zero some possible reasons the request could not be completed are:

- The request was to reverse an existing FlashCopy relationship, but change recording is not active for the specified relationship.
- The request was to do an establish with change recording, but the full volume relationship was not initially established with change recording.
- The request is attempting to create more than one relationship with Version 1 change recording.
- The request is attempting to restore a relationship that was created with Version 2 change recording but Version 2 change recording has been disabled by the MULTINCRFLC=NO setting in the DEVSUP*xx* member PARMLIB.

System action

The command is rejected.

System programmer response

Verify the FlashCopy state of the existing relationship is correct and resubmit the request. If the request continues to fail, contact the IBM Support Center.

Source

ESS FlashCopy

ICKDSF messages affected by Cascading FlashCopy

This topic describes the ICKDSF messages that are affected by Cascading FlashCopy.

ICK34102I MAXIMUM NUMBER OF FLASHCOPY RELATIONSHIPS HAS BEEN EXCEEDED

Explanation

The command cannot complete because the maximum number of Flashcopy relationships has been exceeded for one or more of the source or target tracks specified in the Flashcopy extents.

System action

The command ends.

Operator response

None.

System programmer response

The number of relationships can be reduced by withdrawing existing relationships or waiting for existing relationships to complete (via background copy completing). Background copy completion can be monitored via the FLASHCPY QUERY RELATIONS command.

ICK34104I REQUEST SPECIFIES THAT EXISTING TARGET TRACK BECOME A SOURCE TRACK

Explanation

The command cannot complete because it has specified that an existing target track become a source track. A target track may have only one source.

System action

The command ends.

Operator response

None.

System programmer response

Ensure the device for which the command is intended is the one specified and, if so, then Flashcopy relationships may have to be withdrawn in order to successfully complete this request.

ICK34108I REQUEST SPECIFIES THAT EXISTING TARGET TRACK BECOME A TARGET TRACK

Explanation

The command cannot complete because it specifies that an existing target track become a target track. A target track may have only one source.

System action

The command ends.

Operator response

None.

System programmer response

Ensure the device for which the command is intended is the one specified and, if so, then Flashcopy relationships may have to be withdrawn in order to successfully complete this request.

ICK34109I REQUEST SPECIFIES THAT EXISTING SOURCE TRACK BECOME A TARGET TRACK

Explanation

The command cannot complete because it specifies that an existing source track become a target track. A target track may have only one source.

System action

The command ends.

Operator response

None.

System programmer response

Ensure the device for which the command is intended is the one specified and, if so, then Flashcopy relationships may have to be withdrawn in order to successfully complete this request.

ICK34111I STATE OF EXISTING FLASHCOPY RELATION DOES NOT ALLOW SPECIFIED REQUEST, RSN=*xx*

Explanation

The state of the existing Flashcopy relation does not allow the specified request to be processed.

Reason code *xx* indicates the reason for the error:

00
indicates that the reason code qualifier was not returned. Some possible reasons the request could not be completed are:

- The request was to reverse an existing Flashcopy relationship. However, change recording is not active for the specified relationship.
- The request was to do an establish with change recording, but the full volume relationship was not initially established with change recording.
- The request is attempting to create more than one relationship with version 1 change recording.
- The request is attempting to restore a relationship that was created with version 2 change recording but version 2 change recording

has been disabled by MULTINCRFLC=NO in the DEVSUP*xx* member of PARMLIB.

01

Establish FlashCopy specified starting a new change recording relation and a change recording relation already exists between the two specified volumes.

02

Establish FlashCopy specified Start/Continue Change Recording Type 1, Restore and Change Recording Type 1 was NOT active for the specified source and target.

03

Establish FlashCopy specified Start/Continue Change Recording Type 2, Restore and Change Recording Type 2 was NOT active for the specified source and target.

04

For Establish FlashCopy, no relationship was found for the restore, FlashCopy increment, or the fast reverse restore request.

05

Establish FlashCopy change recording type mismatch. Establish FlashCopy specified Start/Continue Change Recording Type 1 and a Change Recording Type 2 relationship exists for the specified source and target volume OR Establish FlashCopy specified Start/Continue Change Recording Type 2 and a Change Recording Type 1 relationship exists for the specified source and target volume.

06

Establish FlashCopy specified Revertible and the relationship was already in a revertible state and its sequence number is NOT equal to the sequence number specified.

07

Establish FlashCopy specified Revertible and the specified source and target volumes will reverse the original relationship.

08

Establish FlashCopy specified Fast Reverse Restore and the relationship is NOT reversed by the specified parameters.

09

Establish FlashCopy specified Restore and not Fast Reverse Restore or specified Revertible AND a previous Establish FlashCopy specified Fast Reverse Restore for the relationship.

0A

Establish FlashCopy specified Restore or Revertible AND the relationship is in a failed state due to out of space condition on a space efficient target volume or the volume is fenced.

0B

Withdraw FlashCopy specified Revert or Commit AND the relationship is in a failed state.

0C

Withdraw FlashCopy specified Revert or Commit AND the relationship does not exist for the specified volumes.

0E

An error has occurred on the Remote Peer-to-Peer Remote Copy Control Unit or Global Mirror Subordinated Control Unit.

0F

The Establish FlashCopy specified target volume is a Peer-to-Peer Remote Copy Primary Volume and the volume is waiting to release space.

11

Establish FlashCopy specified a source or target volume that is in an existing relationship and that relationship is in a revertible state.

12

Establish FlashCopy specified a source volume that is the target of an existing incremental relationship and the incremental copy has not completed for the other relationship.

14

Establish FlashCopy specified a source volume that is the target volume of an existing relationship and the existing relationship for the volume is in the failed state.

16

Establish FlashCopy specified a target volume that is the source volume of a Safeguarded Copy relationship.

26

A FlashCopy Establish command was not successful because Global Mirror is forcing a consistency group which prevents the use of FlashCopy.

System action

The command ends.

Operator response

None.

System programmer response

Determine the state of the existing Flashcopy relation(s) by issuing either the FLASHCPY QUERY or FLASHCPY QUERY RELATIONS commands.

Appendix A. Accessibility

Accessible publications for this product are offered through IBM Documentation (www.ibm.com/docs/en/zos).

If you experience difficulty with the accessibility of any z/OS information, send a detailed message to the Contact the z/OS team web page (www.ibm.com/systems/campaignmail/z/zos/contact_z) or use the following mailing address.

IBM Corporation
Attention: MHVRCFS Reader Comments
Department H6MA, Building 707
2455 South Road
Poughkeepsie, NY 12601-5400
United States

Accessibility features

Accessibility features help users who have physical disabilities such as restricted mobility or limited vision use software products successfully. The accessibility features in z/OS can help users do the following tasks:

- Run assistive technology such as screen readers and screen magnifier software.
- Operate specific or equivalent features by using the keyboard.
- Customize display attributes such as color, contrast, and font size.

Consult assistive technologies

Assistive technology products such as screen readers function with the user interfaces found in z/OS. Consult the product information for the specific assistive technology product that is used to access z/OS interfaces.

Keyboard navigation of the user interface

You can access z/OS user interfaces with TSO/E or ISPF. The following information describes how to use TSO/E and ISPF, including the use of keyboard shortcuts and function keys (PF keys). Each guide includes the default settings for the PF keys.

- *z/OS TSO/E Primer*
- *z/OS TSO/E User's Guide*
- *z/OS ISPF User's Guide Vol I*

Dotted decimal syntax diagrams

Syntax diagrams are provided in dotted decimal format for users who access IBM Documentation with a screen reader. In dotted decimal format, each syntax element is written on a separate line. If two or more syntax elements are always present together (or always absent together), they can appear on the same line because they are considered a single compound syntax element.

Each line starts with a dotted decimal number; for example, 3 or 3.1 or 3.1.1. To hear these numbers correctly, make sure that the screen reader is set to read out punctuation. All the syntax elements that have the same dotted decimal number (for example, all the syntax elements that have the number 3.1)

© Copyright IBM Corp. 2017, 2021

are mutually exclusive alternatives. If you hear the lines `3.1 USERID` and `3.1 SYSTEMID`, your syntax can include either `USERID` or `SYSTEMID`, but not both.

The dotted decimal numbering level denotes the level of nesting. For example, if a syntax element with dotted decimal number 3 is followed by a series of syntax elements with dotted decimal number 3.1, all the syntax elements numbered 3.1 are subordinate to the syntax element numbered 3.

Certain words and symbols are used next to the dotted decimal numbers to add information about the syntax elements. Occasionally, these words and symbols might occur at the beginning of the element itself. For ease of identification, if the word or symbol is a part of the syntax element, it is preceded by the backslash (\) character. The `*` symbol is placed next to a dotted decimal number to indicate that the syntax element repeats. For example, syntax element `*FILE` with dotted decimal number 3 is given the format `3 \* FILE`. Format `3* FILE` indicates that syntax element `FILE` repeats. Format `3* \* FILE` indicates that syntax element `* FILE` repeats.

Characters such as commas, which are used to separate a string of syntax elements, are shown in the syntax just before the items they separate. These characters can appear on the same line as each item, or on a separate line with the same dotted decimal number as the relevant items. The line can also show another symbol to provide information about the syntax elements. For example, the lines `5.1*, 5.1 LASTRUN, and 5.1 DELETE` mean that if you use more than one of the `LASTRUN` and `DELETE` syntax elements, the elements must be separated by a comma. If no separator is given, assume that you use a blank to separate each syntax element.

If a syntax element is preceded by the % symbol, it indicates a reference that is defined elsewhere. The string that follows the % symbol is the name of a syntax fragment rather than a literal. For example, the line `2.1 %OP1` means that you must refer to separate syntax fragment `OP1`.

The following symbols are used next to the dotted decimal numbers.

? indicates an optional syntax element
The question mark (?) symbol indicates an optional syntax element. A dotted decimal number followed by the question mark symbol (?) indicates that all the syntax elements with a corresponding dotted decimal number, and any subordinate syntax elements, are optional. If there is only one syntax element with a dotted decimal number, the ? symbol is displayed on the same line as the syntax element, (for example `5? NOTIFY`). If there is more than one syntax element with a dotted decimal number, the ? symbol is displayed on a line by itself, followed by the syntax elements that are optional. For example, if you hear the lines `5 ?, 5 NOTIFY`, and `5 UPDATE`, you know that the syntax elements `NOTIFY` and `UPDATE` are optional. That is, you can choose one or none of them. The ? symbol is equivalent to a bypass line in a railroad diagram.

! indicates a default syntax element
The exclamation mark (!) symbol indicates a default syntax element. A dotted decimal number followed by the ! symbol and a syntax element indicate that the syntax element is the default option for all syntax elements that share the same dotted decimal number. Only one of the syntax elements that share the dotted decimal number can specify the ! symbol. For example, if you hear the lines `2? FILE, 2.1! (KEEP), and 2.1 (DELETE)`, you know that `(KEEP)` is the default option for the `FILE` keyword. In the example, if you include the `FILE` keyword, but do not specify an option, the default option KEEP is applied. A default option also applies to the next higher dotted decimal number. In this example, if the `FILE` keyword is omitted, the default `FILE(KEEP)` is used. However, if you hear the lines `2? FILE, 2.1, 2.1.1! (KEEP)`, and `2.1.1 (DELETE)`, the default option KEEP applies only to the next higher dotted decimal number, `2.1` (which does not have an associated keyword), and does not apply to `2? FILE`. Nothing is used if the keyword `FILE` is omitted.

*** indicates an optional syntax element that is repeatable**
The asterisk or glyph (*) symbol indicates a syntax element that can be repeated zero or more times. A dotted decimal number followed by the * symbol indicates that this syntax element can be used zero or more times; that is, it is optional and can be repeated. For example, if you hear the line `5.1* data area`, you know that you can include one data area, more than one data area, or no data area. If you hear the lines `3* , 3 HOST, 3 STATE`, you know that you can include `HOST, STATE`, both together, or nothing.

Notes:

1. If a dotted decimal number has an asterisk (*) next to it and there is only one item with that dotted decimal number, you can repeat that same item more than once.
2. If a dotted decimal number has an asterisk next to it and several items have that dotted decimal number, you can use more than one item from the list, but you cannot use the items more than once each. In the previous example, you can write `HOST STATE`, but you cannot write `HOST HOST`.
3. The * symbol is equivalent to a loopback line in a railroad syntax diagram.

+ indicates a syntax element that must be included

The plus (+) symbol indicates a syntax element that must be included at least once. A dotted decimal number followed by the + symbol indicates that the syntax element must be included one or more times. That is, it must be included at least once and can be repeated. For example, if you hear the line `6.1+ data area`, you must include at least one data area. If you hear the lines `2+, 2 HOST,` and `2 STATE`, you know that you must include `HOST, STATE,` or both. Similar to the * symbol, the + symbol can repeat a particular item if it is the only item with that dotted decimal number. The + symbol, like the * symbol, is equivalent to a loopback line in a railroad syntax diagram.

Notices

This information was developed for products and services that are offered in the USA or elsewhere.

IBM may not offer the products, services, or features discussed in this document in other countries. Consult your local IBM representative for information on the products and services currently available in your area. Any reference to an IBM product, program, or service is not intended to state or imply that only that IBM product, program, or service may be used. Any functionally equivalent product, program, or service that does not infringe any IBM intellectual property right may be used instead. However, it is the user's responsibility to evaluate and verify the operation of any non-IBM product, program, or service.

IBM may have patents or pending patent applications covering subject matter described in this document. The furnishing of this document does not grant you any license to these patents. You can send license inquiries, in writing, to:

IBM Director of Licensing
IBM Corporation
North Castle Drive, MD-NC119
Armonk, NY 10504-1785
United States of America

For license inquiries regarding double-byte character set (DBCS) information, contact the IBM Intellectual Property Department in your country or send inquiries, in writing, to:

Intellectual Property Licensing
Legal and Intellectual Property Law
IBM Japan Ltd.
19-21, Nihonbashi-Hakozakicho, Chuo-ku
Tokyo 103-8510, Japan

The following paragraph does not apply to the United Kingdom or any other country where such provisions are inconsistent with local law: INTERNATIONAL BUSINESS MACHINES CORPORATION PROVIDES THIS PUBLICATION "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF NON-INFRINGEMENT, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Some states do not allow disclaimer of express or implied warranties in certain transactions, therefore, this statement may not apply to you.

This information could include technical inaccuracies or typographical errors. Changes are periodically made to the information herein; these changes will be incorporated in new editions of the publication. IBM may make improvements and/or changes in the product(s) and/or the program(s) described in this publication at any time without notice.

This information could include missing, incorrect, or broken hyperlinks. Hyperlinks are maintained in only the HTML plug-in output for IBM Documentation. Use of hyperlinks in other output formats of this information is at your own risk.

Any references in this information to non-IBM websites are provided for convenience only and do not in any manner serve as an endorsement of those websites. The materials at those websites are not part of the materials for this IBM product and use of those websites is at your own risk.

IBM may use or distribute any of the information you supply in any way it believes appropriate without incurring any obligation to you.

Licensees of this program who wish to have information about it for the purpose of enabling: (i) the exchange of information between independently created programs and other programs (including this one) and (ii) the mutual use of the information which has been exchanged, should contact:

IBM Corporation
Site Counsel
2455 South Road

© Copyright IBM Corp. 2017, 2021

Poughkeepsie, NY 12601-5400
USA

Such information may be available, subject to appropriate terms and conditions, including in some cases, payment of a fee.

The licensed program described in this document and all licensed material available for it are provided by IBM under terms of the IBM Customer Agreement, IBM International Program License Agreement or any equivalent agreement between us.

Any performance data contained herein was determined in a controlled environment. Therefore, the results obtained in other operating environments may vary significantly. Some measurements may have been made on development-level systems and there is no guarantee that these measurements will be the same on generally available systems. Furthermore, some measurements may have been estimated through extrapolation. Actual results may vary. Users of this document should verify the applicable data for their specific environment.

Information concerning non-IBM products was obtained from the suppliers of those products, their published announcements or other publicly available sources. IBM has not tested those products and cannot confirm the accuracy of performance, compatibility or any other claims related to non-IBM products. Questions on the capabilities of non-IBM products should be addressed to the suppliers of those products.

All statements regarding IBM's future direction or intent are subject to change or withdrawal without notice, and represent goals and objectives only.

This information contains examples of data and reports used in daily business operations. To illustrate them as completely as possible, the examples include the names of individuals, companies, brands, and products. All of these names are fictitious and any similarity to the names and addresses used by an actual business enterprise is entirely coincidental.

COPYRIGHT LICENSE:

This information contains sample application programs in source language, which illustrate programming techniques on various operating platforms. You may copy, modify, and distribute these sample programs in any form without payment to IBM, for the purposes of developing, using, marketing or distributing application programs conforming to the application programming interface for the operating platform for which the sample programs are written. These examples have not been thoroughly tested under all conditions. IBM, therefore, cannot guarantee or imply reliability, serviceability, or function of these programs. The sample programs are provided "AS IS", without warranty of any kind. IBM shall not be liable for any damages arising out of your use of the sample programs.

Terms and conditions for product documentation

Permissions for the use of these publications are granted subject to the following terms and conditions.

Applicability

These terms and conditions are in addition to any terms of use for the IBM website.

Personal use

You may reproduce these publications for your personal, noncommercial use provided that all proprietary notices are preserved. You may not distribute, display or make derivative work of these publications, or any portion thereof, without the express consent of IBM.

Commercial use

You may reproduce, distribute and display these publications solely within your enterprise provided that all proprietary notices are preserved. You may not make derivative works of these publications, or

reproduce, distribute or display these publications or any portion thereof outside your enterprise, without the express consent of IBM.

Rights

Except as expressly granted in this permission, no other permissions, licenses or rights are granted, either express or implied, to the publications or any information, data, software or other intellectual property contained therein.

IBM reserves the right to withdraw the permissions granted herein whenever, in its discretion, the use of the publications is detrimental to its interest or, as determined by IBM, the above instructions are not being properly followed.

You may not download, export or re-export this information except in full compliance with all applicable laws and regulations, including all United States export laws and regulations.

IBM MAKES NO GUARANTEE ABOUT THE CONTENT OF THESE PUBLICATIONS. THE PUBLICATIONS ARE PROVIDED "AS-IS" AND WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO IMPLIED WARRANTIES OF MERCHANTABILITY, NON-INFRINGEMENT, AND FITNESS FOR A PARTICULAR PURPOSE.

IBM Online Privacy Statement

IBM Software products, including software as a service solutions, ("Software Offerings") may use cookies or other technologies to collect product usage information, to help improve the end user experience, to tailor interactions with the end user, or for other purposes. In many cases no personally identifiable information is collected by the Software Offerings. Some of our Software Offerings can help enable you to collect personally identifiable information. If this Software Offering uses cookies to collect personally identifiable information, specific information about this offering's use of cookies is set forth below.

Depending upon the configurations deployed, this Software Offering may use session cookies that collect each user's name, email address, phone number, or other personally identifiable information for purposes of enhanced user usability and single sign-on configuration. These cookies can be disabled, but disabling them will also eliminate the functionality they enable.

If the configurations deployed for this Software Offering provide you as customer the ability to collect personally identifiable information from end users via cookies and other technologies, you should seek your own legal advice about any laws applicable to such data collection, including any requirements for notice and consent.

For more information about the use of various technologies, including cookies, for these purposes, see IBM's Privacy Policy at ibm.com®/privacy and IBM's Online Privacy Statement at ibm.com/privacy/details in the section entitled "Cookies, Web Beacons and Other Technologies," and the "IBM Software Products and Software-as-a-Service Privacy Statement" at ibm.com/software/info/product-privacy.

Policy for unsupported hardware

Various z/OS elements, such as DFSMSdfp, JES2, JES3, and MVS™, contain code that supports specific hardware servers or devices. In some cases, this device-related element support remains in the product even after the hardware devices pass their announced End of Service date. z/OS may continue to service element code; however, it will not provide service related to unsupported hardware devices. Software problems related to these devices will not be accepted for service, and current service activity will cease if a problem is determined to be associated with out-of-support devices. In such cases, fixes will not be issued.

Minimum supported hardware

The minimum supported hardware for z/OS releases identified in z/OS announcements can subsequently change when service for particular servers or devices is withdrawn. Likewise, the levels of other software products supported on a particular release of z/OS are subject to the service support lifecycle of those

products. Therefore, z/OS and its product publications (for example, panels, samples, messages, and product documentation) can include references to hardware and software that is no longer supported.

- For information about software support lifecycle, see: IBM Lifecycle Support for z/OS (www.ibm.com/software/support/systemsz/lifecycle)
- For information about currently-supported IBM hardware, contact your IBM representative.

Trademarks

IBM, the IBM logo, and ibm.com are trademarks or registered trademarks of International Business Machines Corp., registered in many jurisdictions worldwide. Other product and service names might be trademarks of IBM or other companies. A current list of IBM trademarks is available on the Web at Copyright and Trademark information (www.ibm.com/legal/copytrade.shtml).

Index

A

accessibility
  contact IBM 41
  features 41
ANTF0447E 35
ANTQFRVL macro 13
assistive technologies 41

C

cascading FlashCopy 9
contact
  z/OS 41

F

FCFASTREVERSERESTORE keyword
  COPY command 34
FCSETGTOK keyword 30
feedback xi
FlashCopy
  cascading 9
  commands
    FCQUERY 8
  FlashCopy V1 defined 5
  FlashCopy V2 defined 5
  modes 6
  objective 5
  relationship 6
FRRECOV command
  optional parameters
    VERIFY 27
  required parameters
    TOVOLUME 27

K

keyboard
  navigation 41
  PF keys 41
  shortcut keys 41

L

LIST COPYPOOL(cpname)
  FCFRR 21

N

navigation
  keyboard 41

P

parameters
parameters *(continued)*
  TOVOLUME 27
  VERIFY 27

Q

QUERY COPYPOOL
  percent complete 21

R

recover copy pool from incremental version 21
recover copy pool using fast reverse restore 21
RIOP keyword 30

S

sending to IBM
  reader comments xi
shortcut keys 41
syntax 30

T

trademarks 48

U

user interface
  ISPF 41
  TSO/E 41
using fast reverse restore 21
using incremental FlashCopy 21

Product Number: 5650-ZOS