



Hitachi Universal Storage Platform V Hitachi Universal Storage Platform VM Hitachi ShadowImage™ for IBM® z/OS® User's Guide

FASTFIND LINKS

[Document Organization](#)

[Product Version](#)

[Getting Help](#)

[Contents](#)

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Contents

Preface	vii
Intended Audience	viii
Product Version.....	viii
Document Revision Level	viii
Source Document(s) for this Revision	ix
Changes in this Revision	ix
Document Organization	ix
Referenced Documents.....	x
Document Conventions.....	xi
Convention for Storage Capacity Values	xii
Getting Help	xii
Comments.....	xiii
Overview of ShadowImage for z/OS®	1-1
Hitachi ShadowImage.....	1-2
Business Benefits	1-3
Feature Highlights.....	1-4
About ShadowImage for z/OS Operations.....	2-1
ShadowImage for z/OS Components	2-2
Volume Pairs and Consistency Groups	2-3
ShadowImage for z/OS Software.....	2-3
License	2-4
Business Continuity Manager	2-4
PPRC Host Software.....	2-4
ShadowImage for z/OS Operations	2-4
Set Reserve Attribute Operation.....	2-4
Add Pair Operation	2-5
Split Pair Operation.....	2-7

Suspend Pair Operation	2-10
Resynchronize Pair Operations	2-10
Delete Pair Operation	2-15
Pair Status	2-17
ShadowImage for z/OS Options	2-22
Swap&Freeze Option	2-22
Host I/O Performance Option	2-24
Copy Threshold Option	2-24
Interoperability with other Products and Functions	3-1
Virtual LVI	3-2
Cache Residency Manager	3-2
Volume Security	3-2
Volume Retention Manager	3-2
Volume Migration	3-3
Universal Volume Manager	3-3
TrueCopy for z/OS	3-3
Universal Replicator for z/OS	3-9
TrueCopy for z/OS and Universal Replicator for z/OS	3-13
Compatible XRC	3-18
Concurrent Copy	3-18
Preparing for ShadowImage for z/OS Operations	4-1
System Requirements	4-2
Volume Requirements	4-2
ShadowImage for z/OS Software Requirements	4-3
System Option Modes	4-4
License Requirements	4-9
Requirements for Other Software	4-10
Assessing ShadowImage for z/OS Requirements	4-11
Calculating Maximum Number of Pairs	4-11
Performance Considerations	4-15
Identifying the Source and Target Volumes	4-17
Requirements for Maintaining ShadowImage for z/OS	4-18
Cautions on Maintaining the Devices	4-18
Cautions on Maintaining the Cache	4-18
Cautions on Switching Off the Power Supply	4-19
Installing ShadowImage for z/OS	4-20
Starting ShadowImage for z/OS	4-20

Using the ShadowImage for z/OS GUI.....	5-1
Pair Operation Window	5-2
Volume List	5-4
Preview List	5-6
History Window.....	5-8
Option Window	5-10
CTG Window.....	5-11
Performing ShadowImage for z/OS Operations Using Storage Navigator ...	6-1
Configuring the Volume List	6-2
Changing or Deleting the Settings in Preview List.....	6-4
Changing the Settings in Preview List.....	6-4
Deleting the Settings in Preview List.....	6-4
Setting or Resetting the Reserve Attribute.....	6-5
Setting the Reserve Attribute	6-5
Resetting the Reserve Attribute	6-7
Setting Options	6-9
Configuring Consistency Groups	6-10
Setting the Reserve Attribute of a Consistency Group	6-11
Resetting the Reserve Attribute of a Consistency Group.....	6-12
Adding Pairs	6-13
Splitting Pairs.....	6-18
Performing Only Pair Splitting	6-22
Performing Pair Addition and Pair Splitting	6-23
Performing At-Time Split Operation (Multiple Pair Splitting)	6-25
Using PPRC Commands to Split, Resynchronize and Delete Pairs in a Consistency Group	6-27
Suspending Pairs.....	6-29
Resynchronizing Pairs	6-31
Deleting Pairs	6-35
Viewing Detailed Volume and Pair Information	6-37
Viewing the Number of Pairs and License Information	6-39
Viewing Pair Operations History.....	6-41
Using Hitachi Business Continuity Manager	7-1
Command Device for Business Continuity Manager	7-2
Business Continuity Manager CLI Commands that Correspond to the PPRC Commands	7-3
Performing ShadowImage for z/OS Pair Operations Using PPRC	8-1
PPRC Command Support.....	8-2

PPRC Command Requirements	8-3
PSF and DEVSERV Commands	8-4
Adding Pairs Using PPRC Commands	8-5
CESTPAIR (Adding Pairs)	8-5
ESTPAIR (Adding Pairs)	8-7
Splitting Pairs Using PPRC Commands	8-9
CSUSPEND	8-9
SUSPEND	8-10
Resynchronizing Pairs Using PPRC Commands	8-12
CESTPAIR (Resynchronizing Pairs)	8-12
ESTPAIR (Resynchronizing Pairs)	8-14
Deleting Pairs Using PPRC Commands	8-16
CDELPAIR	8-16
DELPAIR	8-17
Displaying Pair Status Using PPRC Commands	8-18
CQUERY	8-21
QUERY	8-22

Troubleshooting	9-1
Troubleshooting	9-2
SIM Reporting	9-3
Calling the Hitachi Data Systems Support Center	9-5

Acronyms and Abbreviations

Index



Preface

This document describes and provides instructions for performing Hitachi ShadowImage for IBM z/OS operation on the Hitachi Universal Storage Platform V and Hitachi Universal Storage Platform VM (USP V/VM) storage systems.

Please read this document carefully to understand how to use this product, and maintain a copy for reference purposes.

This preface includes the following information:

- [Intended Audience](#)
- [Product Version](#)
- [Document Revision Level](#)
- [Source Document\(s\) for this Revision](#)
- [Changes in this Revision](#)
- [Document Organization](#)
- [Referenced Documents](#)
- [Document Conventions](#)
- [Convention for Storage Capacity Values](#)
- [Getting Help](#)
- [Comments](#)

Intended Audience

This document is intended for system administrators, Hitachi Data Systems representatives, and Authorized Service Providers who are involved in installing, configuring, and operating the Hitachi Universal Storage Platform V and VM storage systems.

This document assumes the following:

- The user has a background in data processing and understands RAID storage systems and their basic functions.
- The user is familiar with the Universal Storage Platform V and/or VM storage system and has read the *Universal Storage Platform V/VM User and Reference Guide*.
- The user is familiar with the Storage Navigator software for the Universal Storage Platform V/VM and has read the *Storage Navigator User's Guide*.
- The user is familiar with the operating system and web browser software on the system hosting the Storage Navigator software.

Product Version

This document revision applies to USP V/VM microcode 60-08-0x and higher.

Document Revision Level

Revision	Date	Description
MK-96RD619-P	February 2007	Preliminary Release
MK-96RD619-00	April 2007	Initial Release, supersedes and replaces MK-96RD619-P
MK-96RD619-01	May 2007	Revision 1, supersedes and replaces MK-96RD619-00
MK-96RD619-02	September 2007	Revision 2, supersedes and replaces MK-96RD619-01
MK-96RD619-03	November 2007	Revision 3, supersedes and replaces MK-96RD619-02
MK-96RD619-04	January 2008	Revision 4, supersedes and replaces MK-96RD619-03
MK-96RD619-05	March 2008	Revision 5, supersedes and replaces MK-96RD619-04
MK-96RD619-06	May 2008	Revision 6, supersedes and replaces MK-96RD619-05
MK-96RD619-07	August 2008	Revision 7, supersedes and replaces MK-96RD619-06
MK-96RD619-08	November 2008	Revision 8, supersedes and replaces MK-96RD619-07.
MK-96RD619-09	June 2009	Revision 9, supersedes and replaces MK-96RD619-08.
MK-96RD619-10	November 2009	Revision 10, supersedes and replaces MK-96RD619-09
MK-96RD619-11	January 2010	Revision 11, supersedes and replaces MK-96RD619-10
MK-96RD619-12	April 2011	Revision 12, supersedes and replaces MK-96RD619-11

Source Document(s) for this Revision

- MK-96RD619-12c-HDS

Changes in this Revision

- Added information about triggers for the change of pair status to Split ([Split Pair Operation](#)).
- Changed the information of **Copy Pace** (see [Volume List](#)).
- Added information about system option modes (SOMs) and the SOMs for ShadowImage for z/OS (new section [System Option Modes](#)).

Document Organization

The following table provides an overview of the contents and organization of this document. Click the [chapter title](#) in the left column to go to that chapter. The first page of each chapter provides links to the sections in that chapter.

Chapter	Description
Overview of ShadowImage for z/OS	Provides an overview of the Hitachi ShadowImage software for the Hitachi Universal Storage Platform V and Hitachi Universal Storage Platform VM storage system.
About ShadowImage for z/OS Operations	Describes ShadowImage for z/OS operations.
Interoperability with other Products and Functions	Discusses ShadowImage for z/OS support for concurrent operations with other data management functions.
Preparing for ShadowImage for z/OS Operations	Describes requirements for using ShadowImage, installation procedure of ShadowImage, and calculation of the number of pairs that ShadowImage can create. Please read this chapter before you starting the ShadowImage operation.
Using the ShadowImage for z/OS GUI	Describes the ShadowImage for z/OS windows on Storage Navigator.
Performing ShadowImage for z/OS Operations Using Storage Navigator	Provides instructions for performing ShadowImage for z/OS operations using the ShadowImage for z/OS software on Storage Navigator.
Using Hitachi Business Continuity Manager	Provides a brief description of using Hitachi Business Continuity Manager to perform ShadowImage for z/OS pair operations
Performing ShadowImage for z/OS Pair Operations Using PPRC	Provides instructions for performing ShadowImage for z/OS operations issuing TSO PPRC and ICKDSF PPRCOPY commands to the Universal Storage Platform V and Universal Storage Platform VM from the mainframe host.
Troubleshooting	Provides troubleshooting information for ShadowImage and instructions for calling technical support.
Acronyms and Abbreviations	Defines the acronyms and abbreviations used in this document.
Index	Lists the topics in this document in alphabetical order.

Referenced Documents

Hitachi Universal Storage Platform V/VM:

- *Storage Navigator User's Guide, MK-96RD621*
- *Universal Volume Manager User's Guide, MK-94RD626*
- *Business Continuity Manager User and Reference Guide, MK-94RD247*
- *Compatible Mirroring for IBM FlashCopy User's Guide, MK-94RD245*
- *Performance Manager User's Guide, MK-94RD218*
- *Copy-on-Write Snapshot User's Guide, MK-95RD277*
- *Cache Residency Manager User's Guide, MK-96RD609*
- *TrueCopy for IBM z/OS User's Guide, MK-94RD623*





Document Conventions

The terms “Universal Storage Platform V” and “Universal Storage Platform VM” refer to all models of the Hitachi Universal Storage Platform V and VM storage systems, unless otherwise noted.

This document uses the following typographic conventions:

Convention	Description
Bold	Indicates text on a window, other than the window title, including menus, menu options, buttons, fields, and labels. Example: Click OK .
<i>Italic</i>	Indicates a variable, which is a placeholder for actual text provided by the user or system. Example: copy <i>source-file target-file</i> Note: Angled brackets (< >) are also used to indicate variables.
screen/code	Indicates text that is displayed on screen or entered by the user. Example: # pairdisplay -g oradb
< > angled brackets	Indicates a variable, which is a placeholder for actual text provided by the user or system. Example: # pairdisplay -g <group> Note: Italic font is also used to indicate variables.
[] square brackets	Indicates optional values. Example: [a | b] indicates that you can choose a, b, or nothing.
{ } braces	Indicates required or expected values. Example: { a | b } indicates that you must choose either a or b.
| vertical bar	Indicates that you have a choice between two or more options or arguments. Examples: [a | b] indicates that you can choose a, b, or nothing. { a | b } indicates that you must choose either a or b.
underline	Indicates the default value. Example: [<u>a</u> | b]

This document uses the following icons to draw attention to information:

Icon	Meaning	Description
	Note	Calls attention to important and/or additional information.
	Tip	Provides helpful information, guidelines, or suggestions for performing tasks more effectively.
	Caution	Warns the user of adverse conditions and/or consequences (e.g., disruptive operations).
	WARNING	Warns the user of severe conditions and/or consequences (e.g., destructive operations).

Convention for Storage Capacity Values

Physical storage capacity values (e.g., disk drive capacity) are calculated based on the following values:

Physical capacity unit	Value
1 KB	1,000 (10^3) bytes
1 MB	1,000 KB or $1,000^2$ bytes
1 GB	1,000 MB or $1,000^3$ bytes
1 TB	1,000 GB or $1,000^4$ bytes
1 PB	1,000 TB or $1,000^5$ bytes
1 EB	1,000 PB or $1,000^6$ bytes

Logical storage capacity values (e.g., logical device capacity) are calculated based on the following values:

Logical capacity unit	Value
1 block	512 bytes
1 KB	1,024 (2^{10}) bytes
1 MB	1,024 KB or $1,024^2$ bytes
1 GB	1,024 MB or $1,024^3$ bytes
1 TB	1,024 GB or $1,024^4$ bytes
1 PB	1,024 TB or $1,024^5$ bytes
1 EB	1,024 PB or $1,024^6$ bytes

Getting Help

If you need to call the Hitachi Data Systems Support Center, make sure to provide as much information about the problem as possible, including:

- The circumstances surrounding the error or failure.
- The content of any error message(s) displayed on the host system(s).
- The content of any error message(s) displayed on Storage Navigator.
- The Storage Navigator configuration information (use the FD Dump Tool).
- The service information messages (SIMs), including reference codes and severity levels, displayed by Storage Navigator.

The Hitachi Data Systems customer support staff is available 24 hours/day, seven days a week. If you need technical support, please log on to the Hitachi Data Systems Portal for contact information: <https://portal.hds.com>

Comments

Please send us your comments on this document: doc.comments@hds.com. Include the document title, number, and revision, and refer to specific section(s) and paragraph(s) whenever possible.

Thank you! (All comments become the property of Hitachi Data Systems.)

Overview of ShadowImage for z/OS[®]

This chapter provides an overview of the Hitachi ShadowImage software for the Hitachi Universal Storage Platform V and Hitachi Universal Storage Platform VM (herein after referred to as USP V/VM) storage system:

- [Hitachi ShadowImage](#)
- [Business Benefits](#)
- [Feature Highlights](#)

Hitachi ShadowImage

Hitachi Data Systems provides innovative, storage-based technology solutions for enabling continuous business operations. By partnering with customers to understand key business challenges and requirements, Hitachi Data Systems is able to deliver robust, application-focused storage solutions that enhance operational efficiency and resilience.

An essential component of business continuity and risk mitigation strategies and optimized IT operations is the ability to replicate data quickly for critical application processing, testing and development of new applications, zero-downtime recovery, data migration, and necessary backup operations. The high-speed non-disruptive local mirroring technology of Hitachi ShadowImage In-System Replication software rapidly creates multiple copies of mission-critical information within Hitachi storage systems in mainframe and open-systems environments. ShadowImage keeps data RAID-protected and fully recoverable without affecting service or performance levels. Replicated data volumes can be split from the host applications and used for system backups, application testing, and data mining applications while business continues to run at full capacity.

ShadowImage provides heterogeneous replication between any storage systems within a virtualized storage pool managed by USP V/VM. Data that resides on an externally attached storage system can be moved from the source to a target data volume anywhere in the storage pool, including to another externally attached system. Using ShadowImage, you can migrate data volumes from one platform to another through USP V/VM and maximize the use of your storage infrastructure. By providing non-disruptive, high-speed data replication within any Hitachi storage system or within the virtualized storage pool, Hitachi ShadowImage software enables immediate use of data in decision support, software testing and development, and data protection operations.

ShadowImage for z/OS is functionally compatible with the industry-standard IBM® Peer-to-Peer Remote Copy (PPRC) host software functions. PPRC TSO, PPRCOPY ICKDSF and/or Hitachi Business Continuity Manager™ commands may be used to perform ShadowImage for z/OS operations on the USP V/VM system.

This document describes and provides instructions for performing ShadowImage for z/OS operations on USP V/VM using the ShadowImage for z/OS software on Storage Navigator and using PPRC TSO or PPRCOPY ICKDSF commands. The licensed ShadowImage for z/OS software displays the ShadowImage information and allows you to perform ShadowImage operations. For further information on Storage Navigator, see the *Storage Navigator User's Guide* (MK-96RD621).

If you use the BEDs supporting encryption, you can create a ShadowImage for z/OS pair by using an encrypted volume and a non-encrypted volume. For example, you can create the pair specifying an encrypted volume as the S-VOL and a non-encrypted volume as the T-VOL. In this case, data in the encrypted S-VOL will be copied as non-encrypted data in the non-encrypted T-VOL.

Business Benefits

Ensure Business Continuity

- Shortens restart and recovery times with the consistency-group function, which provides multivolume, point-in-time copies for applications and databases that share or span multiple volumes
- Reduces recovery from data corruption time dramatically through the ShadowImage QuickRestore feature, which allows an immediate restore to a disk-resident, point-in-time data copy
- Replicates large data volumes without having an impact on service levels, timing out, or affecting performance levels

Improve Productivity and Processes

- Reduces testing and deployment time and increases the accuracy of application development by providing always-available copies of current production data
- Increases competitive advantage through the ShadowImage QuickSplit function by facilitating the sharing of and immediate access to time-critical information for decision support, populating data warehouses, performing analysis, or other data-mining operations
- Enables normal backup operations on a copy of up-to-date production data while critical applications continue to run unaffected
- Simplifies data migration between storage systems Reduce Operational and Capital Costs
- Allows business to remain online during data center activities, eliminating the need for 24/7 resources to perform these tasks
- Maximizes the storage infrastructure by leveraging the virtualization capabilities of USP V/VM
- Allows the use of cost-effective storage for enhanced data protection purposes

Feature Highlights

Consistency Groups. For USP V/VM storage systems, the ShadowImage software consistency-group function allows a user-defined group of ShadowImage volume pairs to be split simultaneously, at a precise moment in time, with a single command. This copy method creates a consistent point-in-time copy of an entire system, database, or any related sets of volumes—a technique that can replicate data between a primary system and secondary systems anywhere in the world, with full data integrity.

About ShadowImage for z/OS Operations

This chapter describes ShadowImage for z/OS operations.

- [ShadowImage for z/OS Components](#)
- [ShadowImage for z/OS Operations](#)
- [Pair Status](#)
- [ShadowImage for z/OS Operations](#)

ShadowImage for z/OS Components

The System for using ShadowImage for z/OS usually contains the following components.

- Pair of volumes (S-VOL and T-VOL)
- Licensed ShadowImage for z/OS program product

Figure 2-1 shows a typical ShadowImage for z/OS configuration using Storage Navigator.

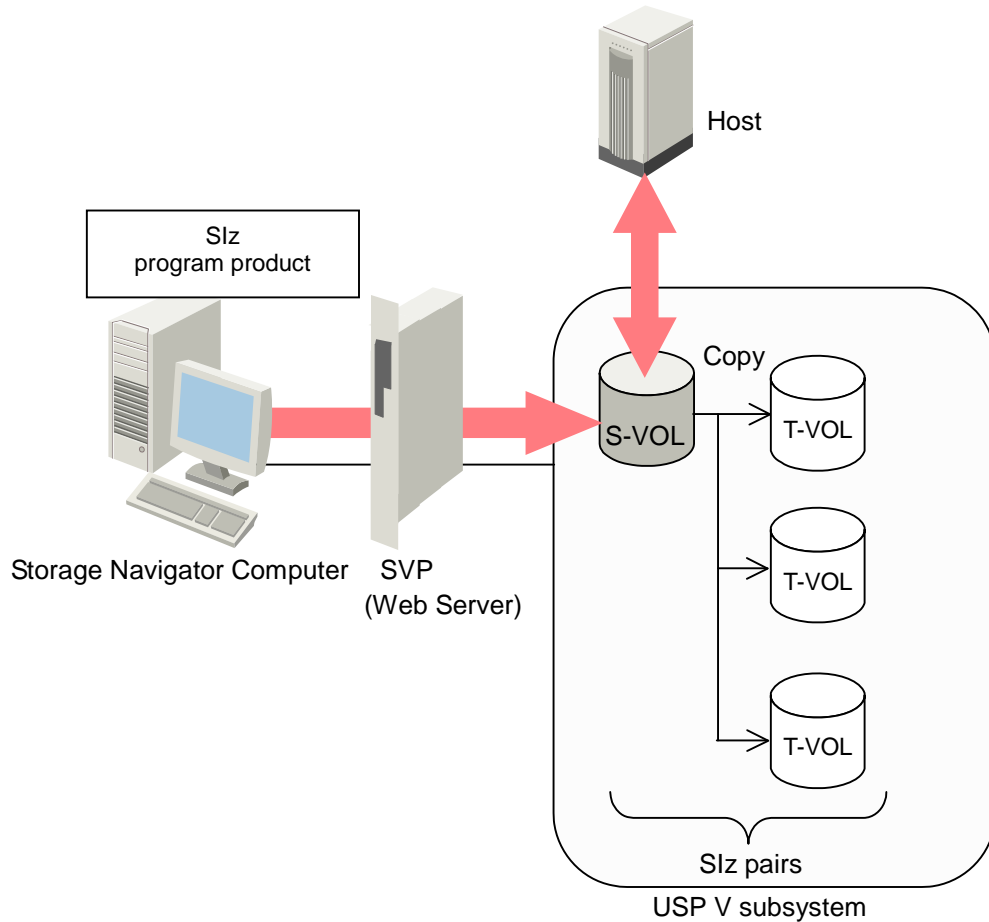


Figure 2-1 ShadowImage for z/OS Components

You operate ShadowImage for z/OS from the Storage Navigator computer, and copy volumes in the storage system. A volume that has original data is called an S-VOL (source volume), and a volume to which the data is copied is called a T-VOL (target volume). A pair of the S-VOL and the T-VOL made by ShadowImage for z/OS is called a "Siz pair".

You may operate SIz directly from the host and do not need to use the Storage Navigator computer, if you use VOS3 DMFVSS, Business Continuity Manager, IBM PPRC host software functions, or IBM DFSMSdss host software functions.

Volume Pairs and Consistency Groups

ShadowImage for z/OS performs internal copy operations for logical volume pairs established by the user. Therefore, you need at least two volumes to use SIz, one for copy source (S-VOL), and another for copy target (T-VOL). Each SIz pair consists of one S-VOL and up to three T-VOLs, which are located in the same storage system.

The SIz S-VOLs are the source volumes which contain the original data. The SIz T-VOLs are the target volumes which contain the backup data. Each T-VOL must be paired with only one S-VOL. During normal SIz operations, the S-VOLs remain available to all hosts at all times for read and write I/O operations (except during reverse copy and quick restore operations). When the pair status is Duplex and if the S-VOL is updated, the differential data between S-VOL and T-VOL will be copied to the T-VOL regularly. However, since SIz T-VOLs are updated asynchronously, the S-VOL and T-VOL of the pair in Duplex status may not be identical. Remember that the T-VOLs become available for host access only after a split operation has been performed.

By using a PPRC command or Business Continuity Manager, you can define multiple SIz pairs as one consistency group. If you define a consistency group, you can split all SIz pairs in the group by using the At-Time Split function. For details about the At-Time Split function, see Split Pair Operation.

ShadowImage for z/OS Software

You can operate ShadowImage for z/OS by using the Storage Navigator computer. The Storage Navigator computer can be attached to the USP V/VM storage systems using the TCP/IP local-area network (LAN). The Storage Navigator computer communicates and exchanges data directly with the service processor (SVP) of attached storage systems. You become able to acquire the information of the structure or status of the storage system, or issue commands to the storage system.

License

You need to purchase the SIZ license and make sure that there is enough licensed capacity to accommodate the capacity of pairs you are going to create. ShadowImage for z/OS regards S-VOLs, T-VOLs, and reserved volumes as the volumes that require the license capacity of SIZ, and manage these volumes. When you purchase a license for volume capacity for use with ShadowImage for z/OS, you need to examine how much capacity of volumes you wish to use as S-VOLs, T-VOLs or reserved volumes. The total capacity of volume that you can use cannot exceed the maximum volume capacity that is licensed to you. You must therefore purchase a license for volume capacity that is equal to, or more than, the total volume capacity you wish to use.

Business Continuity Manager

If you issue the Business Continuity Manager commands to the storage system from the mainframe hosts, you can create, split, resynchronize, or delete SIZ pairs, or you can display the pair status. For details about the Business Continuity Manager commands, see Chapter 7.

PPRC Host Software

ShadowImage for z/OS supports the IBM PPRC host software functions, including TSO PPRC commands and ICKDSF PPRCOPY commands. SIZ pairs can be added, split, resynchronized, and deleted using these PPRC commands. Chapter 8 describes and provides instructions for using PPRC commands to create and maintain SIZ pairs on the USP V/VM storage system.

ShadowImage for z/OS Operations

This section describes the main operations of ShadowImage for z/OS.

Set Reserve Attribute Operation

The ShadowImage for z/OS set reserve attribute operation reserves a volume so that it can be used as a SIZ T-VOL. Reserved volumes can only be used as SIZ T-VOLs. The USP V/VM storage system rejects all write operations to reserved volumes (unless in Split or V-Split status). You can reserve up to 16,384 volumes in one USP V/VM storage system.

When TSO or ICKDSF commands are used to establish SIZ pairs, the T-VOLs do not need to be reserved. The CESTPAIR and PPRCOPY ESTPAIR commands require that potential T-VOLs be offline to the host. For details, see Chapter 8.

Add Pair Operation

To create (add) a SIZ pair, the volume, which will be the S-VOL, must be in the simplex state. You may set reserve attribute on the T-VOL before adding it to a SIZ pair. You can also create a pair with an un-reserved simplex volume. For detailed information about how to create SIZ pairs, see [Adding Pairs and Performing Pair Addition and Pair Splitting](#). When you create a new volume pair, initial copy starts and all the data in the S-VOL is copied to the T-VOL. Figure 2-2 shows the change of the status of a pair from the start to end of the initial copy operation.

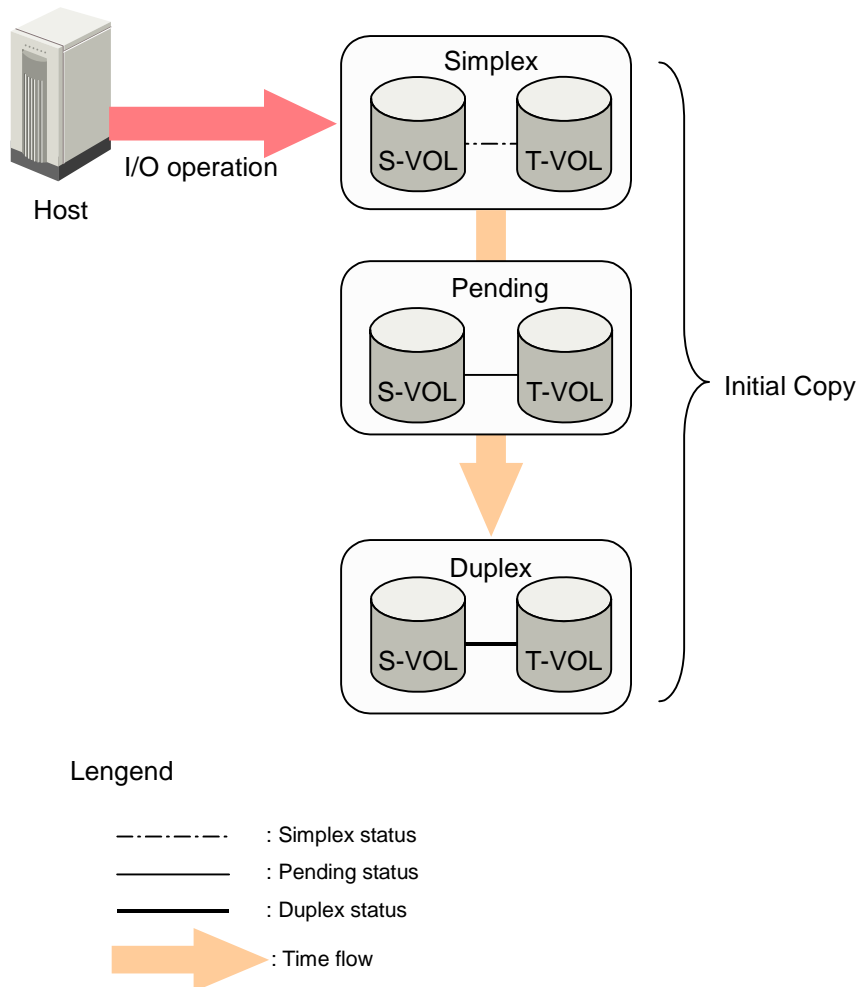


Figure 2-2 Adding a Pair (Initial Copy)

Before the initial copy operation, the status of a pair is Simplex. The status of the pair is pending while the initial copy operation is in progress. The status changes to Duplex when the initial copy is complete.

Write operations performed on the S-VOL during the initial copy operation will be duplicated at the T-VOL by update copy operations after the initial copy is complete.

Since an S-VOL remains available to all hosts for read and write I/Os during the initial copy operation, the S-VOL might be updated during the operation. Therefore, when the status of the pair changes to Duplex after the initial copy operation is complete, the update copy operations start and the differential data of the S-VOL is copied to the T-VOL. As write I/Os are performed on a duplex S-VOL, the USP V/VM storage system stores the differential bitmap, and then performs update copy operations periodically based on the amount of differential data present on the S-VOL as well as the elapsed time between update copy operations. Figure 2-3 illustrates an update copy operation in a SIZ pair with only one T-VOL.

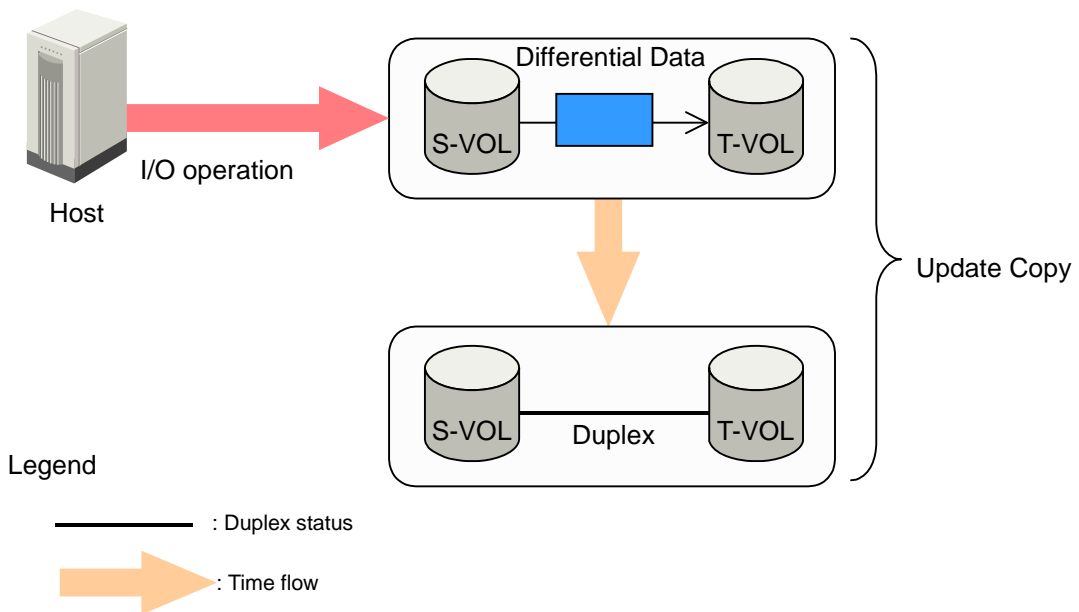


Figure 2-3 Update Copy Operation



Caution: Even if the copy operation is completed without any host I/O, the data in the S-VOL and the data in the T-VOL may not be the same. Whether the S-VOL and the T-VOL have the same data depends on the condition of the storage system. To make the S-VOL data and the T-VOL data equal, split the pair and make the pair status *split*.

Update copy operations are not performed for SIZ pairs with the following status: pending, SP-pend, V-Split, split, resync, resync-R, and suspend.

Update copy operations do not occur every time a host issues a write I/O operation to the S-VOL of a ShadowImage for z/OS pair. SIZ update copy operations are performed asynchronously according to the differential bitmap, which is stored in shared memory.

If shared memory is lost (e.g., offline micro exchange, volatile power supply on), the differential bitmap is also lost. In this case, the USP V/VM storage system treats the entire S-VOL (T-VOL for resync-R pairs) as difference data and recopies all data to the T-VOL (S-VOL for resync-R pairs) to ensure proper pair resynchronization. For pairs in SP-pend or V-Split status, the storage system changes the status to suspend due to the loss of the differential bitmap, ensuring proper resynchronization of these pairs. If shared memory has been lost, extra time is required for SIZ operations, since the USP V/VM needs to copy the entire volume.

Split Pair Operation

The ShadowImage for z/OS split capability provides point-in-time backup of your data, and also facilitates real data testing by making the SIZ copies (T-VOLs) available for host access. The SIZ split operation copies whole S-VOL data or differential data at that time to the T-VOL to make the T-VOL identical to the state of the S-VOL when the split command was issued. If there are many host I/Os for the S-VOL, it may take time to synchronize the S-VOL and the T-VOL. When the split operation is complete, the pair status changes to split. Split operations cannot be performed on the pair whose status is suspend, resync or resync-R.

While the pair is split, the USP V/VM storage system establishes a differential bitmap for the split S-VOL *and* T-VOL and records all updates to *both* volumes. The S-VOL remains fully accessible during the split operation. Whether you can access the T-VOL depends on what split type is specified. There are two kinds of split types, Quick Split and Steady Split. In addition to the split types, there is At-Time Split which allows you to split all the pairs in the consistency group. You can perform Quick Split and Steady Split in the Split Volume Pair dialog box. On the other hand, you need Business Continuity Manager to perform At-Time Split.

- Split pair operation by Quick Split:

When the quick split operation starts, the pair status changes to *V-split*. You have full read/write access to the split T-VOL (even though it is still reserved). The whole S-VOL data or differential data at that time will be copied to the T-VOL in the background.

For information about Read/Write operations from host servers to S-VOLs and T-VOLs of SIZ pairs during quick split operation, see Table 6-2.

- Split pair operation by Steady Split:

When the steady split operation starts, the pair status changes to *SP-pending*. The whole S-VOL data or differential data at that time will be copied to the T-VOL. When the steady split operation is complete, you have full read/write access to the split T-VOL (even though it is still reserved). If you want to quickly finish the copy operation to access the T-VOL, make the S-VOL offline before the operation.

For information about Read/Write operations from host servers to S-VOLs and T-VOLs of SIZ pairs during steady split operation, see Table 6-2.

- Split pair operation by At-Time Split

To split pair by the At-Time Split function, you need Business Continuity Manager software. To perform the split operation by using the At-Time Split function, you must specify a copy group or register the split time in the copy group. The split time indicates the time when you want to store the S-VOL data to the T-VOL. For example, if you register the consistency group of ShadowImage for z/OS as the copy group of the Business Continuity Manager, the At-Time Split function enables you to copy data from the SIZ S-VOLs in the same consistency group to T-VOLs simultaneously. The T-VOLs will contain the same data as the S-VOLs when the Split operation is performed.

Figure 2-4 and Figure 2-5 show the outline of the At-Time Split function.

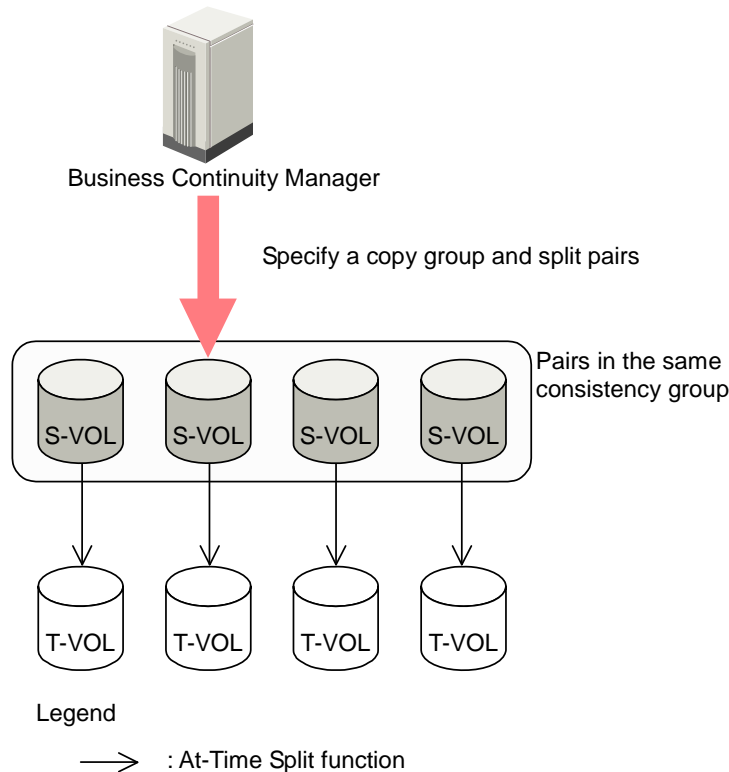


Figure 2-4 Split Pair Operation by At-Time Split (Specifying Copy Group)

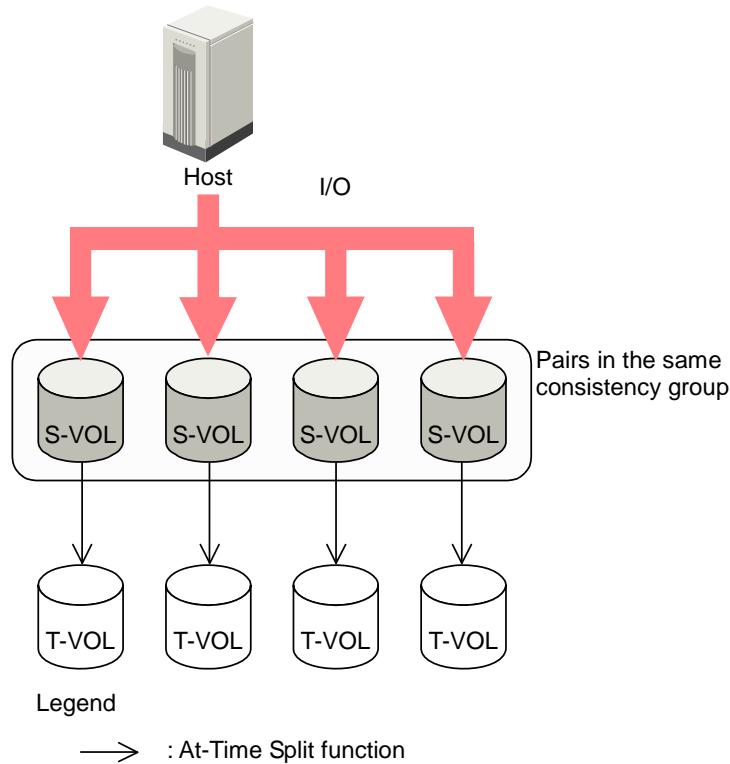


Figure 2-5 Split Pair Operation by At-Time Split (Specifying the Split Time)

- Splitting all the pairs in the same consistency group
 A PPRC command enables you to copy data from the SIZ S-VOLs in the same consistency group to T-VOLs simultaneously. The T-VOLs will contain the same data as the S-VOLs when the pairs are split.
 The operation for splitting all the pairs in the same consistency group is similar to the operation for splitting pairs when a copy group is specified by using Business Continuity Manager. However, the operation for splitting pairs in a consistency group works in Quick Split, so you cannot specify Steady Split. Also, you cannot specify the split time when using the PPRC command to split pairs. The split time indicates when you want to store the S-VOL data to the T-VOL.
- Triggers for the change of pair status to Split
 Performance in the V-Split or SP-Pend state is different depending on the value of system option mode 459 (ON or OFF, OFF by default) and whether the T-VOL or the volume in a pool that is associated with the T-VOL is an external volume or an internal volume.

Table 2-1 Performance in the V-Split or SP-Pend state vs. SOM 459 and T-VOL type

System option mode 459	S-VOL	PSUS(SP) or COPY(SP)
------------------------	-------	----------------------

OFF	Internal volume	The pair status changes to Split after all the differential data is copied to the cache in the storage system.
	External volume	
ON	Internal volume	The pair status changes to Split after all the differential data is copied to the cache in the storage system and the destage operation in the external storage system is complete.
	External volume	

Suspend Pair Operation

The ShadowImage for z/OS suspend pair operation suspends the update copy operations to the T-VOL of the pair. When a SIZ pair is suspended, the USP V/VM storage system stops performing update copy operations to the T-VOL, and the pair status changes to *suspended*. The storage system continues accepting write I/O operations to the S-VOL, and marks the entire S-VOL track as difference data. When a pairresync operation is performed on a suspended pair, the pair status changes to *resync* and the entire S-VOL is copied to the T-VOL. While the pairresync operation for a split pair can be very fast, the pairresync operation for a suspended pair will take as long as the initial copy operation.

The USP V/VM storage system will automatically suspend a SIZ pair when it cannot keep the pair mirrored for any reason. When the storage system suspends a pair, sense information is generated to notify the host. The storage system will automatically suspend a SIZ pair under the following conditions:

- When the storage system detects an error condition related to an update copy operation, and
- When the differential bitmap in shared memory is lost (e.g., due to offline microprogram exchange). This applies to *SP-pend* and *V-split* pairs only. For *duplex*, *split*, *resync*, or *resync-r* pairs, the pair is not suspended but the entire S-VOL (T-VOL for reverse copy) is marked as difference data.

Resynchronize Pair Operations

To change the status of the pairs from **Split** to **Duplex**, or from **Suspend** to **Duplex**, you must resynchronize the pairs. ShadowImage for z/OS allows you to perform two different types of pairresync operations: forward pairresync operation (Normal Copy and Quick Resync) and backward pairresync operation (Reverse Copy and Quick Copy). Forward pairresync means copying S-VOL data to the T-VOL, and backward pairresync means copying T-VOL data to the S-VOL.

- Normal Copy (forward pairresync in normal speed)

The normal resync operation first edits the differential bitmap of S-VOL and T-VOL, and then (see Figure 2-6) resynchronizes the T-VOL with the S-VOL based on the information of the edited differential bitmap. The copy direction for a normal resync operation is S-VOL to T-VOL. Pair status changes to **Duplex** when the copying process of differential data is completed.

The pair status during a normal resync operation is *resync*, and the S-VOL remains accessible to all hosts for both read and write operations during a normal resync operation. The T-VOL becomes inaccessible to all hosts during a normal resync operation.

- Quick Resync (forward pairresync in fast speed)

The quick resync operation first edits the differential bitmap of S-VOL and T-VOL, and change the pair status to **Duplex** when the editing process completes. The differential data based on the information of the edited differential bitmap will be copied when update copy operations are performed for duplex pairs (see Figure 2-6). The resync operation by Quick Resync is faster than Normal Copy since Quick Resync changes pairs status to **Duplex** before actually copying differential data to the T-VOL.

The pair status during a quick resync operation is *resync*, and the S-VOL remains accessible to all hosts for both read and write operations. The T-VOL becomes inaccessible to all hosts during a quick resync operation.

Figure 2-6 illustrates how the data changes during the forward pairresync operations.

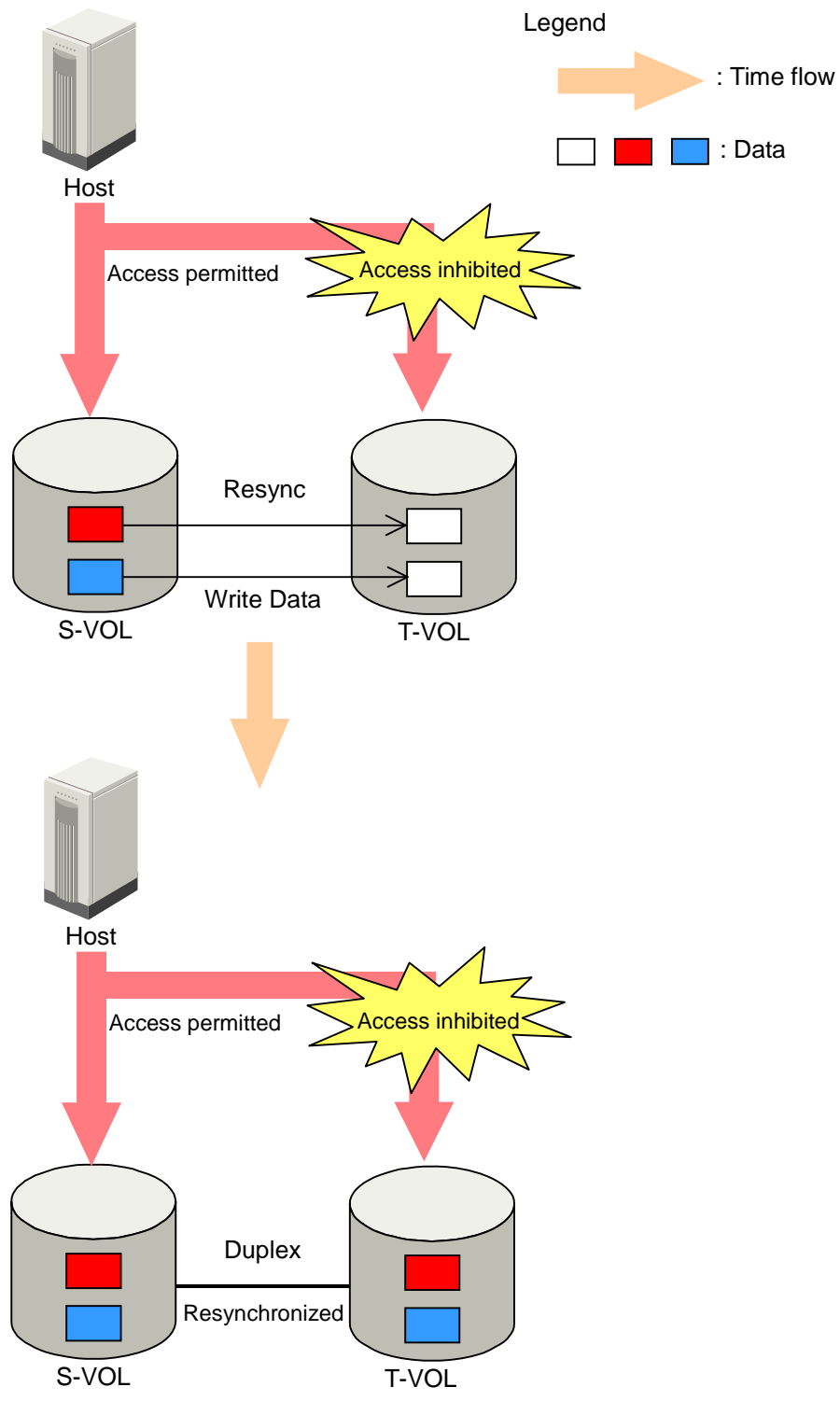


Figure 2-6 Forward Pairresync Operations



Caution: Even if the copy operation is completed without any host I/O, the data in the S-VOL and the data in the T-VOL may not be the same. Whether the S-VOL and the T-VOL have the same data depends on the condition of the storage system. To make the S-VOL data and the T-VOL data equal, split the pair and make the pair status *split*.

- Reverse Copy (backward pairresync in normal speed)

The reverse copy operation (see Figure 2-7) synchronizes the S-VOL with the T-VOL. The copy direction for a reverse copy operation is T-VOL to S-VOL. The pair status during a reverse copy operation is *resync-r*, and the S-VOL and T-VOL become inaccessible to all hosts for write operations during a reverse copy operation. As soon as the reverse copy operation is complete, the S-VOL becomes accessible.

- Quick Restore (backward pairresync in fast speed)

The quick restore operation (see Figure 2-7) speeds up the reverse copy operation by changing the volume map in the USP V/VM storage system to swap the contents of the S-VOL and T-VOL without copying the T-VOL data to the S-VOL. The S-VOL (used to be the T-VOL) and T-VOL (used to be the S-VOL) are resynchronized when update copy operations are performed for pairs in the *duplex* status.

The pair status during a quick restore operation is *resync-r* until the volume map change is complete. The S-VOL and T-VOL become inaccessible to all hosts for write operations during the quick restore operation.

- After quick restore operation is executed, the Storage Navigator window may display old configuration information on components such as logical volumes (LDEVs); the window may display configurations before the quick restore operation is performed. To refresh configuration information on the Storage Navigator window, wait until the quick restore operation completes, click **File**, and then **Refresh** on the menu bar of the window.
- If the differential data between S-VOL and T-VOL is small, the reverse copy operation may be completed faster than the quick restore operation.
- If you create a pair by using an encrypted volume and a non-encrypted volume and then execute Quick Restore, the S-VOL encryption status and the T-VOL encryption status will be reversed. For example, if you perform Quick Restore on an encrypted S-VOL and a non-encrypted T-VOL, S-VOL will be a non-encrypted volume, and T-VOL will be an encrypted volume.

Figure 2-7 illustrates how the data changes during the backward pairresync operations.

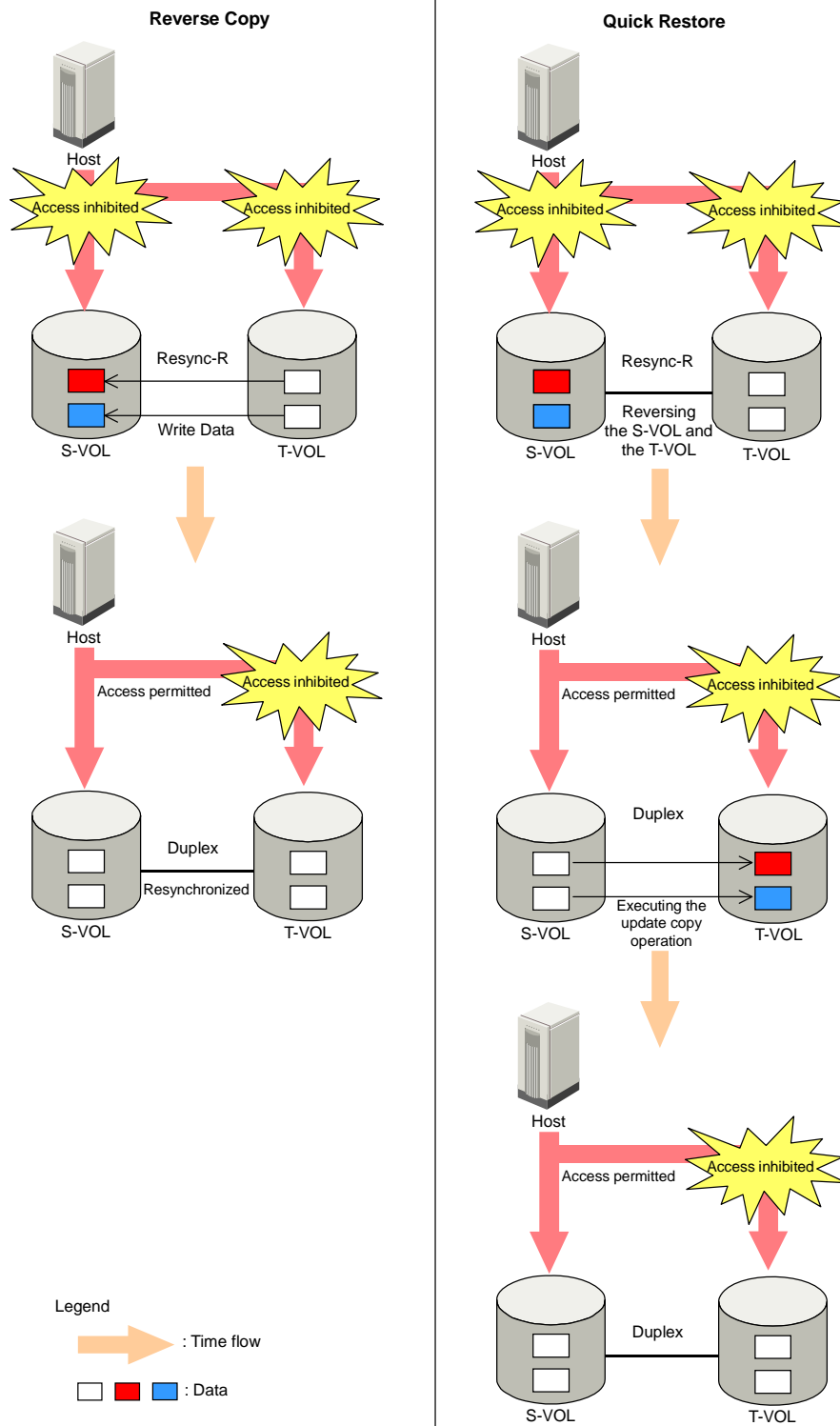


Figure 2-7 Backward Pairresync Operations

The S-VOL remains fully accessible during a normal/quick resync operation, but become inaccessible to all hosts during a reverse copy or quick restore operation.

During reverse copy or quick restore is in progress, you cannot perform add, split, or resync pair for any other pair that shares the same S-VOL (delete pair and suspend pair are allowed).

Pairresync operation time depends on the pair status, *split* or *suspend*. The relation between the pair status and the time required for pairresync operations are as follow:

- Pairresync for *split* pair

When a normal/quick resync operation is performed on a split pair, the USP V/VM storage system copies all differential data from the S-VOL to the T-VOL. When a reverse copy or quick restore operation is performed on a split pair, the storage system copies all differential data from the T-VOL to the S-VOL. This ensures that the S-VOL and T-VOL are properly resynchronized in the desired direction, and also greatly reduces the time needed to resynchronize the pair.

- Pairresync for *suspend* pair

When a normal/quick resync operation is performed on a suspended pair, the USP V/VM storage system copies all data on the S-VOL to the T-VOL, since all S-VOL tracks were flagged as difference data when the pair was suspended. Therefore, the normal resync operation for suspended pairs is equivalent to and takes as long as the SIZ initial copy operation. If you perform the quick resync operation on the suspended pairs, the update copy operation will be performed and all the data will be copied to the T-VOL. In this case, the update copy operation will take much more time than the initial copy operation.

- Resynchronizing all the pairs in the same consistency group

A PPRC command enables you to resynchronize all SIZ pairs in the same consistency group.

Pairresync operation on all the pairs in the same consistency group works in Normal Resync. Therefore, you cannot specify Quick Resync, Reverse Copy, or Quick Restore. If you want to perform Quick Resync, Reverse Copy, or Quick Restore, you issue the PPRC command on one pair.

Delete Pair Operation

The ShadowImage for z/OS delete pair operation stops the SIZ update copy operations to the T-VOL of the pair and changes the pair status of both volumes to *Simplex*. A SIZ pair can be deleted by the user at any time except during the quick split operation (i.e., any status except **Simplex** and **V-split**). After you delete a SIZ pair, the T-VOL is still not available for write operations until the reserve attribute is reset.

When a delete pair operation is performed on a pair in **Split** status, the reserve attribute of the T-VOL is reset automatically.

The T-VOL of a duplex pair may not be identical to its S-VOL, due to the asynchronous SIZ update copy operations. For information about how to synchronize the volumes before deleting the pair, see [Deleting Pairs](#).

Pair Status

Figure 2-8 illustrates the pair status transitions and the relationship between the pair status and the SIZ operations.

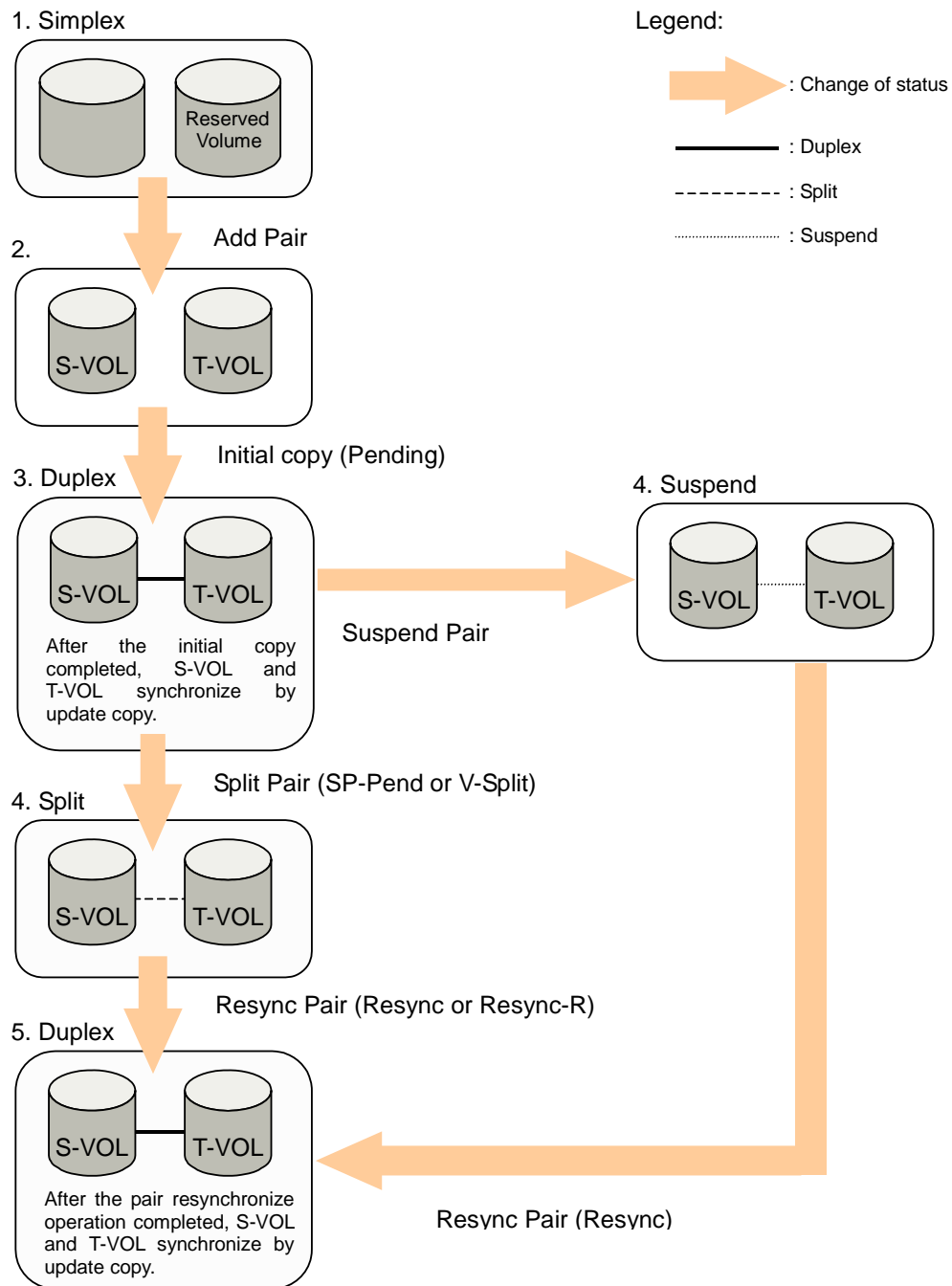


Figure 2-8 ShadowImage for z/OS Pair Status Transitions

If a volume is not assigned to a SIZ pair, its status is Simplex.

1. Select the Simplex volumes for S-VOL and T-VOL to create a SIZ pair. When you create a SIZ pair, the initial copy operation starts. During the initial copy operation, the status of the S-VOL and T-VOL changes to pending.
2. When the initial copy operation is complete, the pair status becomes duplex. When the initial copy is completed, the differential data between the S-VOL and the T-VOL will be copied by the update copy.
3. There are two kinds of pair status (*split* and *suspend*) when the pair is not synchronized
4. When you split a pair (pairsplit), the pair status changes to *split*.
 - During the pairsplit process, the pair status becomes *SP-pending*.
If you specify **Quick Split** pairsplit, the pair status becomes *V-Split* during the process. When the split is complete, the pair status changes to *split*, and you can access the split T-VOL. The update copy operation is not performed on the pairs which status is *split*.
 - If the USP V/VM cannot maintain *duplex* status for any reason, or if you suspend the pair, the pair status changes to *suspend*.
5. When you start a pairresync operation, the pair status changes to *resync* or *resync-r*. When the pairresync operation is complete, the pair status changes to **Duplex**.

When you specify reverse or quick restore mode for a pairresync operation, the pair status changes to *resync-r* (data is copied in the reverse direction from the T-VOL to the S-VOL). For details on the settings of the pairresync operation, see [Resynchronize Pair Operations](#).

When you delete a pair, the status of the volumes that were used by that pair changes to *Simplex*. You cannot delete the pair which status is *V-Split*.

Table 2-2 lists and describes the Siz pair status conditions.

Table 2-2 ShadowImage for z/OS Pair Status

Status	Description	Host Status	S-VOL Access	T-VOL Access
Simplex	The volume is not assigned to a Siz pair. The USP V/VM storage system accepts read and write I/Os for all <i>simplex</i> volumes that are not reserved.	S-VOL = SIMPLEX T-VOL = SIMPLEX	N/A (there is no S-VOL yet).	N/A (there is no T-VOL yet). If the volume is reserved as a T-VOL, the storage system does not accept read and write I/Os.
Pending	The pair create operation has been accepted normally. The initial copy operation is executed.* No update copy operations are performed.	S-VOL = PPRI-PNDG T-VOL = PSEC-PNDG	Read/write-enabled	Read/write-disabled
Duplex	The initial copy operation is complete, and the USP V/VM storage system starts performing asynchronous update copy operations from the S-VOL to the T-VOL as needed. The S-VOL and T-VOL of a duplex pair may not be identical.	S-VOL = PPRIMARY T-VOL = PSECONDRY	Read/write-enabled	Read/write-disabled
SP-Pend	The pair split operation in Steady Split mode has been accepted normally. The split operation starts a copy operation.* All S-VOL updates prior to the split command are being copied to the T-VOL. When these updates are complete, the split T-VOL is identical to the state of the S-VOL when the split started.	S-VOL = PPRI-PNDG T-VOL = PSEC-PNDG	Read/write-enabled	Read/write-disabled
V-Split	The pair split operation in Quick Split mode has been accepted normally. The split operation starts a copy operation.* Only the S-VOL differential data is being copied to the T-VOL in background. The <i>V-Split</i> pairs cannot be deleted.	S-VOL = PPRI-SUSP T-VOL = SIMPLEX	Read/write-enabled	Read/write-enabled, can be varied online.
Split	The USP V/VM storage system stops performing update copy operations for split pairs, and starts accepting write I/Os for split T-VOLs. The storage system keeps track of all updates to the split S-VOL and T-VOL, so the pair can be resynchronized accurately and quickly.	S-VOL = PPRI-SUSP T-VOL = SIMPLEX	Read/write-enabled	Read/write-enabled, can be varied online.

Status	Description	Host Status	S-VOL Access	T-VOL Access
Resync	The pairresync operation has been accepted normally. The pairresync operation is executed.* When a split pair is resynchronized in normal mode, only the S-VOL differential data is copied to the T-VOL. When a suspended pair is resynchronized, the entire S-VOL is copied to the T-VOL. No update copy operations are performed during resync operation.	S-VOL = PPRI-PNDG T-VOL = PSEC-PNDG	Read/write-enabled	Read/write-disabled
Resync-R	The reverse resync operation on the pair has been accepted normally. The reverse resync operation is executed.* When a split pair is reverse resynchronized, the USP V/VM storage system copies only the T-VOL differential data to the S-VOL. The reverse copy cannot be performed on suspended pairs. No update copy operations are performed during reverse copy or quick restore.	S-VOL = PPRI-PNDG T-VOL = PSEC-PNDG	Read/write-disabled	Read/write-disabled
Suspend	The USP V/VM storage system does not perform update copy operations to a suspended T-VOL. The storage system marks the entire S-VOL track map as differential data, so the entire S-VOL is copied to the T-VOL when the pair is resumed. Use resync command to resume a suspended pair. Reverse copy and quick restore cannot be used to resume suspended pairs.	S-VOL = PPRI-SUSP T-VOL = PSEC-SUSP	Read/write-enabled	Read/write-disabled
*: It might take time before the copying process starts, depending on the number of pairs and system environment.				



Caution: When you execute DEVSERVE to a read/write disabled volume in Table 2-2, "INTERVENTION REQUIRED" will be returned. However, when you create pairs with the volumes online, and when you execute DESERVE to a read/write disabled volume, a normal value will be returned instead of "INTERVENTION REQUIRED".

Table 2-3 shows the allowable operations for each pair status.

Table 2-3 Pair Status and Allowable Operations

Operation	Pair Status								
	Simplex	Pending	Duplex	SP-Pend	V-Split	Split	Resync	Resync-R	Suspend
Add Pair	OK	NG	NG	NG	NG	NG	NG	NG	NG
Split Pair	OK	OK	OK	NG	NG	NG	NG	NG	NG
Suspend Pair	NG	OK	OK	OK	OK	OK	OK	OK	NG
Resync Pair (forward)	NG	NG	NG*	NG	OK	OK	NG*	NG	OK
Resync Pair (backward)	NG	NG	NG	NG	NG	OK	NG	NG	NG
Delete Pair	NG	OK	OK	OK	NG	OK	OK	OK	OK
<p>*: There are following cases.</p> <ul style="list-style-type: none"> ▪ If you try to resynchronize a pair in <i>duplex</i> or <i>resync</i> status by copying data from the S-VOL to the T-VOL using PPRC TSO command, the processing will end normally. However, since no resynchronize processing will be performed, the pair status does not change. ▪ If you use ICKDSF PPRCOPY command, the command will abnormally end by reporting CC = 12. ▪ If you use Business Continuity Manager, the processing will end normally. However, since no resynchronize processing will be performed as in case 1, the pair status does not change. For further information about how to use Business Continuity Manager, see the <i>Business Continuity Manager User and Reference Guide</i>. 									

ShadowImage for z/OS Options

You can use the options in Table 2-4 for SIZ operations.

Table 2-4 Types of ShadowImage for z/OS Options

Option Type	Features	Requirement
Swap&Freeze	Swap&Freeze option suppresses the update copy. For details, see Swap&Freeze Option.	You must change the storage system setting to allow the quick restore operation.
Host I/O Performance	Host I/O Performance option suppresses the copy operations by ShadowImage for z/OS. For details, see Host I/O Performance Option.	-
Copy Threshold	Copy Threshold option temporarily stops the copy operation of ShadowImage for z/OS. For details, see Copy Threshold Option.	-

Note: Available option types depend on the USP V/VM storage system settings.

Swap&Freeze Option

The **Swap&Freeze** option allows the S-VOLs of a SIZ pair to remain unchanged after the quick restore operation. If the quick restore operation is performed on a SIZ pair with the **Swap&Freeze** option, update copy operations are suppressed, and thus are not performed for pairs in the duplex status after the quick restore operation. If the quick restore operation is performed without the Swap&Freeze option, the S-VOL and T-VOL are resynchronized when update copy operations are performed for pairs in the **Duplex** status.

Make sure that the **Swap&Freeze** option remains in effect until the pair status becomes *Duplex* after the quick restore operation.

Figure 2-9 shows the state of the T-VOL after the quick restore operation with or without the **Swap&Freeze** option.

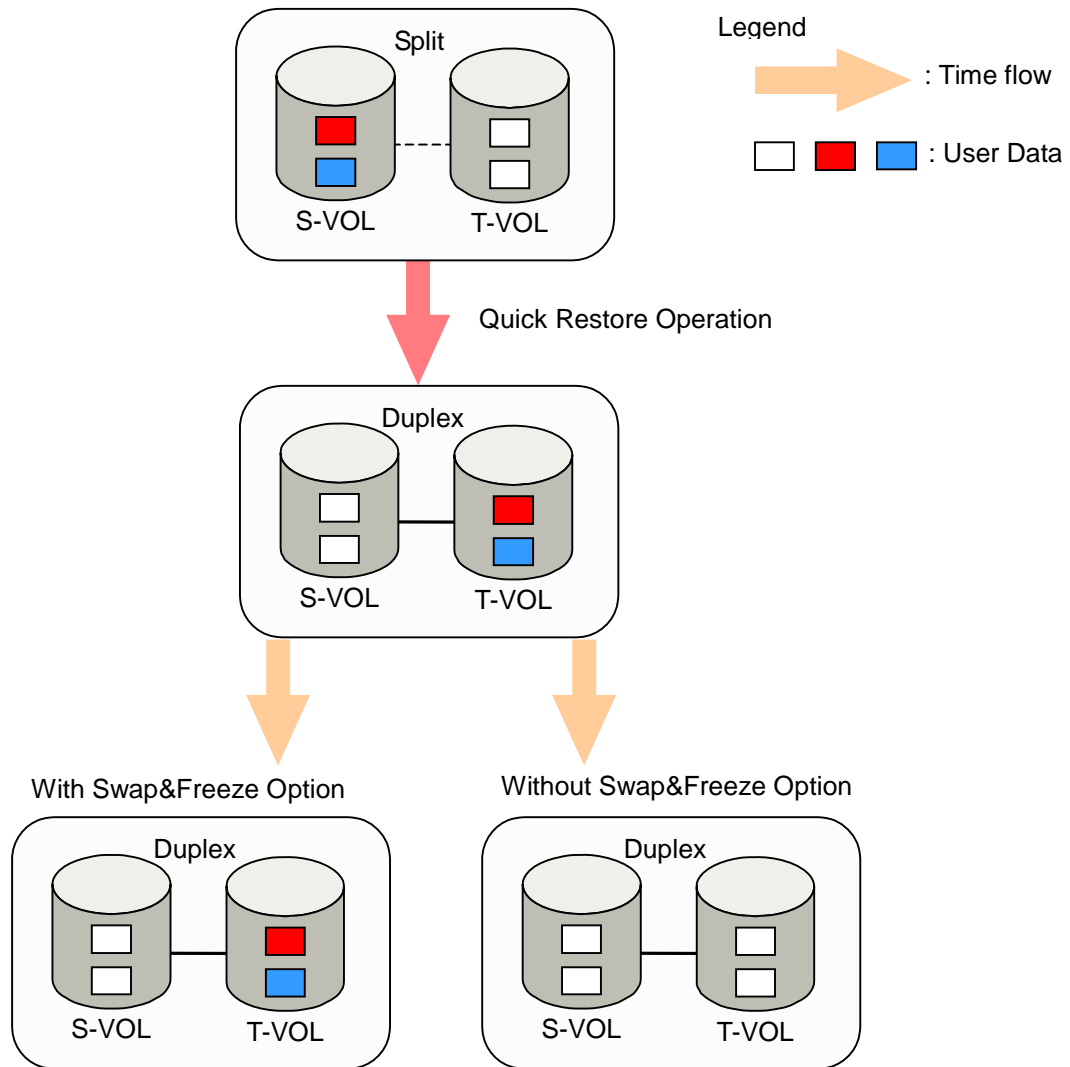


Figure 2-9 Quick Restore Operation With or Without Swap&Freeze Option

The Quick Restore pairresync operation on a pair which status is *split* exchanges the data in the S-VOL and the T-VOL of the pair. If you use **Swap&Freeze** option when performing the Quick Restore pairresync operation, the update copy operation will not take place after the Quick Restore pairresync operation is complete. Therefore, the data of the S-VOL and the T-VOL is kept exchanged. If you do not use **Swap&Freeze** option when performing the Quick Restore pairresync operation, the update copy operation will take place after the Quick Restore pairresync operation is complete, and the data in the S-VOL overwrites the T-VOL.

Host I/O Performance Option

The Host I/O Performance option is used to improve host I/O responses over SIZ copying processing time. When the Host I/O Performance option is in effect, the storage system suppresses execution of SIZ copying processing, and consequently host I/O responses improve.

When SIZ copying processing is suppressed by the Host I/O Performance option, the time taken for copying increases. Also, if ShadowImage pairs exist, host I/O responses might not be improved. In this case, set the Host I/O Performance option for ShadowImage as well.

Copy Threshold Option

If the load of USP V/VM storage system increases, host server I/O performance (response) may be degraded. If ShadowImage for z/OS performs copy operations when the load of the storage system is heavy, it is more likely that host server I/O performance (response) may be degraded. The **Copy Threshold** option temporarily stops SIZ copy operations when the load of the storage system is heavy. If you set this option in effect, you can minimize the degradation of host I/O performance by temporarily stopping SIZ copy operations when the load of the storage system is heavy.

ShadowImage for z/OS has another option called the **Host I/O Performance** option, which maintains host I/O performance (response). **Host I/O Performance** option suppresses SIZ copy operation regardless of the status of the storage system. On the other hand, the **Copy Threshold** option is effective only when the load of the storage system is heavy. When the **Copy Threshold** option is in effect, all the SIZ copy operations stop.

For information about the setting of the **Host I/O Performance** option, see Host I/O Performance Option. For information about the setting of the **Copy Threshold** option, please call the Support Center.

Copy operations that are stopped by the **Copy Threshold** option will resume when the storage system load becomes light. If this option is in effect, not only SIZ copy operation but also the copy operations of the following program products will stop when the load of the storage system is heavy.

- ShadowImage
- Compatible Mirroring for IBM FlashCopy Version 1
- Compatible Mirroring for IBM FlashCopy Version 2
- Copy-on-Write Snapshot
- Volume Migration

Interoperability with other Products and Functions

ShadowImage for z/OS supports concurrent operations with the following data management functions.

- [Virtual LVI](#)
- [Cache Residency Manager](#)
- [Volume Retention Manager](#)
- [Volume Migration](#)
- [Universal Volume Manager](#)
- [TrueCopy for z/OS](#)
- [Universal Replicator for z/OS](#)
- [TrueCopy for z/OS and Universal Replicator for z/OS](#)
- [Compatible XRC](#)
- [Concurrent Copy](#)

Virtual LVI

Virtual LVI volumes can be assigned to SIz pairs, provided that the T-VOL has the same capacity as the S-VOL. If you need to perform Virtual LVI operations on an existing SIz S-VOL or T-VOL, you must delete the pair first to return the volume to *Simplex* status.

Cache Residency Manager

Cache Residency Manager for z/OS volumes can be assigned to SIz pairs, and Cache Residency Manager for IBM z/OS operations can be performed on existing SIz S-VOLs and T-VOLs.



Caution: See Performance Considerations for important information on performing quick restore operations on Cache Residency Manager volumes.

Volume Security

Volume Security operations do not directly affect SIz operations. Secure LDEVs can be assigned to SIz pairs, and SIz volumes can be secured. A secure LDEV will accept SIz initial and update copy operations. However, you cannot specify volumes that are selected as invalid T-VOLs for SIz T-VOLs. When an S-VOL is secured by Volume Security, this setting does not apply to the corresponding T-VOLs.

SIz T-VOLs cannot be accessed by any host except when the pair is split.

Volume Retention Manager

Normal volumes have the read/write attribute so that you can access and update the data without any restrictions. By using Volume Retention Manager, you may set the read only attribute, which prohibit writing operation, or the protect attribute which prohibit both reading and writing operations. Remember that you cannot create SIz pairs with the volumes with protect attribute.

Volume Migration

SIz volumes can be assigned to migration volumes of Volume Migration. However, if the SIz S-VOL is already paired with three T-VOLs, you must delete the SIz pairs before migrating the volumes by Volume Migration. Also, if you want to assign SIz volumes to destination volumes of migration by Volume Migration, or reserve SIz volumes for Volume Migration, you must delete the SIz volumes or un-reserve SIz volumes before using the volumes by Volume Migration. If you assign a SIz S-VOL that is already paired with three T-VOLs to migration volumes of Volume Migration, or assign SIz volumes to other Volume Migration volumes than migration volumes, the command will be rejected.

Also, if you split the SIz pair that is assigned to Volume Migration's migration volumes, migration of those volumes will be canceled.

You cannot use migration volumes, destination volumes, and reserved volumes of Volume Migration for SIz pair operations (the command will be rejected). If you want to use Volume Migration volumes for SIz pair operations, you must release the volumes by Volume Migration.

Universal Volume Manager

SIz operations can also be performed in conjunction with Universal Volume Manager operations to create pairs with external volumes. For the details on the external volumes, see the *Universal Volume Manager User's Guide*.

TrueCopy for z/OS

TCz volumes can be assigned to SIz pairs, and vice versa.



Caution: When performing the Quick Restore pairresync operation on the SIz pair which shares the volume with TrueCopy Asynchronous for z/OS, SIz S-VOL and T-VOL must be allocated to the same CLPR. Please specify the Reverse Copy mode instead of the Quick Restore mode when resynchronizing the SIz pair whose S-VOL and T-VOL are allocated to the different CLPR.

ShadowImage for z/OS is recommended for intra-storage system copy operations. If ShadowImage for z/OS is not installed, TCz (synchronous only) can be used to copy within the same USP V/VM storage system. This TCz configuration requires at least one external Fibre Channel interface cable loop (a minimum of two is recommended).

ShadowImage for z/OS and TrueCopy for z/OS can function together in the same USP V/VM storage system to provide both internal and remote backup for your important data.

- When SIz and TCz pairs share the same volume, to obtain the SIz pair status, query from the host:
 - The T-VOL status of the SIz pair if the SIz S-VOL and TCz M-VOL share the same volume,
 - The T-VOL status of the SIz pair if the SIz S-VOL and TCz R-VOL share the same volume, and
 - The S-VOL status of the SIz pair if the SIz T-VOL and TCz M-VOL share the same volume.
- ShadowImage for z/OS supports multiple T-VOLs for each S-VOL. If you issue a pair status query to a SIz S-VOL, the status for only one SIz pair is reported (the pair with the T-VOL with the lowest LDEV ID). To obtain the pair status for the SIz pair(s) with the other T-VOL(s), you must direct the host query to the specific T-VOL using the T-VOL's LDEV ID in the host command. The SIz remote console software displays the LDEV ID and SIz pair status of all T-VOLs associated with an S-VOL.
- Reverse copy and quick restore operations can be performed on shared SIz/TCz pairs only when the TCz pair is suspended.

Table 3-1 describes the host pair status reporting for SIZ volumes, TCz volumes, and SIZ/TCz shared volumes.

Table 3-1 Host Pair Status Reporting for SIZ/TCz Shared Volumes

Number of SIZ S-VOLs	Number of TCz Pairs	Pair Status Reported by Storage System
0	0	Simplex
1	0	SIZ pair status
2 or more	0	SIZ pair status for the pair whose T-VOL has the lowest LDEV ID
0	1	TCz pair status
1	1	TCz pair status
2 or more	1	TCz pair status

Table 3-2 lists the currency of the data on shared SIZ/TCz volumes based on the SIZ and TCz pair status.

Table 3-2 Currency of a Shared SIZ and TCz Volume

SIZ Pair Status	TCz Pair Status		
	Pending	Duplex	Suspended
Pending	Not current	Not current	Not current
Duplex	Not current	Not current	CURRENT
SP-Pending	Not current	Not current	CURRENT
V-Split	Not current	Not current	CURRENT
Split	CURRENT	CURRENT	CURRENT
Resync	Not current	Not current	CURRENT
Resync-r	-	-	CURRENT
Suspended	Not current	Not current	Not current

Figure 3-1 shows a volume that is functioning as both a SIZ S-VOL and a TCz M-VOL. This configuration allows you to:

- Use ShadowImage for z/OS to provide on-site backup copies of TCz M-VOLs, and/or
- Use TCz to provide remote backup copies of SIZ S-VOLs.

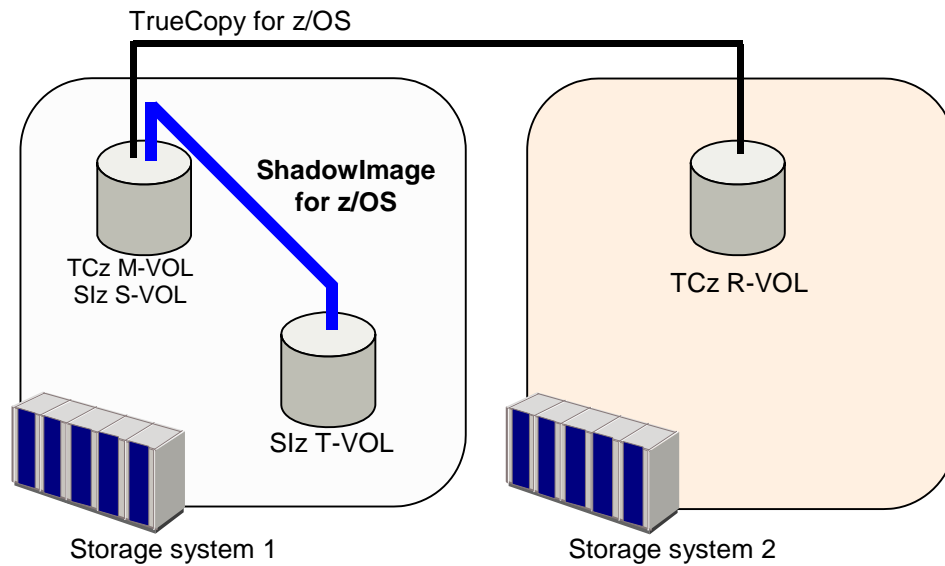


Figure 3-1 SIz and TCz: Shared S-VOL / M-VOL

Figure 3-2 shows a volume that is functioning as both a SIz S-VOL and a TCz R-VOL. This configuration allows you to use SIz to provide additional remote copies of TCz R-VOLs.

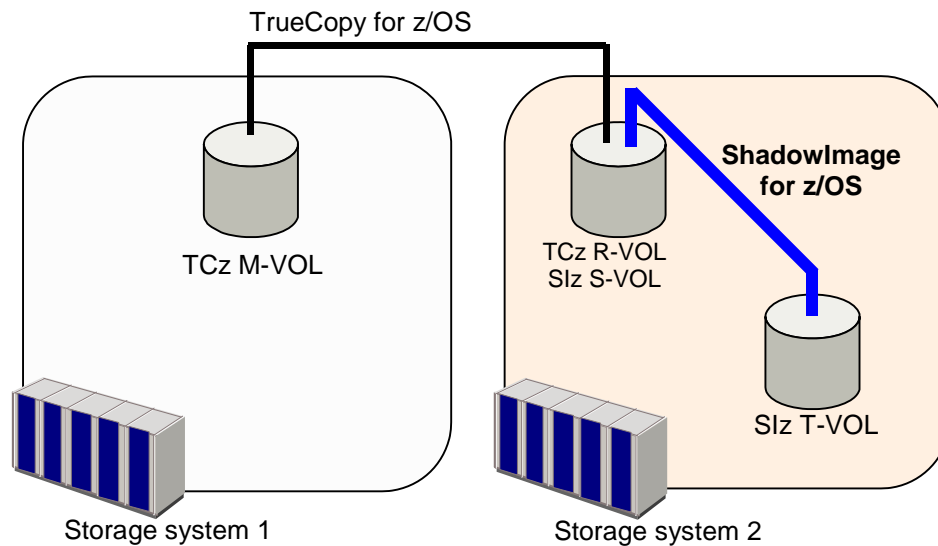


Figure 3-2 SIz and TCz: Shared S-VOL / R-VOL



Caution: When you share a SIz S-VOL with a TCz R-VOL as shown in Figure 3-2, the write operation to the TCz M-VOL takes time. Especially, when the SIz pair is in the V-Split status, the write operation to the TCz M-VOL may take extra time according to the time for copying process of the SIz pair.

When you split SIz pairs, if a volume is shared with TCzA and SIz, consider the following points.

- Split the SIz pair after you have changed the status of TCzA pair to **Suspend**.
- If you split SIz pairs for each consistency group, split the pairs after you have changed the status of all TCzA pairs in the specified consistency group to **Suspend**, and also made the consistency time (C/T) of the consistency group equal to the C/T of each TCzA pair.

You can also prevent the SIz split operation which is under the condition that does not meet the above points. For details, please call the Support Center.

In addition, note that in the case of TCzA, the TCz pair may be suspended by failure because of the shortage of the capacity of its side file.

Figure 3-3 is an example of a volume, which is functioning as both a TCz M-VOL and a SIz S-VOL, while the R-VOL of the same TCz pair is also functioning as the S-VOL of another SIz pair. This configuration allows you to:

- Use ShadowImage for z/OS to provide on-site backup copies of TCz M-VOLs and R-VOLs, and/or
- Use TCz to provide remote backup of SIz S-VOLs.

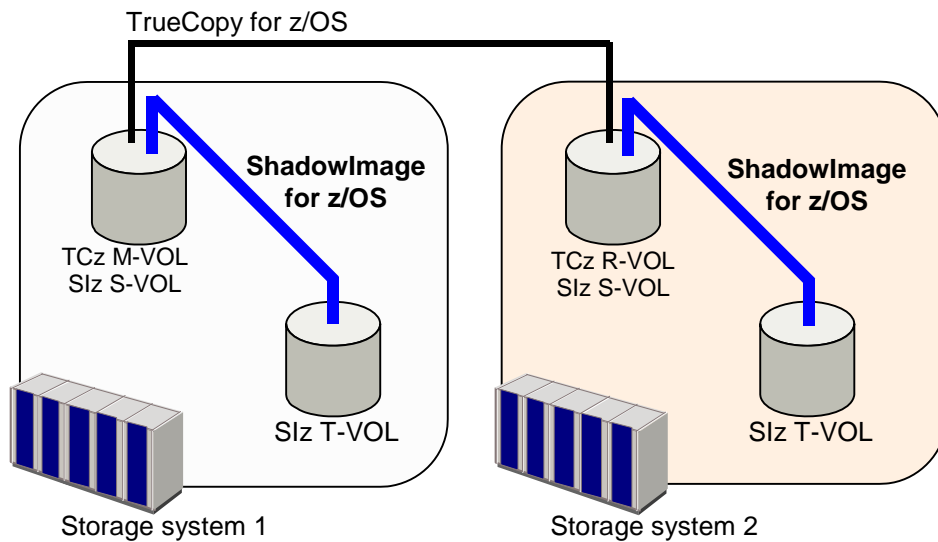


Figure 3-3 SIz and TCz: Shared S-VOL / M-VOL and S-VOL / R-VOL

Figure 3-4 shows a volume functioning as both a SIz T-VOL and a TCz M-VOL.

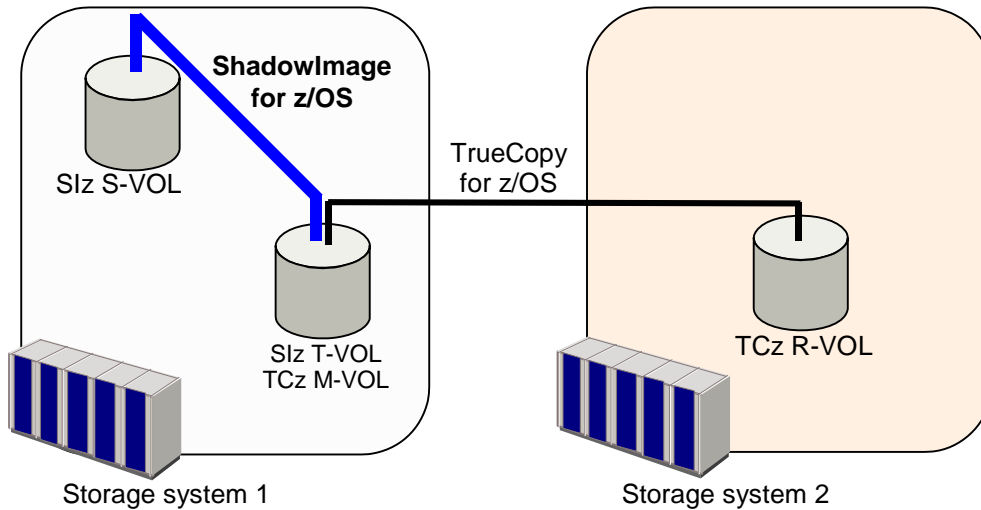


Figure 3-4 SIz and TCz: Shared T-VOL/M-VOL

The configuration of Figure 3-4 does not allow SIz and TCz to copy at the same time. Add the SIz pair first, and then split the pair before creating the TCz pair. You must suspend the TCz pair in order to resynchronize the SIz pair. The TCz pair status cannot be changed when the SIz pair is in the V-Split status.

You cannot distinguish the *Split* status from the *V-Split* status with the PPRC command. When you use the SIz and TCz shared configuration shown in Figure 3-4, you must either use the PPRC command to perform the Steady Split operation, or use the Storage Navigator computer to confirm the pair statuses. You can perform the Steady Split operation by specifying the CSUSPEND parameters (Byte 7 = 'M', Byte 8 = 'P', Byte 9 = 'S'). For details about the PPRC commands, see Chapter 8.

If a volume is shared with a SIz pair and a TCz pair, you can perform Quick Restore on the SIz pair when the TCz pair is suspended. You cannot perform Quick Restore on the SIz pair when the TCz pair is not suspended. Table 3-3 shows whether you can perform Quick Restore when a volume is shared with a SIz pair and a TCz pair.

Table 3-3 Quick Restore Operation when Volume is Shared with SIz Pair and TrueCopy Pair

Shared Volume		Quick Restore Operation on SIz Pair
ShadowImage for z/OS	TrueCopy for z/OS	
P-VOL	P-VOL	OK
	S-VOL	OK
S-VOL	P-VOL	OK

Universal Replicator for z/OS

URz volumes can be assigned to SIz pairs, and vice versa. A primary volume (P-VOL) of Universal Replicator for z/OS means a primary data volume of Universal Replicator for z/OS. A secondary volume (S-VOL) of Universal Replicator for z/OS means a secondary data volume of Universal Replicator for z/OS.

ShadowImage for z/OS and Universal Replicator for z/OS can function together in the same storage system to provide both internal and remote backup for your important data.

To query the status of a SIz pair when SIz and URz pairs share the same volume, do the following:

- Query the SIz S-VOL and T-VOL status from the host if the SIz S-VOL and URz P-VOL share the same volume,
- Query the SIz T-VOL status from the host if the SIz S-VOL and URz S-VOL share the same volume.
- Query the SIz S-VOL status from the host if the SIz T-VOL and URz P-VOL share the same volume.

ShadowImage for z/OS supports multiple T-VOLs for each S-VOL. If you issue a pair status query to an SIz S-VOL, the status for only one SIz pair is reported (the pair with the T-VOL with the lowest LDEV ID). To obtain the pair status for the SIz pair(s) with the other T-VOL(s), you must direct the host query to the specific T-VOL using the T-VOL's LDEV ID in the host command. The SIz remote console software displays the LDEV ID and SIz pair status of all T-VOLs associated with an S-VOL.

When you perform PPRC command to the SIz/URz shared volumes to query the pair status, the storage system reports pair status of the SIz. To query pair status of the URz from the host, use Business Continuity Manager. For details regarding how to use Business Continuity Manager, see the *Business Continuity Manager User and Reference Guide*.

Table 3-4 lists the currency of the data on shared SIz/URz volumes based on the SIz and URz pair status.

Table 3-4 Currency of a Shared SIz and URz Volume

SIz Pair Status	URz Pair Status		
	Pending duplex	Duplex	Suspended
Pending	Not current	Not current	Not current
Duplex	Not current	Not current	CURRENT
SP-Pending	Not current	Not current	CURRENT
V-Split	Not current	Not current	CURRENT

SIz Pair Status	URz Pair Status		
	Pending duplex	Duplex	Suspended
Split	CURRENT	CURRENT	CURRENT
Resync	Not current	Not current	CURRENT
Resync-r	-	-	CURRENT
Suspended	Not current	Not current	Not current

Figure 3-5 shows a volume, which is functioning as both a SIz S-VOL and an URz P-VOL. This configuration allows you to:

- Use ShadowImage for z/OS to provide on-site backup copies of URz P-VOLs, and/or
- Use URz to provide remote backup copies of SIz S-VOLs.

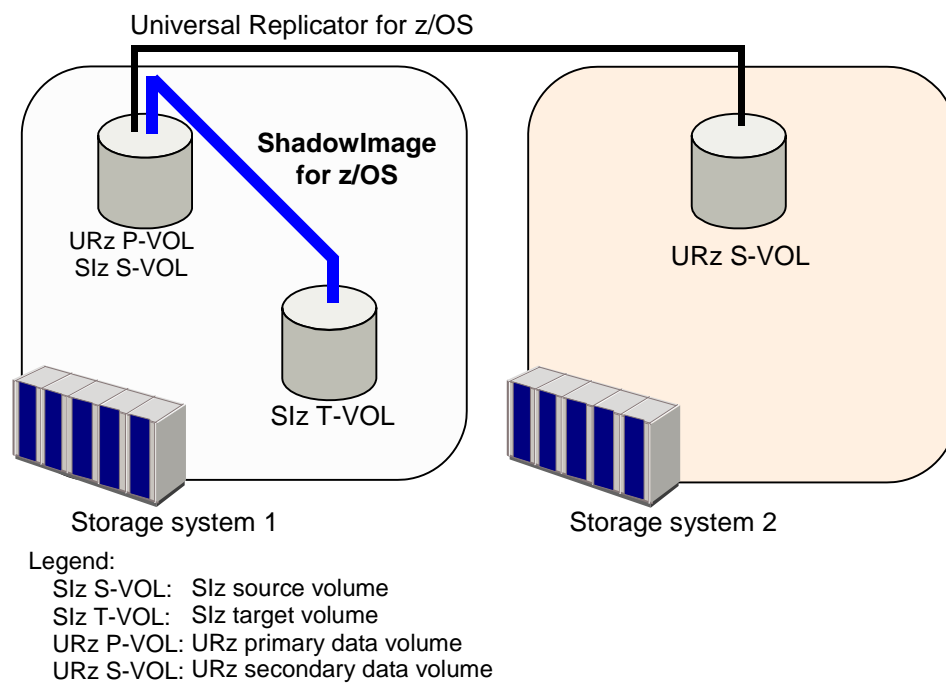


Figure 3-5 SIz and URz: Shared S-VOL/P-VOL

Figure 3-6 shows a volume functioning as both a SIz S-VOL and an URz S-VOL. This configuration allows you to use SIz to provide additional remote copies of URz S-VOLs.

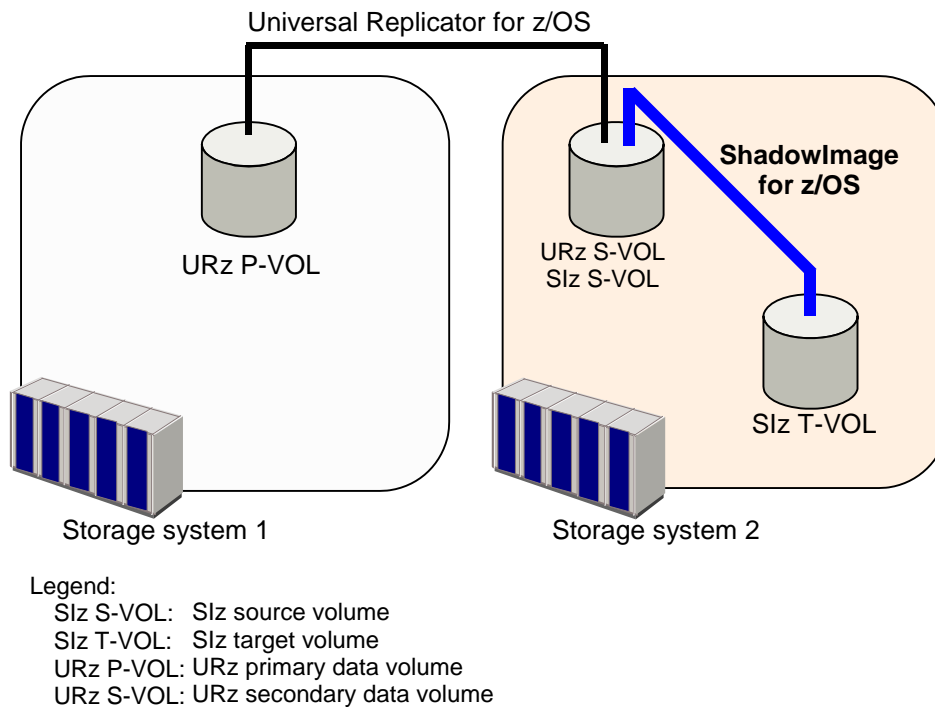


Figure 3-6 SIz and URz: Shared S-VOL/S-VOL



Caution: When you share a SIz S-VOL with an URz S-VOL as shown in Figure 3-6, the write operation to the URz P-VOL takes time. Especially, when the SIz pair is in the V-Split status, the write operation to the URz P-VOL may take extra time according to the time for copying process of the SIz pair.

In addition, note that if the journal volume size is small, the URz pair may be suspended by failure because of the shortage of the capacity of its journal volume.

Figure 3-7 shows a volume that is functioning as both an URz P-VOL and a SIz S-VOL, while the S-VOL of the same URz pair is also functioning as the S-VOL of another SIz pair. This configuration allows you to:

- Use ShadowImage for z/OS to provide on-site backup copies of URz P-VOLs and S-VOLs, and/or
- Use URz to provide remote backup of SIz S-VOLs.

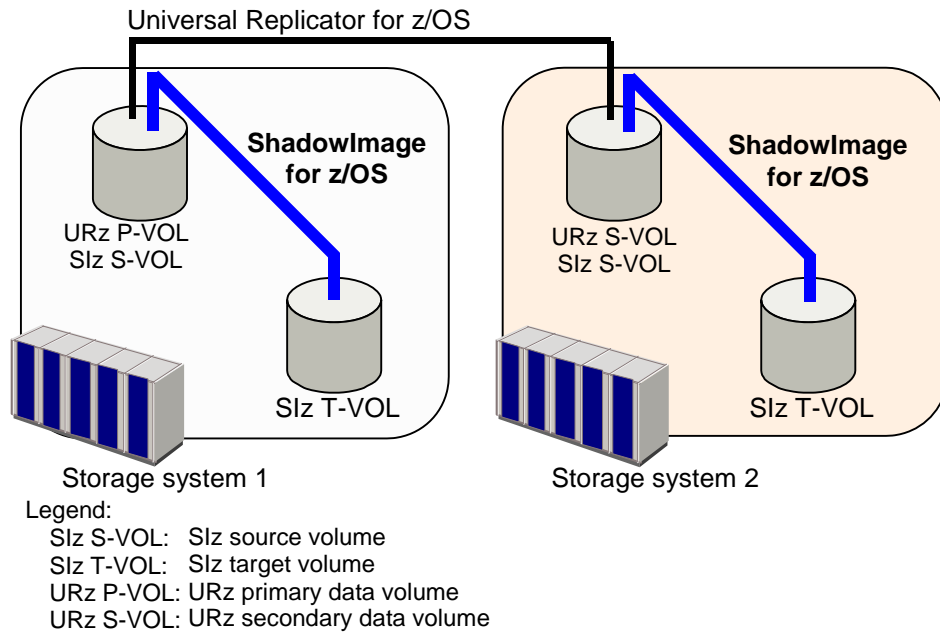


Figure 3-7 SIZ and URz: Shared S-VOL/P-VOL and S-VOL/S-VOL

Figure 3-8 shows a volume that is functioning as both a SIZ T-VOL and an URz P-VOL. This configuration allows you to use URz to provide remote copies of SIZ T-VOLs.

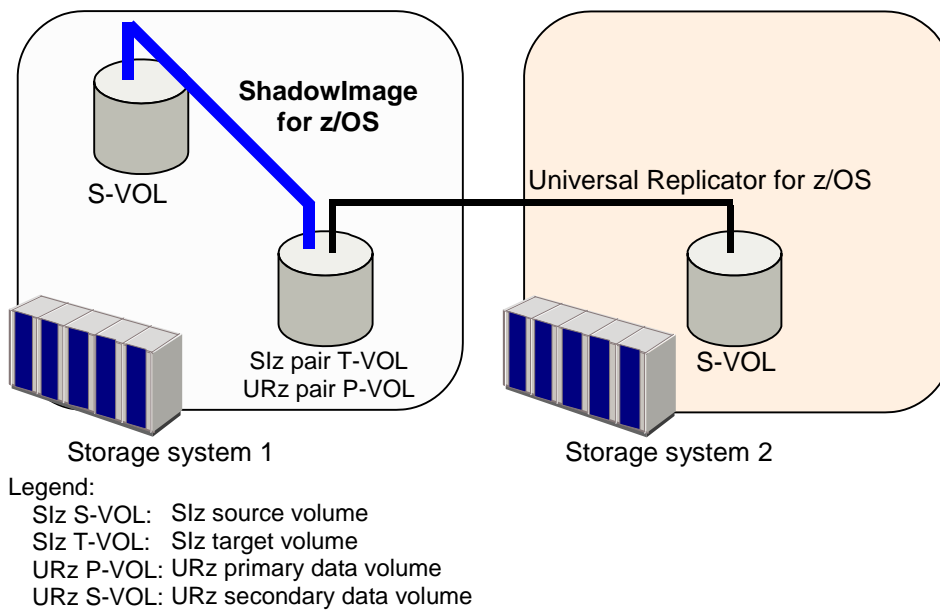


Figure 3-8 SIZ and URz: Shared T-VOL/P-VOL

In the configuration shown in Figure 3-8, you cannot perform the SIz and URz copy operations at the same time. In Figure 3-8, first you need to create and split the SIz pair, then create the URz pair. If you want to resynchronize the SIz pair, suspend the URz pair beforehand.

You cannot change the URz pair status while the SIz pair is in *V-Split* status.

If a volume is shared with a SIz pair and an URz pair, you can perform Quick Restore on the SIz pair when the URz pair is suspended. You cannot perform Quick Restore on the SIz pair when the URz pair is not suspended. Table 3-5 shows whether you can perform Quick Restore when a volume is shared with a SIz pair and an URz pair.

Table 3-5 Quick Restore Operation when Volume is Shared with SIz Pair and URz Pair

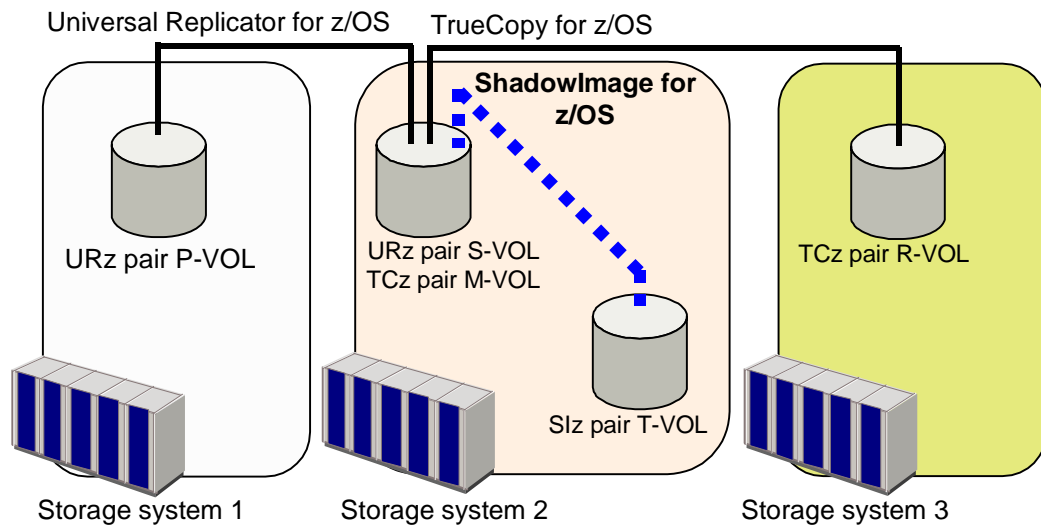
Shared Volume		Quick Restore Operation on SIz Pair
ShadowImage for z/OS	Universal Replicator for z/OS	
P-VOL	P-VOL	OK
	S-VOL	OK
S-VOL	P-VOL	OK

TrueCopy for z/OS and Universal Replicator for z/OS

Figure 3-9 and Figure 3-10 show examples of using SIz, TCz, and URz at the same time.

A primary volume (P-VOL) of Universal Replicator for z/OS means a primary data volume of Universal Replicator for z/OS. A secondary volume (S-VOL) of Universal Replicator for z/OS means a secondary data volume of Universal Replicator for z/OS.

The configuration shown in Figure 3-9 shows a volume functioning as both an URz S-VOL and a TCz M-VOL.

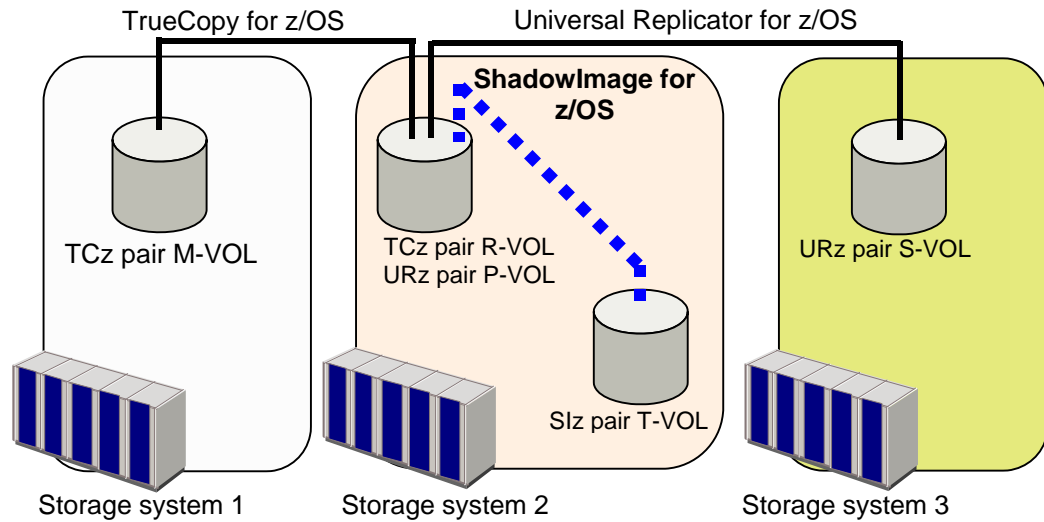


Legend:

- Slz S-VOL: Slz source volume
- Slz T-VOL: Slz target volume
- URz P-VOL: URz primary data volume
- URz S-VOL: URz secondary data volume
- TCz M-VOL: TCz main volume
- TCz R-VOL: TCz remote volume

Figure 3-9 Slz, URz, and TCz: Shared S-VOL / S-VOL / M-VOL

Figure 3-10 shows a volume functioning as both a TCz R-VOL and an URz P-VOL.



Legend:
 SIz S-VOL: SIz source volume
 SIz T-VOL: SIz target volume
 URz P-VOL: URz primary data volume
 URz S-VOL: URz secondary data volume
 TCz M-VOL: TCz main volume
 TCz R-VOL: TCz remote volume

Figure 3-10 SIz, TCz, and URz: Shared S-VOL / R-VOL / P-VOL

If the combination of Figure 3-9 or Figure 3-10 is used, you cannot perform Quick Restore on SIz pairs.

Figure 3-11 shows an example of a 3DC multi-target configuration where the following pairs are used:

- URz pair
- URz pair for delta resync operation
- SIz pairs
- TCz pair

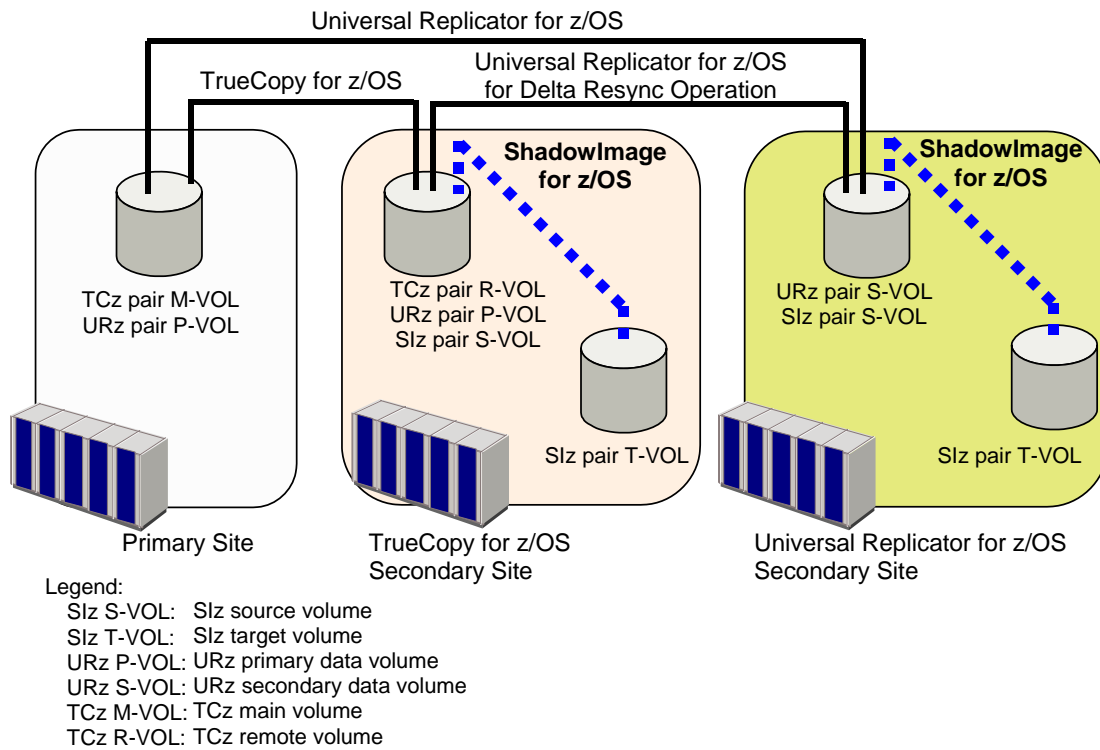


Figure 3-11 Example of Combination of Siz Pairs, a TCz pair, and a URz pair in 3DC Multi-target Configuration

Table 3-6 describes the availability of ShadowImage for z/OS operation in the TrueCopy for z/OS secondary site.

Table 3-6 Availability of ShadowImage for z/OS Operation in the TrueCopy for z/OS Secondary Site

TCz Pair Status	Status of URz Pair for Delta Resync Operation	ShadowImage for z/OS Operation							
		Add Pair	Split Pair	Suspend Pair	Delete Pair	Resync Pair			
						Normal Copy	Quick Resync	Reverse Copy	Quick Restore
Duplex	Hold	OK	OK	OK	OK	OK	OK	NO	NO
Pending Duplex		OK	OK	OK	OK	OK	OK	NO	NO
Suspended		OK	OK	OK	OK	OK	OK	OK	NO
Swapping		OK	OK	OK	OK	OK	OK	OK	NO
Duplex	Hlde	OK	OK	OK	OK	OK	OK	NO	NO
Pending Duplex		OK	OK	OK	OK	OK	OK	NO	NO
Suspended		OK	OK	OK	OK	OK	OK	OK	NO
Swapping		OK	OK	OK	OK	OK	OK	OK	NO

Table 3-7 describes the availability of ShadowImage for z/OS operation in the Universal Replicator for z/OS secondary site.

Table 3-7 Availability of ShadowImage for z/OS Operation in the Universal Replicator for z/OS Secondary Site

URz Pair Status	Status of URz Pair for Delta Resync Operation	ShadowImage for z/OS Operation							
		Add Pair	Split Pair	Suspend Pair	Delete Pair	Resync Pair			
						Normal Copy	Quick Resync	Reverse Copy	Quick Restore
Duplex	Hold	OK	OK	OK	OK	OK	OK	NO	NO
Pending Duplex		OK	OK	OK	OK	OK	OK	NO	NO
Suspended		OK	OK	OK	OK	OK	OK	OK	NO
Swapping		OK	OK	OK	OK	OK	OK	OK	NO

Compatible XRC

If SIZ S-VOLs and Compatible XRC source volume (original data) share the same volumes, you cannot perform the reverse copy or quick restore operation for those volumes. Do not use Compatible XRC T-VOLs (copied data) for SIZ volumes.

Concurrent Copy

If SIZ S-VOLs and Concurrent Copy source volume (original data) share the same volumes, you cannot perform the reverse copy or quick restore operation for those volumes. Do not use Concurrent Copy T-VOLs (copied data) for SIZ volumes.

Preparing for ShadowImage for z/OS Operations

This chapter describes the ShadowImage requirements, ShadowImage installation procedure, and calculation of the number of pairs that ShadowImage can create. Please read this chapter before you start the ShadowImage operation.

- [System Requirements](#)
- [Assessing ShadowImage for z/OS Requirements](#)
- [Requirements for Maintaining ShadowImage for z/OS](#)
- [Installing ShadowImage for z/OS](#)
- [Starting ShadowImage for z/OS](#)

System Requirements

SIz operations involve the USP V/VM storage system containing the S-VOLs and T-VOLs, the licensed ShadowImage for z/OS feature enabled on the Storage Navigator computer. The SIz system requirements are as follows.

Volume Requirements

The requirements for the volumes to be used as SIz pairs are as follows:

- RAID level
The RAID level combinations of the S-VOL and the T-VOL of a SIz pair must be one of the following combinations listed in Table 4-1.

Table 4-1 Supported Combinations of RAID Levels

S-VOL	T-VOL
RAID1	RAID1
RAID1	RAID5
RAID1	RAID6
RAID5	RAID1
RAID5	RAID5
RAID5	RAID6
RAID6	RAID1
RAID6	RAID5
RAID6	RAID6

- Types of volumes
Besides normal volumes, you can use external volumes and custom-sized volumes. When using external volumes or custom-sized volumes, please note the following points:
 - External volumes
The license of Universal Volume Manager is required.
 - Custom-sized volumes
The license of Virtual LVI is required. To create a SIz pair with custom-sized volumes, S-VOL must be paired with T-VOLs of the same capacity and the same emulation type.
- Emulation type
Only volumes with mainframe emulation type such as 3390-3, 3390-3A, 6588-1 can be used.
You need to select the volumes of the same emulation type for S-VOL and T-VOL. However, as for the DKC emulation types, there is no restriction. The DKC emulation type for the S-VOL and T-VOL can be the same or different (for example, 3990 S-VOL and 2105 T-VOL).

- Logical DKC (LDKC), CU, LDEV number
You can use volumes whose LDKC:CU:LDEV (a combination of an LDKC number, a CU number, and an LDEV number) is within the range of 00:00:00 to 00:FE:FF, or 01:00:00 to 01:FE:FF.
- Number of T-VOLs per one S-VOL
You can assign up to three T-VOLs to one S-VOL. However, you cannot assign two or more S-VOLs to one T-VOL.
- Maximum number of pairs
Up to 16,384 SIZ pairs can be created (when S-VOLs and T-VOLs are in a one-to-one relationship).

Even if the above requirements are fulfilled, the URz journal volumes cannot be used for creating SIZ pair.

ShadowImage for z/OS Software Requirements

To use ShadowImage for z/OS, all USP V/VM hardware, microcode, and software required for SIZ operations must be installed and enabled. You also need to purchase the ShadowImage for z/OS license key and install it in Storage Navigator. For detailed information about the license key and software installation, see the *Storage Navigator User's Guide*.

Operate the Storage Navigator computer in modify mode to perform SIZ operations. Users in view mode can only view SIZ information, but they cannot create new pairs or change the pair status. For information about how to set up and use the Storage Navigator computer, see the *Storage Navigator User's Guide*.

System Option Modes

To provide greater flexibility, the USP V/VM storage system has additional operational parameters called *system option modes* (SOMs) that allow you to tailor the USP V/VM to your unique operating requirements. The SOMs are set on the service processor (SVP) by your Hitachi Data Systems representative.

Table 4-2 lists and describes the SOMs that apply to ShadowImage for z/OS:

- **SOM:** SOM number
- **Category:** Functions to which the SOM applies
- **Description:**
 - Function that the SOM provides
 - Default setting (ON or OFF)

For a complete list of all SOMs for the USP V/VM, see the *User and Reference Guide*. Work with your Hitachi Data Systems team to make sure the appropriate SOMs are set on your storage system.



Note: The SOM information may have changed since this document was published. Contact your Hitachi Data Systems team for the latest SOM information.

Table 4-2 SOMs for ShadowImage for z/OS

SOM	Category	Description
80	ShadowImage for z/OS	Determines whether Quick Restore or Reverse Copy, if not specified, is performed when the CCI pairresync command is executed. ON: Reverse Copy is performed. OFF (default): Quick Restore is performed.
459	ShadowImage ShadowImage for z/OS	PAIR → PSUS(SP) → PSUS: This SOM function is running at copy pending from P-VOL to S-VOL, such as PSUS(SP) → PSUS. This SOM works under the following conditions: <ul style="list-style-type: none"> ▪ The ShadowImage S-VOL is an external volume ▪ SI: COPY(SP) → PSUS SIz: SP-Pend → Split ▪ SI: PSUS(SP) → PSUS SIz: V-Split → Split ON: Waits for cache memory to completely destage the delta data to the S-VOL external volume before changing pair status to PSUS/Split. OFF (default): The status changes to PSUS/Split as soon as all the delta data is copied to S-VOL cache. The status does not wait for cache to destage to the S-VOL external volume.

SOM	Category	Description
460	TrueCopy TrueCopy for z/OS ShadowImage ShadowImage for z/OS Universal Replicator Universal Replicator for z/OS Volume Migration FlashCopy V1, V2 Copy-on-Write Snapshot Dynamic Provisioning	<p>Backup and recovery of control information of certain products from the SVP when the storage system is powered OFF for more than 72 hours.</p> <p>When power is turned off, the control information (in shared memory) of certain products is backed up on the SVP. After that, when volatile power ON is performed, the control information is restored into shared memory from the SVP.</p> <p>MCU/RCU: This SOM applies to both the MCU and the RCU.</p> <p>ON: Set this SOM to ON when using TC, TCz, SI, SIz, VM, FCv1, FCv2, UR, URz, COW Snapshot, or DP.</p> <p>OFF (default): Disabled</p> <p>Notes:</p> <ol style="list-style-type: none"> 1. When this SOM is ON, the completion time of power OFF for shared memory backup, or the completion time of volatile power ON after shared memory recovery, is up to 30 minutes. 2. When using power monitoring devices (such as PCI), the monitoring time for power OFF/ON must be set to the maximum of 30 minutes. 3. When the storage system is powered off automatically in a power outage while destage mode is ON, shared memory is not backed up on the SVP even when this SOM is ON. 4. For Dynamic Provisioning: The DP management information is stored in a dedicated area in the pool in case data is lost from shared memory. However, restoring the data from the dedicated area in the pool may take more time than restoring the data from the SVP. Therefore, setting this SOM to ON is recommended to enable data backup and recovery functions from the SVP.
467	ShadowImage ShadowImage for z/OS FlashCopy Copy-on-Write Snapshot Volume Migration Universal Volume Manager	<p>Controls the copy threshold to slow down copy processing to provide overload protection so that host I/O performance is not affected.</p> <p>Copy processing slows down when the percentage of "dirty" data is 60% or higher, and it stops when the percentage is 75% or higher. This happens when using these replication products: ShadowImage, ShadowImage for z/OS, FlashCopy, Copy-on-Write SnapShot, Volume Migration, Universal Volume Manager.</p> <p>This SOM is provided to prevent the percentage from exceeding 60% so that host performance is not affected.</p> <p>ON (default): Enables copy overload prevention. Copy processing stops when the percentage of "dirty" data reaches 60% or higher. When the percentage falls below 60%, copy processing restarts.</p> <p>OFF: Normal operation. Copy processing slows down if the dirty percentage is 60% or larger, and it stops if the dirty percentage is 75% or larger.</p> <p>Caution: This SOM must always be set to ON when using an external volume as the secondary volume of any of the above-mentioned replication products.</p> <p>Notes:</p> <ul style="list-style-type: none"> ▪ It takes longer to finish the copy processing because it stops for prioritizing the host I/O performance. ▪ This SOM supports background copy only. This SOM does not support the processing to copy the pre-update data to the S-VOL, which occurs when overwriting data to un-copied slots of P-VOL in Split processing or reading or writing data to un-copied slots of S-VOL.

SOM	Category	Description
491	ShadowImage ShadowImage for z/OS FlashCopy V1	<p>Improves the performance of copy processing.</p> <p>ON: The option (Reserve 05) of SI/SIz is available. When this SOM is ON, copy operations (SI, SIz, FCv1) are increased from 64 processes to 128 processes for improved performance.</p> <p>OFF (default): The option (Reserve 05) of SI/SIz is not available. Copy operations (SI, SIz, FCv1) are performed with 64 processes.</p> <p>Notes:</p> <ol style="list-style-type: none"> 1. This SOM requires at least three BED features. If there are less than three BED features, this SOM is not effective. 2. Enable this SOM when the performance of ShadowImage, ShadowImage for z/OS, or is considered to be important. 3. Do not enable this SOM when host I/O performance is important. 4. When this SOM is ON, set SOM 467 to OFF. If SOM 467 is ON, the performance may not improve.
548	Using Business Continuity Manager to perform SIz, TCz, or URz operations.	<p>Controls whether pair operations of TCz, URz, or SIz are available via the online command device.</p> <p>MCU/RCU: This SOM applies to both the MCU and the RCU.</p> <p>ON: Pair operations of TCz, URz, or SIz via online command device are not available. SSB = 0x64fb is output.</p> <p>OFF (default): Pair operations of TCz, URz, or SIz via online command device are available. SIM is output.</p> <p>Notes:</p> <ol style="list-style-type: none"> 1. When the command device is used online, if a script containing an operation via the command device is executed, the script may stop if this SOM is ON. As described in the BCM User Guide, the script must be performed with the command device offline. 2. This SOM applies to BCM operations on MVS.
573	TrueCopy for z/OS ShadowImage for z/OS	<p>For CU emulation types 2105 and 2107, specifies whether the CASCADE option for the ICKDSF ESTPAIR command is allowed.</p> <p>MCU/RCU: This SOM applies to the storage system (MCU or RCU) in which TCz and SIz use the same volume in a cascading configuration.</p> <p>ON: The ESTPAIR CASCADE option is allowed.</p> <p>OFF (default): The ESTPAIR CASCADE option is not allowed. (When specified, the option is rejected.)</p> <p>Notes:</p> <ol style="list-style-type: none"> 1. Apply this SOM when the CU emulation type is 2105 or 2107 and when pair creation in a TCz-SIz cascading configuration in the ICKDSF environment fails with the following message: Message: ICK30111I DEVICE SPECIFIED IS THE SECONDARY OF A DUPLEX OR PPRC PAIR 2. The CASCADE option can also be specified in the TSO environment. 3. Although the CASCADE option can be specified for the ESTPAIR command, the PPRC-XD function is not supported. 4. Perform thorough precheck for any effect on GDPS/PPRC. 5. The SOM must be enabled only when the CASCADE option is specified for the ESTPAIR command for CU emulation type 2105 or 2107.

SOM	Category	Description
697	TrueCopy Async TrueCopy for z/OS Async ShadowImage ShadowImage for z/OS	<p>Controls whether to prevent the SI split command execution when the coordinated TCA pair status is suspend and its consistency state is not guaranteed.</p> <p>MCU/RCU: This SOM applies to both the MCU and the RCU.</p> <p>ON: SI split is not executed when the coordinated TCA pair status is suspend and its consistency state is not guaranteed.</p> <p>OFF (default): SI split is executed regardless of the pair status or consistency state of the coordinated TCA.</p> <p>Note: This SOM should be applied only to prevent SI split when the following conditions 1 and 2, or 1 and 3 are met.</p> <ol style="list-style-type: none"> 1. The TCA S-VOL and SI P-VOL coexist (for mainframe or open). 2. The TCA pair that is coordinated with SI is not in suspend. 3. The TCA that is coordinated with SI is in suspend, and its consistency state is not current.
704	ShadowImage ShadowImage for z/OS Volume Migration Copy-on-Write Snapshot FlashCopy Resync copy	<p>Controls whether copy processing is registered into a new queue or an existing queue.</p> <p>To reduce the chance of MIH, use this SOM to lower the priority of copy processing so that host I/O has a higher priority. This SOM creates new work queues where these jobs can be assigned with a lower priority.</p> <p>ON: Copy processing requested is registered into a new queue so that the processing is scheduled with a lower priority than host I/O.</p> <p>OFF (default): Copy processing requested is not registered into a new queue. The existing queue is used.</p> <p>Note: If the PDEV is highly loaded, the priority of read/write copy processing may become lower. As a consequence the copy speed may be slower.</p>
714	TrueCopy Async TrueCopy for z/OS Async ShadowImage ShadowImage for z/OS Volume Migration	<p>Accepts or rejects a Quick Restore or Volume Migration request.</p> <p>MCU/RCU: This SOM applies to both the MCU and the RCU.</p> <p>ON: When TCA is coordinated with SI or VM, a request for Quick Restore or Volume Migration is accepted regardless of the CLPR number of the Quick Restore P-VOL and S-VOL or the Volume Migration source and target volumes.</p> <p>OFF (default): When TCA is coordinated with SI or VM, a request for Quick Restore or Volume Migration is rejected if the CLPR number is not the same as the CLPR number of the Quick Restore P-VOL and S-VOL or the Volume Migration source and target volumes.</p> <p>Note: Apply this SOM when canceling the prevention of the request (1) or (2) below.</p> <ol style="list-style-type: none"> (1) A Quick Restore operation is requested when the P-VOL and S-VOL of SI that is coordinated with TCA have a different CLPR number. (2) A Volume Migration request when the source and target volumes have a different CLPR number from the migration source volume also used as a TCA volume.

SOM	Category	Description
727	ShadowImage ShadowImage for z/OS FlashCopy V1, V2 Volume Migration Copy-on-Write Snapshot Dynamic Provisioning	<p>Controls whether control information for local copy products that resides in shared memory is saved and recovered to a system disk when power to the storage system is turned OFF.</p> <p>ON: The control information in shared memory is automatically saved to a system disk for use after power off. A system disk is required to use this setting.</p> <p>If shared memory is volatilized and recovery of the control information from the SVP fails when power is restored following power off, recovery of the control information from the system disk to shared memory is implemented.</p> <p>OFF (default): Automatic save and recovery of control information using a system disk is not available.</p> <p>Notes:</p> <ol style="list-style-type: none"> 1. Set this SOM to ON when the following local copy products are used and you want to save and recover control information for these products: SI, SIz, FCv1, FCv2, Volume Migration, COW Snapshot, or Dynamic Provisioning. 2. Set this SOM to ON after preparing a normal system disk that has more than 7.744 MB available capacity (9,082 cylinders for 3390 format). If Define Configuration & Install is performed at the SVP, set this SOM to ON after formatting the system disk. 3. Review the timeout settings on connected systems when this SOM is ON, because power ON/OFF can take up to 15 minutes longer than when this SOM is OFF. 4. You can also set this SOM to ON or OFF using Virtual LVI/LUN (Additional Configuration Back Up setting on the System Disk Options dialog box).
733	ShadowImage ShadowImage for z/OS Volume Migration	<p>Allows or suspends Volume Migration or Quick Restore operation during LDEV-related maintenance. This is for functional improvement to avoid maintenance failure.</p> <p>ON: Suspends operation of Volume Migration or Quick Restore during LDEV-related maintenance.</p> <p>OFF (default): Allows operation of Volume Migration or Quick Restore during LDEV-related maintenance.</p> <p>Notes:</p> <ol style="list-style-type: none"> 1. Use this SOM to suspend operation of Volume Migration or Quick Restore during LDEV-related maintenance. 2. When this SOM is ON, the time to complete Volume Migration or Quick Restore copy increases. If virtual volume capacity expansion operation conflicts with Volume Migration or Quick Restore operation, the virtual volume capacity expansion operation may fail. 3. Setting this SOM to ON is recommended, because operations from Storage Navigator may be disabled when a problem occurs. 4. If this SOM is not set to ON, maintenance ends in failure if Volume Migration or Quick Restore is active while LDEV-related maintenance is being performed.

License Requirements

SIz license capacity will be required for SIz S-VOLs, T-VOLs, and reserved volumes. You need to make sure that the SIz license capacity will be larger than the total capacity of these volumes when you decide the SIz license capacity.

Even if a volume is used for multiple purposes, only the capacity of this volume itself is added to the total volume capacity. There is no need to multiply the capacity of this volume by the number of purposes it is used for. For example, if you specify a volume as an S-VOL, and use it as a reserved volume as well by setting its reserve attribute, only the capacity of the volume itself is added to the total volume capacity and there is no need for it to be doubled.

The following illustrations are case examples showing how to calculate the total capacity of volumes that you will use with ShadowImage for z/OS. For these examples, the capacity of each volume is assumed to be 1. The colored volume or volumes represent the volumes that are used.

Figure 4-1 shows one reserved volume and one unreserved volume.



Figure 4-1 Total Capacity of SIz Volumes (Example 1)

In Figure 4-1, the total capacity of the SIz volume is 1.

Figure 4-2 shows two SIz pairs.

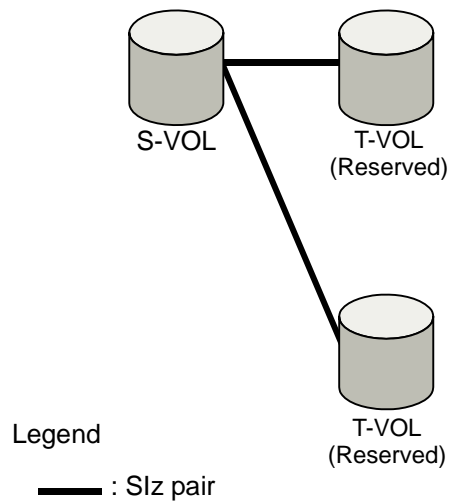


Figure 4-2 Total Capacity of SIZ Volumes (Example 2)

In Figure 4-2, the total capacity of the SIZ volumes is 3.

Requirements for Other Software

You may use the following program products for SIZ operations.

- Business Continuity Manager
- IBM PPRC host software: TSO PPRC and ICKDSF PPRCOPY commands

For information about the requirements of using these program products on ShadowImage for z/OS, see the appropriate P.P. documents.

Assessing ShadowImage for z/OS Requirements

This section describes the assessments about SIz operations, such as how many pairs you are going to create or how to decide the settings like copy pace and paths.

Calculating Maximum Number of Pairs

When you create SIz pairs, resources called differential tables and pair tables will be required. The number of available differential tables and pair tables in one storage system depends on whether the additional shared memory is installed or not. There are several patterns of additional shared memory for differential tables and pair tables, and you can choose any pattern you like. Table 4-3 describes the pattern of additional shared memory.

Table 4-3 Additional Shared Memory for Differential Tables

Additional Shared Memory for SIz	Number of Differential Tables	Number of Pair Tables	Number of Volumes in Storage System
No additional shared memory for SIz	0	0	1,024
Additional shared memory for SIz is installed	26,176	8,192	16,384
Extension 1	57,600	8,192	16,384
Extension 2	104,768	16,384	65,536
Extension 3 *	146,688	16,384	131,072
Extension 4 *	209,600	16,384	131,072

*: This can be used only in USP V.

To install additional shared memory for differential tables, please call the Support Center.

If you install additional shared memory for differential tables and pair tables, the maximum number of pairs is half of the total number of volumes in the storage system (see Table 4-3). For example, if additional shared memory for SIz is installed (second line in Table 4-3), and when S-VOLs and T-VOLs are in a one-to-one relationship, you can create up to 8,192 pairs. However, note that in the case of Extension 2 to Extension 4, the maximum number of pairs is 16,384 regardless of the total number of volumes in the storage system.

To calculate the maximum number of SIz pairs, first you need to calculate how many differential tables and pair tables are required to create SIz pairs, and then compare the result with the number of differential tables and pair tables in the whole storage system. In addition to ShadowImage for z/OS, the following program products will also use differential tables and pair tables.

- Program products using differential tables
 - ShadowImage
 - Compatible FlashCopy Version 1
 - Compatible FlashCopy Version 2
 - Volume Migration
 - Copy-on-Write Snapshot
- Program products using pair tables
 - ShadowImage for z/OS
 - Compatible FlashCopy Version 1
 - Volume Migration

If you use ShadowImage for z/OS in the same storage system together with any or all of the above program products, calculate the number of available differential tables and pair tables for SIz pairs as follows:

$$\begin{aligned} & (\text{differential tables and pair tables in the whole storage system}) - (\text{the} \\ & \text{number of differential tables and pair tables used by the pairs (migration} \\ & \text{plans in case of Volume Migration) of the program products shown above}) \\ & = (\text{the number of available differential tables and pair tables for SIz pairs}). \end{aligned}$$

For information about how to calculate the number of differential tables and pair tables that are required for ShadowImage, see the *ShadowImage Guide*, and as for Compatible Mirroring for IBM FlashCopy Version 1 and Compatible Mirroring for IBM FlashCopy Version 2, see the *Compatible FlashCopy User's Guide*. For information about how to calculate the number of differential tables and pair tables that are required for Volume Migration, contact the Hitachi Data Systems Support Center. See [Calling the Hitachi Data Systems Support Center](#) and see the *Copy-on-Write Snapshot User's Guide* to calculate the number of differential tables that are required for Copy-on-Write Snapshot.

Assuming that only ShadowImage for z/OS uses differential tables and pair tables, this section describes how to calculate the number of differential tables and pair tables required for one SIz pair, and the conditions you need to consider when calculating the number of SIz pairs that can be created.

- The capacity of each volume used to create a pair (this is the capacity specified as the CVS or customized volume size)

Use the following expression to calculate the total number of the differential tables and pair tables per pair.

$\text{Total number of the differential tables per pair} = ((X) + (Y)) \times 15 \div (Z)$
--

(X): The number of the cylinders of the volume.

(Y): The number of the control cylinders. (See Table 4-4)

(Z): 20,448 (The number of the slots that can be managed by a differential table)

Round up the number to the nearest whole number. For example, in case of a volume which emulation type is 3390-3, and when provided that the number of the cylinders of the divided volume is 3,390 ((X) in the expression above), the calculation of the total number of the differential table is as follows.

$$(3,339 + 6) \times 15 \div 20,448 = 2.4537\dots$$

When you round up 2.4537 to the nearest whole number, it becomes 3. Therefore, the total number of the differential table for one pair is 3 when emulation type is 3390-3.

You may use 36 differential tables per one pair table. Therefore, the total number of the pair tables is 1 when emulation type is 3390-3. For example, if the emulation type is 3390-M and the number of the cylinders of the volume is the default value, the number of pair tables is 2. However, only the emulation type 3390-M can be used, if you use plural pair tables on a mainframe system.

Table 4-4 lists the number of the control cylinders according to the emulation types.

Table 4-4 Number of the Control Cylinders According to the Emulation Types

Emulation Type	Number of the Control Cylinders
3380-3	7
3380-3A	7
3380-3B	7
3380-3C	7
3380-F	22
3380-K	7
3380-KA	7
3380-KB	7
3380-KC	7
3390-3	6
3390-3A	6
3390-3B	6
3390-3C	6
3390-3R	6
3390-9	25
3390-9A	25
3390-9B	25
3390-9C	25
3390-L	23
3390-LA	23

Emulation Type	Number of the Control Cylinders
3390-LB	23
3390-LC	23
3390-M	53
3390-MA	53
3390-MB	53
3390-MC	53
NF80-F	22
NF80-K	7
NF80-KA	7
NF80-KB	7
NF80-KC	7

If you intend to create pairs with volumes of different emulation types, the maximum number of pairs you can create will depend on the following conditions.

For details about the calculation of the total number of the differential tables per a pair, see the expression described just before Table 4-4.

The maximum number of pairs that you can create is the largest number that meets the equation, $\Sigma(a) \leq (\beta)$, and $\Sigma(\gamma) \leq (\delta)$, where:

$\Sigma(a)$ stands for the total number of differential tables per pair (see Table 4-4), and

(β) stands for the number of differential tables available in the storage system, and

$\Sigma(\gamma)$ stands for the total number of pair tables per pair, and

(δ) stands for the number of pair tables available in the storage system.

(β) and (δ) will differ according to the installed additional shared memory for differential tables. For details, see Table 4-3.

For example, if you are to create 10 pairs of 3390-3 volumes and 20 pairs of 3390-L volumes in a storage system that has 26,176 differential tables, the following equation would be used to calculate $\Sigma(a)$ and $\Sigma(\gamma)$:

$$\Sigma(a) : (3 \times 10) + (24 \times 20) = 510$$

$$\Sigma(\gamma) : (1 \times 10) + (1 \times 20) = 30$$

Since 510 is smaller than 26,176, and 30 is smaller than 8,192, it meets the equation, $\Sigma(a) \leq (\beta)$ and $\Sigma(\gamma) \leq (\delta)$, thus ensuring you that 10 pairs of 3390-3 volumes and 20 pairs of 3390-L volumes can be created.

Performance Considerations

Consider performance options under the following considerations: for operating ShadowImage for z/OS, load sharing of parity groups, and resynchronizing using QuickRestore.

- When you operate ShadowImage for z/OS:

SIz operations affect the I/O performance of the USP V/VM storage system because of the additional write operations to the T-VOLs. You should consider the relative importance of the storage system's I/O performance and the SIz operations when you decide the number or structures of pairs and their copy pace.

For example, assigning three T-VOLs to each S-VOL takes more resources than assigning only one or two. More T-VOLs you assign on an S-VOL, the risk of affection on the I/O performance of the storage system increases.

Even if you assign only one T-VOL on an S-VOL, pace of the initial copy operations may affect the I/O performance of the storage system. Using a slower copy pace minimizes the impact of SIz operations on I/O performance, while a faster copy pace produces point-in-time copies more quickly but may affect I/O performance.

- Load sharing of parity groups:

SIz S-VOLs or T-VOLs should not be concentrated in the same parity group. To disperse workloads of the parity groups, each parity group should have both S-VOLs and T-VOLs evenly distributed. SIz pairs for which a SIz operation is performed simultaneously should be in different parity groups. If SIz pairs are concentrated in only a few parity groups, the host I/O performance may be degraded. To minimize effect on the host I/O performance, take the following actions:

- Specify **Slower** for the copy pace when you create, split, or resynchronize SIz pairs.
- If SIz pairs that you want to perform copy operation are in the same parity group, reduce the number of pairs at one copy operation. For example, if you want to split multiple SIz pairs in the same parity group, wait until one pair is completely split before splitting another pair.

If the USP V/VM storage system is overloaded, you must increase cache, disk adapters, and/or parity groups. It is recommended that SIz T-VOLs are assigned in the newly installed parity groups. If you continue SIz operations with an overloaded storage system, host I/O performance may be degraded.

- When you resynchronize a pair by Quick Restore:

During the quick restore operation, the **RAID levels**, **Cache Residency Manager for IBM z/OS settings**, and **HDD types** of the S-VOL and T-VOL are exchanged. For example, if the S-VOL has a RAID-1 level and the T-VOL has a RAID-5 level, the quick restore operation changes the RAID level of the S-VOL to RAID-5 and of the T-VOL to RAID-1. This also applies to RAID-6 volumes. To avoid any performance impact due to the quick restore operation:

 - Make sure that the S-VOL and T-VOL have the same RAID level and HDD type before performing the quick restore operation. If you want to restore the original RAID levels after quick restore, stop host I/Os to the pair, split the pair, perform the quick restore operation for that pair again, and then restart the host I/Os to the pair.
 - Because the Cache Residency Manager for IBM z/OS settings are exchanged during a quick restore operation, you must perform one of the two following operations:
 - Set the same Cache Residency Manager for IBM z/OS settings (locations) for the S-VOL and T-VOL before performing the quick restore operation.
 - Release the Cache Residency Manager for IBM z/OS settings of the S-VOLs and T-VOLs before the quick restore operation, and then reset the Cache Residency Manager for IBM z/OS settings of the S-VOLs and T-VOLs after the pair status changes to *duplex* status as a result of the quick restore operation.

If you do not do one of the abovementioned operations, the change of location of the cache residence areas may cause I/O performance to the Cache Residency Manager for IBM z/OS data to be down. For details about Cache Residency Manager for IBM z/OS settings, see the *Cache Residency Manager User's Guide*.

Identifying the Source and Target Volumes

For each volume, write down the CU image and LDEV ID, whether the volume will be an S-VOL or T-VOL, and the other volume(s) in its pair (see Table 4-5 for a sample table). The S-VOLs will remain fully accessible to all hosts throughout normal SIz operations (except during reverse copy and quick restore). The T-VOLs will need to be varied offline before being reserved for SIz operations. Once assigned to a pair, a T-VOL rejects all write I/Os, except when the pair is split.

Table 4-5 SIz Configuration Information

CU #	LDEV #	S-VOL?	Associated T-VOL(s)	T-VOL?	Associated S-VOL
0	00	Yes	0:10, 0:11	No	--
0	01	Yes	0:12, 0:13	No	--
etc.	...	...	...	...	...
0	0F	Yes	0:2E, 0:2F	No	--
0	10	No	--	Yes	0:00
0	11	No	--	Yes	0:00
0	12	No	--	Yes	0:01
etc.	...	...	...	...	...

Requirements for Maintaining ShadowImage for z/OS

This section describes the requirements for the maintenance of ShadowImage for z/OS. When the storage system maintenance is performed, or the microprogram is updated, you may have to add SIZ pairs again. Also note that if the SIZ operations are not completed because of failures, the copying process will be automatically suspended.

Cautions on Maintaining the Devices

- Maintenance of PDEV

The maintenance of a PDEV (which is not used by ShadowImage for z/OS) does not affect the SIZ operations and the status of SIZ pairs. You can maintain a PDEV which contains LDEVs used by ShadowImage for z/OS independently of the SIZ operations or SIZ pair status. Even if a PDEV failure occurs, SIZ pair status is not affected because of the RAID architecture.

If a failure occurs that requires use of dynamic sparing or automatic correction copy, the status of the paired volumes associated with the failed PDEV will not be affected.

- Maintenance of LDEV

- If an LDEV failure occurs, the pair is suspended.
- If the status of a SIZ pair is either Pending, Duplex, Split, SP-Pend, V-Split, Resync or Resync-R, the maintenance for the LDEVs that are used by that pair will be restricted. In addition, LDEV maintenance cannot be performed on the LDEVs which are assigned to SIZ reserved volumes. If LDEV maintenance requires access to a SIZ reserved volumes, you need to delete or suspend the pair, or the Reserve attribute must be reset (un-reserved).

Cautions on Maintaining the Cache

If USP V/VM cache maintenance is performed during a period of high I/O usage, one or more SIZ pairs may be suspended. Reduce the I/O load before cache maintenance.

Cautions on Switching Off the Power Supply

If you have to switch off the power supply of the USP V/VM storage system during SIZ operations, make sure to:

- Complete copying for the SIZ pair in the *SP-pend* or *V-split* status first to change the pair status from *SP-pend* or *V-split* to *split*, and then switch off the power supply.

If the shared memory is volatilized when you switch on the power supply again, the pair in the *SP-pend* or *V-split* status changes to *suspend*.

- First complete the processing of At-Time Split function, and then switch off the power supply.

If the status of only a part of the pairs in the same consistency group is changed, the processing of At-Time Split function may not resume when you switch on the power supply, and the status of some pairs may remain unchanged.

- Establish a timetable for SIZ copying operations according to required copying time that may take longer because of the power-supply off.

If the shared memory is volatilized when you switch on the power supply again, the following conditions occur.

- If the SIZ pair was in the *pending* or *resync* status, data that was already copied before the power-supply off again becomes the target data to be copied after the power-supply on. Even if there is no host I/O, the data consistency rate does not reach 100% when the SIZ pair status changes to duplex. When the SIZ pair status changes to duplex, the target data is copied to the T-VOL.
- If the SIZ pair was in the duplex status, data that was already copied before the power-supply off again becomes the target data to be copied after the power-supply on. In this case, the data consistency rate is 0%, and the target data is copied to the T-VOL.
- If the SIZ pair was in the *split* status, the entire volume becomes the differential data. In this case, the data consistency rate is 0%, and the entire volume is copied to the T-VOL when you perform the pairresync operation.

Installing ShadowImage for z/OS

The user enables the license key required for SIz operations on the Storage Navigator computer.

To install the SIz license key:

1. Log on to the SVP and start up the Java application of the Storage Navigator.

For information about how to log on to the SVP, see the *Storage Navigator User's Guide*.

2. Install ShadowImage for z/OS on the Storage Navigator computer.

You need to install ShadowImage for z/OS in every storage system on which you want to use ShadowImage for z/OS. For information about how to install ShadowImage for z/OS, see the *Storage Navigator User's Guide*.

Starting ShadowImage for z/OS

After you have completed the preparation to use the Storage Navigator computer and prepared for SIz operations, you are ready to start up ShadowImage for z/OS.

To start ShadowImage for z/OS and display the window you need:

1. Display the Storage Navigator main window.

For information about how to display the Storage Navigator main window, see the *Storage Navigator User's Guide*.

2. Click **Go** and then **ShadowImage for z/OS** on the menu bar of the Storage Navigator main window.

Names of the windows that you need for SIz operations will be displayed in the submenu.

3. Click the name of the window you want to display.

ShadowImage for z/OS starts up, and the window whose name you clicked in the submenu displays.

For details about the displayed windows, see Chapter 5.

Using the ShadowImage for z/OS GUI

This chapter describes the ShadowImage for z/OS windows on Storage Navigator.

- [Pair Operation Window](#)
- [History Window](#)
- [Option Window](#)
- [CTG Window](#)

Pair Operation Window

The Pair Operation window (see Figure 5-1) displays the SIZ volume and pair information for the selected CU image of the connected USP V/VM storage system and allows you to perform all SIZ operations.

An S-VOL or T-VOL LDEV number that ends with a pound or gate symbol (#) mark indicates that the LDEV is an external volume (e.g., 00:00:01 #). For details regarding the external volumes, see the *Universal Volume Manager User's Guide*.

The Pair Operation window displays pair information of SIZ and relationship information of Compatible Mirroring for IBM FlashCopy and Compatible Mirroring for IBM FlashCopy Version 2, however, this section only explains the items related to the SIZ pairs. For details about the items related to the relationships, see the *Compatible Mirroring for IBM FlashCopy User's Guide*.

The screenshot shows the 'Pair Operation' window for 'ShadowImage for z/OS(R)'. The window has tabs for 'Pair Operation', 'History', 'Option', 'CTG', and 'FCv2'. The main area is titled 'ShadowImage for z/OS(R) Pair Operation' and includes a 'Display Filter' button. On the left, a tree view shows the 'Subsystem' structure: 'LDKC : 00' containing 'CU Gr.(20)' with a sub-entry '20'. The main table lists the following data:









S-VOL	Status	T-VOL	Copy Pace	Sync.	Emulation	C
00:20:82	Duplex	00:20:A0	---	100%	3390-2	
00:20:82	Duplex	00:20:A1	---	100%	3390-2	
00:20:82	Duplex	00:20:A2	---	100%	3390-2	
00:20:83	Duplex	00:20:A3	---	100%	3390-2	
00:20:84	Duplex	00:20:A4	---	100%	3390-2	
00:20:85	Duplex	00:20:A5	---	100%	3390-2	
00:20:86	Duplex	00:20:A6	---	100%	3390-2	
00:20:87	Duplex	00:20:A7	---	100%	3390-2	
00:20:88	Duplex	00:20:A8	---	100%	3390-2	
00:20:89	Duplex	00:20:A9	---	100%	3390-2	
00:20:8A	Duplex	00:20:AA	---	100%	3390-2	
00:20:8B	Duplex	00:20:AB	---	100%	3390-2	
00:20:8C	Duplex	00:20:AC	---	100%	3390-2	
00:20:8D	Duplex	00:20:AD	---	100%	3390-2	
00:20:8E	Duplex	00:20:AE	---	100%	3390-2	

Below the table is a 'Preview' section with the following data:

S-VOL	T-VOL	Copy Pace	CLPR(S)	CLPR(T)	Error Code
00:20:82	00:20:A0	---	00:CLPR0	00:CLPR0	---

At the bottom of the preview section, it says 'Preview : 1 (Delete Pair)'. The window also has 'Apply' and 'Cancel' buttons at the bottom right.

Figure 5-1 Pair Operation Window

Item	Description
Tree	Allows you to select a defined CU image or LDEV ID. By selecting a CU image or an LDEV ID, the corresponding volume or volume pair displays in the Volume List on the upper right of the Pair Operation window. Note that no volume displays when you select Subsystem on the top of the Tree. The tree is located on the left of the Pair Operation window.
Volume List	Displays all available volumes and is located on the upper right of the Pair Operation window. For details, see Volume List .
Icons	Indicates the status of a volume or pair on the Pair Operation window: <ul style="list-style-type: none"> ▪ : S-VOL ▪ : T-VOL ▪ : Reserved volume when displayed in the Volume List. Preview item when displayed in the Preview List. ▪ : An error occurred during operations. (This error icon is displayed in the Preview List on the Pair Operation window.) ▪ : LDEV when displayed in the Tree. Simplex volume when displayed in the Volume List. ▪ : CU (displayed in the Tree) ▪ : Root (displayed in the Tree)
Display Filter button	Allows you to display the Display Filter dialog box (see Figure 6-1) where you can filter the volumes displayed in the Volume List.
Previous button	Allows you to return to the previous page of the Volume List. This button is selectable only when the number of volumes defined in the storage system exceeds 1,024 volumes, which is the maximum number of volumes that can be displayed on one page. It remains dimmed when the total number of volumes defined in the storage system is less than 1,024 volumes.
Next button	Allows you to turn to the next page of the Volume List. This button is selectable only when the number of volumes defined in the storage system exceeds 1,024 volumes, which is the maximum number of volumes that can be displayed on one page. It remains dimmed when the total number of volumes defined in the storage system is less than 1,024 volumes.
Preview List	Displays the content of the operations (volume/pair information) that have been set or specified in the Pair Operation window, but are still not applied to the USP V/VM storage system. The Preview List is located under the Volume List. For details, see Preview List.
Apply button	Applies the SIz operations displayed in the Preview List to the USP V/VM storage system. If the specified operations complete successfully, the Preview List will be cleared. If an error occurs during an operation, the failed operation will remain in the Preview List with an error icon () displayed on the left of the operation name. For the entire list of SIz error codes, see the <i>Storage Navigator Messages</i> .
Cancel button	Cancels all the operations set in the Preview List .

Volume List

The Volume List (see [Figure 5-2](#)) displays the information of volumes/pairs that can be used by SIZ, Compatible Mirroring for IBM FlashCopy Version 1, and Compatible Mirroring for IBM FlashCopy Version 2. The Volume List displays the information based on the filter options you select in the Tree (located along the left side of the window). You can sort the volumes by any of the items displayed as the column header of the Volume List. You can also filter the volumes by reserve attribute, by pair condition, and by pair status using the Display Filter dialog box. For information about how to use this dialog box, see [Configuring the Volume List](#).

The number of volumes that can be displayed in the Volume List at a time is limited to 1,024 volumes. In case the number of volumes defined in the storage system exceeds this limit, use the **Previous** and **Next** buttons on the upper right of the Volume List to turn the pages of the Volume List and see the entire list.

The Volume List lists all the installed volumes (LDEVs) on the selected CU image and displays the information for each volume.

S-VOL	Status	T-VOL	Copy Pace	Sync.	Emulation	C
00:01:00	Pending	00:03:00	Faster	10%	3390-9	
00:01:01	Pending	00:03:01	Faster	10%	3390-9	
00:01:02	Pending	00:03:02	Faster	10%	3390-9	
00:01:03	Pending	00:03:03	Faster	10%	3390-9	
00:01:04	Pending	00:03:04	Faster	10%	3390-9	
00:01:05	Pending	00:03:05	Faster	10%	3390-9	
00:01:06	Pending	00:03:06	Faster	10%	3390-9	
00:01:07	Pending	00:03:07	Faster	10%	3390-9	
00:01:08	Pending	00:03:08	Faster	10%	3390-9	
00:01:09	Pending	00:03:09	Faster	10%	3390-9	
00:01:0A	Simplex	---	---	---	3390-9	
00:01:0B	Simplex	---	---	---	3390-9	
00:01:0C	Simplex	---	---	---	3390-9	
00:01:0D	Simplex	---	---	---	3390-9	
00:01:0E	Simplex	---	---	---	3390-9	

Figure 5-2 Volume List

Item	Description
Message	Displays a message when there is no volume or pair to display. If you see the message in the Volume List, click a different icon in the Tree on the left area of the Pair Operation window.
S-VOL	Displays the S-VOL information in XX:YY:ZZ (LDKC number: CU number: LDEV ID) format.
Status	Displays the status of the SIZ pair and Compatible Mirroring for IBM FlashCopy Version 1 relationships. For detailed information for the relationship status, see the <i>Compatible Mirroring for IBM FlashCopy User's Guide</i> .
T-VOL	Displays the T-VOL information in XX:YY:ZZ (LDKC number: CU number: LDEV ID) format. If there is no T-VOL, --- displays.
Copy Pace	Displays the specified copy pace. For details, see Table 5-1.

Item	Description
Sync.	Displays varied information according to the pair status. For details, see Table 5-2.
Emulation	Displays the emulation type of the paired volume. For details on the emulation type, see Table 4-4.
Capacity(Cyl)	Displays the number of cylinders assigned to the volume.
CTG	Displays the registered ID of the consistency group. If there is no consistency group, --- displays.
CLPR (S)	Displays the cache logical partition of the S-VOL.
CLPR (T)	Displays the cache logical partition of the T-VOL.
Relationship(S)	Displays the current state of the volume in terms of whether the Compatible Mirroring for IBM FlashCopy Version 2 relationship is established or not. For details, see the <i>Compatible Mirroring for IBM FlashCopy User's Guide</i> .

Information to be displayed in **Copy Pace** and **Sync.** depends on the status of the pair, as shown in the following tables.

Table 5-1 Displayed Information in Copy Pace

Pair Status	Displayed Information
Simplex	- - - is displayed.
Pending	The copy pace (Slower, Medium, or Faster) for the pair being created
Duplex	- - - is displayed.
SP-Pend	The copy pace (Slower, Medium, or Faster) for the pair being created
V-Split	
Split	- - - is displayed.
Resync	The copy pace (Slower, Medium, or Faster) for the pair being created
Resync-R	
Suspend	- - - is displayed.
F-Copy	
Deleting	

Table 5-2 Displayed Information in Sync.

Pair Status	Displayed Information
Simplex	- - - is displayed.
Pending	The progress (%) of copying.
Duplex	Identical data (%) of S-VOL and T-VOL.
SP-Pend	Copy completed data (%).
V-Split	

Pair Status	Displayed Information
Split	Identical data (%) of S-VOL and T-VOL.
Resync	
Resync-R	
Suspend	- - - is displayed.
F-Copy	Copy completed data (%).
Deleting	- - - is displayed.

You can perform SIZ operations for the desired volume(s) in the Volume List, by using the following menu commands that you can display by right-clicking the mouse while selecting the desired volume in the Volume List.

Table 5-3 ShadowImage for z/OS Menu Commands of the Pair Operation Window

Command	Feature
Detail	Opens the Detail dialog box that displays information for the selected volume or pair (see Figure 6-10).
Add Pair	Opens the Add Pair dialog box, which allows you to create (add) new SIZ pairs (see Figure 6-5).
Split Pair	Opens the Split Volume Pair dialog box, which allows you to split SIZ pairs (see Figure 6-6).
Resync Pair	Opens the Resynchronize Volume Pair dialog box, which allows you to resynchronize SIZ pairs (see Figure 6-8).
Suspend Pair	Opens the Suspend Volume Pair dialog box, which allows you to suspend SIZ pairs (see Figure 6-7).
Delete Pair	Opens the Delete Volume Pair dialog box, which allows you to delete SIZ pairs (see Figure 6-9).
Change Reserve	Opens the Set Reserve Attribute dialog box or Reset Reserve Attribute dialog box allows you to set/reset the SIZ reserve attribute (see Figure 6-2 and Figure 6-3).
Information	Opens the Information dialog box (see Figure 6-11), which displays the number of SIZ pairs or reserved volumes.

Preview List

The **Preview List** (see Figure 5-3) is located below the Volume List, and lists the operations (volume/pair information), which have not been applied to the storage system.

Preview					
S-VOL	T-VOL	Copy Pace	CLPR(S)	CLPR(T)	Error Code
00:20:82	00:20:A0	---	00:CLPR0	00:CLPR0	---

Preview : 1 (Delete Pair)

Figure 5-3 Preview List

Item	Description
S-VOL	Displays S-VOL information in <i>XX:YY:ZZ</i> (LDKC number: CU number: LDEV ID) format.
T-VOL	Displays T-VOL information in <i>XX:YY:ZZ</i> (LDKC number: CU number: LDEV ID) format.
Copy Pace	Displays copying pace information for all pairs being added.
CLPR (S)	Displays the cache logical partition information (CLPR) of the S-VOL.
CLPR (T)	Displays the cache logical partition information (CLPR) of the T-VOL.
Error Code	Displays the reason code if the preview operations (settings) cannot be applied successfully with the Apply button.

The following information displays in the information field below the **Preview List**:

Preview: X(Y)/Z, where

X = the number of settings remaining in the **Preview List** that are still not applied to the USP V/VM system

Y = the type of pair operation

Z = command option

You can change the **Preview List** by right-click the setting in the **Preview List** and display the menus.

Command	Feature
Delete	Cancels the selected setting(s). If you perform this command, the selected setting(s) will be cleared.
Modify	Allows you to change the setting of the selected operation. This command becomes accessible only when the item you select from the Preview List is set to Add Pair , Split Pair or Resync Pair operation.
Error Detail	Displays the error message dialog box, which displays the error code and message. For the SIZ error codes, see the <i>Storage Navigator Messages</i> .

History Window

The History window (see Figure 5-4) displays the past record of pair and relationship operations. For information about how to look up the operation history, see Viewing Pair Operations History.

An S-VOL or T-VOL LDEV number that ends with a pound or gate symbol (#) mark indicates that the LDEV is an external volume (e.g., 00:00:01 #). For details about the external volumes, see the *Universal Volume Manager User's Guide*.

An S-VOL LDEV number that ends with the letter M indicates that the LDEV is a migration volume (e.g., 00:00:01 M).

The upper area of the History window lists the operation history of SIZ pairs and Version 1 relationships, and the lower area of the window lists the operation history of Version 2 relationships. For details about the operation history of Version 1 and Version 2 relationships, see the *Compatible Mirroring for IBM FlashCopy User's Guide*. The upper area of the History window displays the items in the following table:

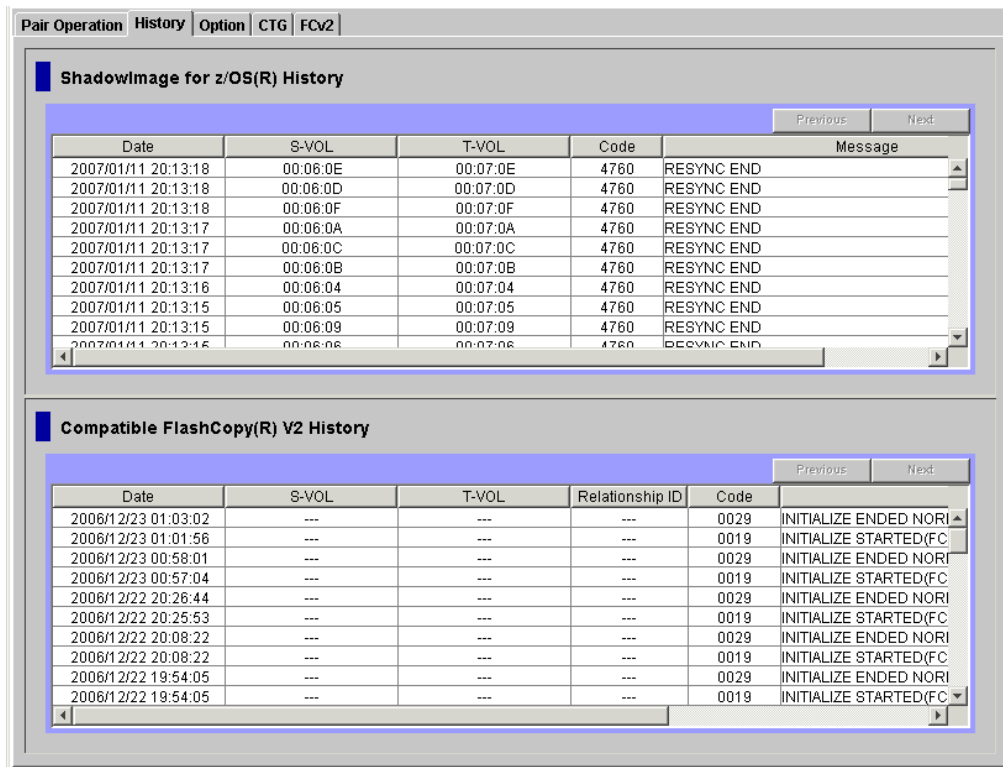


Figure 5-4 History Window

Item	Description
Previous button	Allows you to return to the previous page of the list. This button is selectable only when the number of operation histories in the storage system exceeds 16,384, which is the maximum number of histories that can be displayed on one page. The button is grayed out if the total number of operation histories in the storage system is less than 16,384.
Next button	Allows you to turn to the next page of the list. This button is selectable only when the number of operation histories in the storage system exceeds 16,384 volumes, which is the maximum number of histories that can be displayed on one page. The button is grayed out if the total number of operation histories in the storage system is less than 16,384.
Date	Displays the date and time (YYYY/MM/DD hour/min/sec) when a SIZ pair or volume operation has been performed.
S-VOL	Displays the LDKC:CU:LDEV of the S-VOLs used for pair operation in the past.
T-VOL	Displays the LDKC:CU:LDEV of the T-VOLs used for pair operation in the past.
Code	Displays the reference codes of ShadowImage for z/OS.
Message	Displays the messages to inform the conditions of the past SIZ pair. For details about the messages, see the following table.

The following table lists the ShadowImage for z/OS Status & History Reference Codes and Messages.

Table 5-4 ShadowImage for z/OS Status & History Reference Codes and Messages

Code	Message	Description
4710	DUPLEX START	The SIZ initial copy operation started.
4720	DUPLEX END	The SIZ initial copy operation ended, and the pair status changed to <i>Duplex</i> .
4730	SPLIT START	The SIZ split operation started.
4740	SPLIT END	The SIZ split operation ended, and the pair status changed to <i>Split</i> .
4750	RESYNC START RESYNC-R START	The SIZ resync operation started.
4760	RESYNC END RESYNC-R END	The SIZ resync operation ended, and the pair status changed to <i>Duplex</i> .
4780	PAIR DELETE	The SIZ pair is deleted, and the pair status changed to Simplex.
4790	PAIR SUSPEND	The SIZ pair suspended, and the pair status changed to Suspend.
47D0	PENDING ABNORMAL END	A copy ended abnormally (reason other than above).
47E9	INITIALIZE START	Initialization started.
47EA	INITIALIZE END	Initialization ended normally.
47EB	INITIALIZE ENDED ABNORMAL	Initialization ended abnormally.

Option Window

You can set options for ShadowImage for z/OS on the Option window (see Figure 5-5). For detailed information about how to set options, see Setting Options.

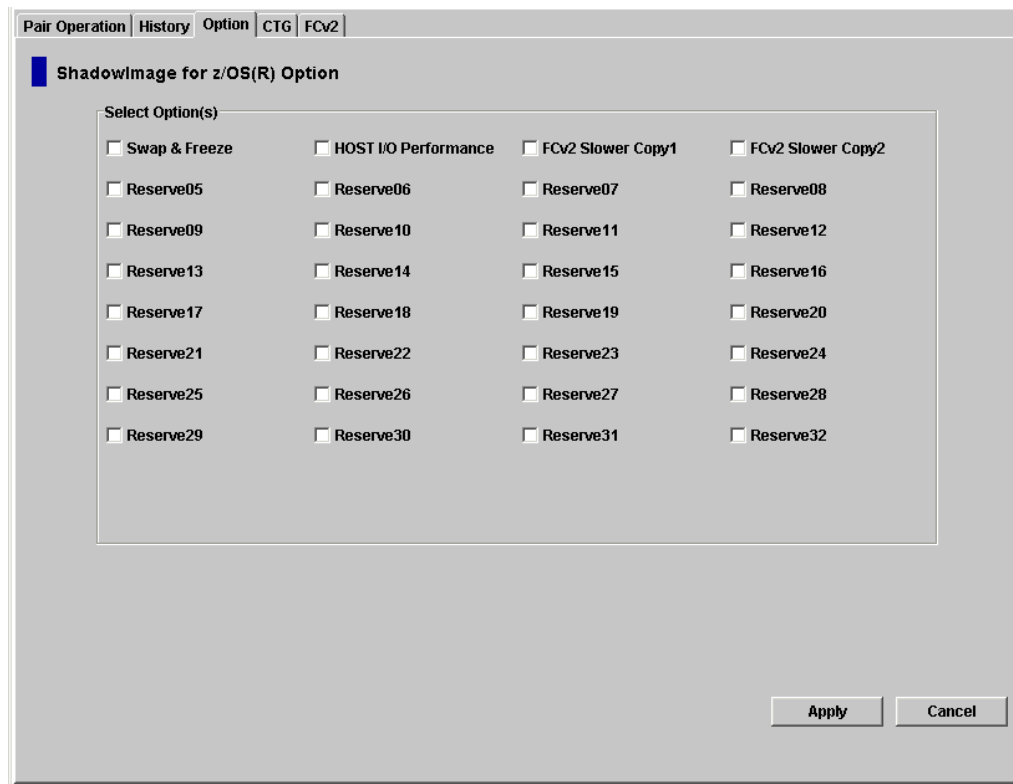


Figure 5-5 Option Window

Item	Description
Select Option(s) box	Enables an option name when you check the check box of an option name. If you clear the check box, that option will be disabled. Note that only options that are available for SIZ in this box are Swap & Freeze and HOST I/O Performance . FCv2 Slower Copy1 and FCv2 Slower Copy2 are the options for Compatible Mirroring for IBM FlashCopy Version 2. See the <i>Compatible Mirroring for IBM FlashCopy User's Guide</i> for detailed information about these options. Even if you have selected the check boxes of other option names, they will not be enabled.
Apply button	Applies the SIZ options checked in the Select Option(s) box to the storage system.
Cancel button	Cancels all the options set in the Select Option(s) box.

CTG Window

The CTG window (see Figure 5-6) displays the information of the selected consistency groups (abbreviated hereafter to CTG or CT Group where applicable) that are either registered or not used.

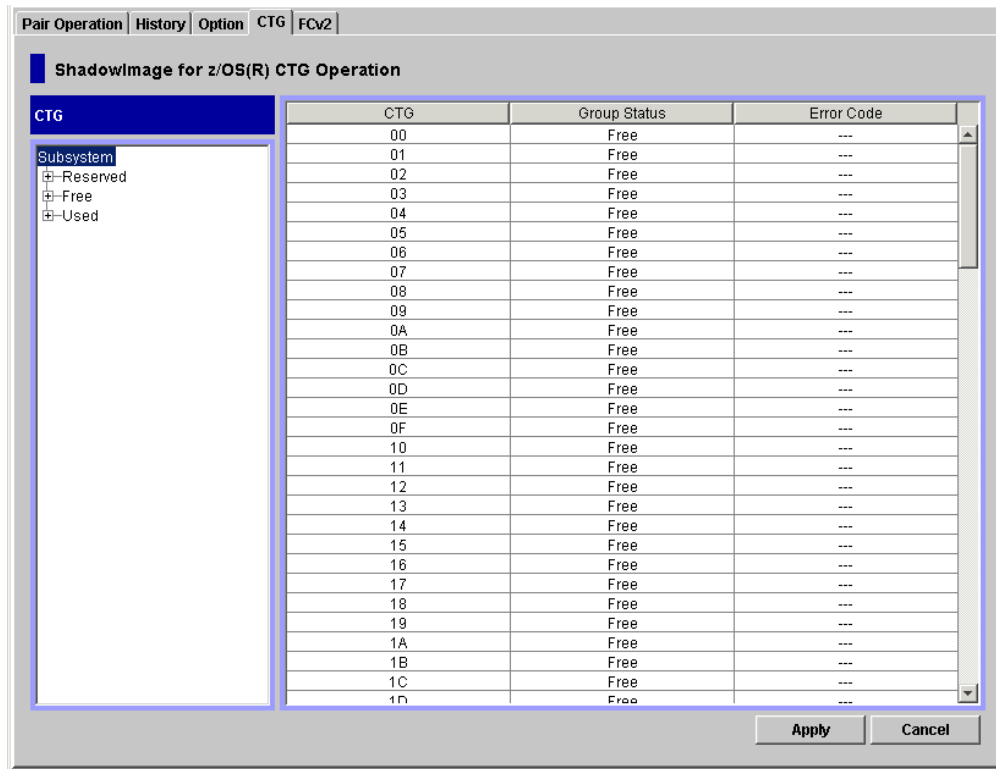


Figure 5-6 CTG Window

Item	Description
CTG Tree	<p>Displays all the consistency groups in layers, regardless of their registrations and is located on the left of the CTG window</p> <ul style="list-style-type: none"> ▪ To display all the consistency groups, select Subsystem on the top of the Tree. Note that the consistency groups that you can display on the CTG window are only those reserved in a mainframe storage system. ▪ To display only the reserved consistency groups, select Reserved. ▪ To display only the unreserved consistency groups, select Free. ▪ To display only the consistency groups that are currently used (meaning those with registered pairs), select Used.

Item	Description
CTG List	<p>Displays the following information and is located on the right of the CTG window.</p> <ul style="list-style-type: none"> ▪ CTG: Displays the ID of the CTGs selected in the CTG Tree by attribute or by Subsystem on the top of the tree. The consistency groups that you can display on the CTG window are only those reserved in a mainframe storage system. ▪ Group Status: Displays the status of the selected CTGs displayed with an ID. If the status of the CTG has been changed due to operations performed earlier, the latest status will be displayed. In case a CTG operation could not be applied successfully to the USP V/VM storage system after clicking the Apply button, the data of the CTG before the operation has been applied to the USP V/VM storage system displays. The status of the CTGs displayed here will be one of the following three: <ul style="list-style-type: none"> Used: Status indicating that the consistency group is used. Reserved: Status indicating that the consistency group is reserved. Free: Status indicating that the consistency group is not used. ▪ Code: Displays the error code when a CTG operation fails to be applied to the USP V/VM storage system.
Apply button	Applies the Slz operations displayed in the CTG List to the USP V/VM storage system.
Cancel button	Cancels all the ongoing operations specified in the CTG List without applying them to the USP V/VM storage system.

To perform a CTG operation, use the desired command selected from the menu that can be displayed by right-clicking one of the CTGs displayed in the CTG List that you want to work on. The following table lists the available menu commands in the CTG List.

Command	Feature
Add CT Group	Select this command when you want to reserve a free CTG. When you select this command, the new CTG will be ready to be added. Note that this command will remain dimmed when you open the menu by right-clicking a CTG whose status is not set to "Free".
Delete CT Group	Select this command when you want to change the status of a reserved CTG to "Free". When you select this command, the CTG will be ready to change its status of unused CTG. Note that this command will remain dimmed when you open the menu by right-clicking a CTG whose status is already set to "Free".
CT Group Status	Select this command when you want to display the information of a pair or pairs registered in the selected CTG. When you select this command, the CT Group Status dialog box opens. Note that this command will remain dimmed when you open the menu by right-clicking a CTG whose status is set either to "Reserved" or "Free".
Error Detail	Select this command when you want to display the error information of the CTG operation that failed. Note that this command will remain dimmed when there is no error. <i>Note:</i> For the list of Slz error codes and corrective actions, see the <i>Storage Navigator Messages</i> .

Performing ShadowImage for z/OS Operations Using Storage Navigator

This chapter provides instructions for performing ShadowImage for z/OS operations using the ShadowImage for z/OS software on Storage Navigator.

- [Configuring the Volume List](#)
- [Changing or Deleting the Settings in Preview List](#)
- [Setting or Resetting the Reserve Attribute](#)
- [Setting Options](#)
- [Configuring Consistency Groups](#)
- [Adding Pairs](#)
- [Splitting Pairs](#)
- [Suspending Pairs](#)
- [Resynchronizing Pairs](#)
- [Deleting Pairs](#)
- [Viewing Detailed Volume and Pair Information](#)
- [Viewing the Number of Pairs and License Information](#)
- [Viewing Pair Operations History](#)

When you want to check the result or progress of the operations, or when you want to display the latest information on the windows, click **File** and then **Refresh** on the menu bar of the Storage Navigator main window.

Configuring the Volume List

The Display Filter dialog box (see Figure 6-1) allows you to "filter" the volumes displayed in the Volume List by reserve attribute, by pair condition, and by pair status.

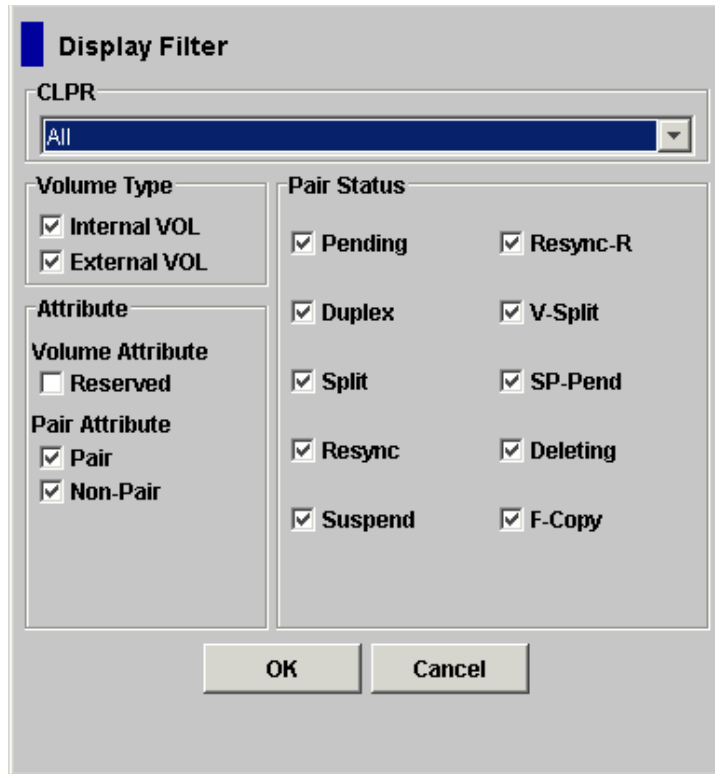


Figure 6-1 Display Filter Dialog Box

The Display Filter dialog box has the following features:

- The **CLPR** drop-down list allows you to display the specified cache logical partition (CLPR).
- The **Volume Type** box:
 - The **Internal VOL** check box allows you to display the internal volumes.
 - The **External VOL** check box allows you to display the external volumes.

Both check boxes are selected by default. You need to select either one of these two check boxes, otherwise all the settings in the Display Filter dialog box become invalid.

- The **Attribute** box:
 - The **Reserved** check box allows you to display reserved or unreserved volumes. If you select the **Reserved** check box, reserved volumes and volumes specified as the T-VOL are displayed in the Volume List. If you clear the **Reserved** check box, only unreserved volumes are displayed.
 - If you select the **Reserved** check box, you cannot select any other check boxes.
 - Volumes specified as the T-VOL of a SIz pair are automatically reserved by the storage system.
 - The **Pair** check box allows you to display paired volumes.
 - The **Non-Pair** check box allows you to display non-paired (simplex) volumes.
- The **Pair Status** box allows you to filter the pairs displayed in the Volume List by pair status. If you select the check boxes, you can display the pairs in those statuses. Since **F-Copy** is the status of Version 1 relationships, you do not need to select this check box when you are using ShadowImage for z/OS.
- The **OK** button applies the settings, and closes the dialog box.
- The **Cancel** button resets the settings, and closes the dialog box.

To configure the Volume List:

1. Click **Display Filter** in the Pair Operation window.
The Display Filter dialog box displays.
2. Select the CLPR where the volumes you want to display in the Volume List belong, and then select the check boxes of volume type, attribute, and pair status.
3. Click **OK**.
The Display Filter dialog box closes and only the volumes that meet the conditions you set in the dialog box will display in the Volume List.

The settings in the Display filter dialog box are only effective within the current SIz operations. If you switch to another option program, or click a button on the toolbar on the Storage Navigator main window, the settings in the Display Filter dialog box will be reset.

Changing or Deleting the Settings in Preview List

The **Preview** list temporarily retains multiple operations of the same type. The setting in the **Preview** list will be reflected in the storage system when you click **Apply**. If the specified operations complete successfully, the **Preview** list will be cleared. If an error occurs during an operation, the failed operation will remain in the **Preview** list with an error icon (🚫) displayed on the left of the operation name.

The setting of the **Preview** list can be changed or deleted only before clicking **Apply**. Procedures for changing and deleting the setting of the **Preview** list are as below.

Changing the Settings in Preview List

To change the settings of the **Preview** list:

1. Verify that the **Preview** list shows settings made in the Add Pair dialog box,
2. Split Volume Pair dialog box, or Resynchronize Volume Pair dialog box. Select and right-click the setting you want to change.

A menu will be displayed.

3. Select the **Modify** command from the menu.

The dialog box which enables you to change the selected setting will be displayed.

4. Change the setting and click **OK**.

The dialog box will close and the change of the setting will be reflected in the **Preview** list.

Deleting the Settings in Preview List

To delete all of the settings in the **Preview** list, click **Cancel**.

To delete only some of the settings in the **Preview** list:

1. Select and right-click the setting that you want to delete.

A menu will be displayed.

2. Select the **Delete** command from the menu.

Only the selected setting will be deleted from the **Preview** list.

Setting or Resetting the Reserve Attribute

You set reserve attribute to the volumes when you want to make sure that you can use those volumes for SIz T-VOLs. This section describes how to set and reset the reserve attribute.

Setting the Reserve Attribute

The **Set Reserve Attribute** dialog box (see Figure 6-2) enables you to set the reserve attribute for the Simplex volume(s) selected on the Pair Operation window, and reserve the volumes as SIz T-VOLs.

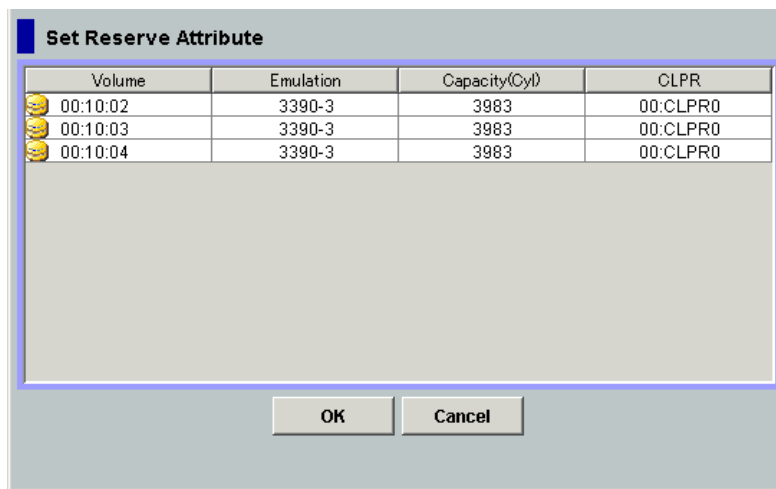


Figure 6-2 Set Reserve Attribute Dialog Box

The Set Reserve Attribute dialog box displays the unreserved *simplex* volume(s) that you selected on the Pair Operation window.

- **Volume:** Information of the volume displays in *XX:YY:ZZ* (LDKC number: CU number: LDEV number) format.
- **Emulation:** The emulation type of the volume.
- **Capacity (Cyl):** The number of the cylinders of the volume displays.
- **CLPR:** The cache logical partition of the volume displays.
- The **OK** button allows you to set the reserve attribute for unreserved volume(s).

The setting(s) will display in the **Preview List** on the Pair Operation window. To apply the setting(s) to the storage system, click **Apply** on the Pair Operation window.

- The **Cancel** button closes the Set Reserve Attribute dialog box without setting the reserve attribute.

To reserve one or more volumes for use as SIz T-VOLs (by setting the reserve attribute):

1. From the host, set the volume(s) that you will be reserving to offline.
The storage system will reject all read/write I/Os to reserved volumes (except when in the *split* status).
2. Go to the Pair Operation window, and select the desired CU image in the Tree.
3. Select and right-click the desired Simplex volume(s). The menu displays.
You can display only the Simplex volumes in the Volume List by using the Display Filter dialog box.
4. Select the **Change Reserve** command in the menu. The Set Reserve Attribute dialog box opens.
Select only unreserved and unpaired volumes to use the **Change Reserve** command.
5. On the Set Reserve Attribute dialog box, assure that the right volume(s) are displayed, and then click **OK**.
The setting will be reflected in the **Preview List** on the Pair Operation window.
6. Click **Apply** on the Pair Operation window.
The settings are reflected in the storage system.
7. Verify that the settings are reflected in the USP V/VM storage system.
You can check whether the attribute setting is updated or not on the Display Filter dialog box.

Resetting the Reserve Attribute

The Reset Reserve Attribute dialog box (see Figure 6-3) enables you to reset the reserve attribute for (i.e., unreserve) the volume(s) selected on the Pair Operation window.

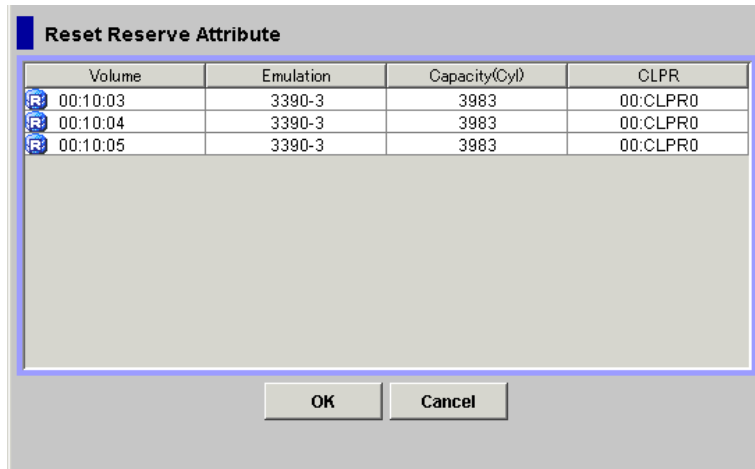


Figure 6-3 Reset Reserve Attribute Dialog Box

The Reset Reserve Attribute dialog box displays the reserved volume(s) that you selected on the Pair Operation window.

- **Volume:** Information of the volume displays in *XX:YY:ZZ* (LDKC number: CU number: LDEV number) format.
- **Emulation:** The emulation type of the volume.
- **Capacity (Cyl):** The number of the cylinders of the volume displays.
- **CLPR:** The cache logical partition of the volume displays.
- The **OK** button resets the reserve attribute of the SIZ T-VOL(s) and sets the status of the volume(s) back to *simplex*.

The setting(s) will be displayed in the **Preview List** on the Pair Operation window. To apply the settings to the storage system, click the **Apply** button on the Pair Operation window.

- The **Cancel** button closes the Reset Reserve Attribute dialog box without resetting the reserve attribute.

To unreserve one or more volumes (by resetting the reserve attribute):

1. Make sure that the volumes you want to un-reserve are no longer assigned to SIZ pairs as T-VOLs.

If the reserved volume is assigned to a SIZ pair, you need to delete the pair before you unreserve the volume. See *Deleting Pairs* for instructions on deleting SIZ pairs.

2. Go to the Pair Operation window, and select the CU image in the Tree.
3. Select and right-click the desired Simplex volume(s).
The menu displays.
You can display only the Simplex volumes in the Volume List by using the Display Filter dialog box.
4. Select the **Change Reserve** command in the menu. The Reset Reserve Attribute dialog box opens.
Select only reserved and unpaired volumes to use the **Change Reserve** command.
5. On the Reset Reserve Attribute dialog box, assure that the right volume(s) display, and then click **OK**.
The setting will be reflected in the **Preview List** on the Pair Operation window.
6. Click **Apply** on the Pair Operation window.
The settings are reflected in the storage system.
You can check whether or not the attribute setting is updated on the Display Filter dialog box.

Setting Options

The Option window (see Figure 5-5) allows you to specify the options to expand SIZ operations.

To set options:

1. Display the Option window.

If you are already displaying the other window shown by a tab, click the **Option** tab. For information about how to display the Option window directly by starting up Storage Navigator, see Starting ShadowImage for z/OS.

2. Select the check box of the option you want to set.

- For detailed information about options, see [ShadowImage for z/OS Options](#).
- If you do not want to set any option, clear all check boxes in the **Select Option(s)** box.

3. Click **Apply**

You can now perform SIZ operations with the specified option.

Configuring Consistency Groups

This section provides instructions on setting or resetting the reserve attribute for a consistency group. Check pair information in a consistency group before setting the reserve attribute for the group by following the next steps:

1. Display the CTG window (see Figure 5-6).

If you are already displaying the other window shown by a tab, click the CTG tab. For information about how to display the CTG window directly by starting up Storage Navigator, see Starting ShadowImage for z/OS.

2. Select and right-click the consistency group in the CTG List in the window.
The menu displays.

3. Select the **CT Group Status** command in the menu.

The CT Group Status dialog box displays.

The information of the registered pairs displayed in the CT Group Status dialog box is only for display and cannot be edited to perform any pair operation.

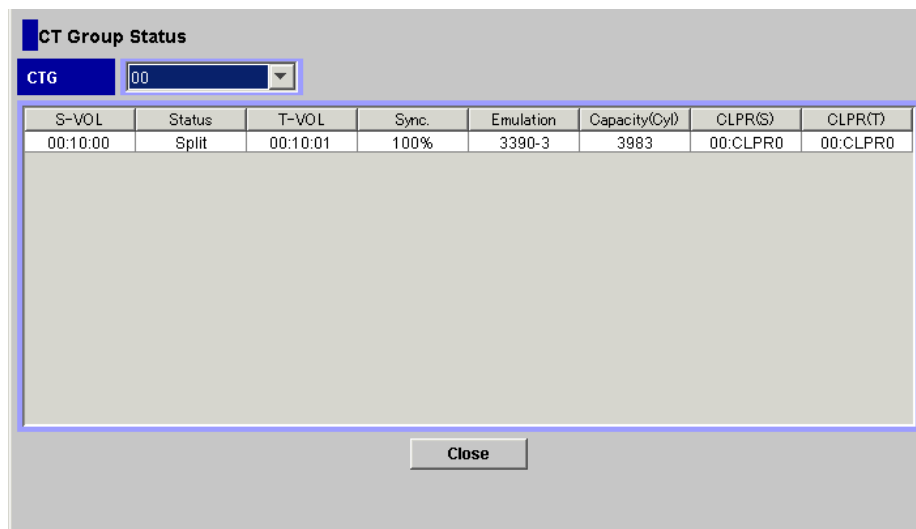


Figure 6-4 CT Group Status Dialog Box

The items displayed in the CT Group Status dialog box are as follows:

- **CTG** drop-down list allows you to select the consistency group that you want to display in the Pair Information List.
- Pair Information List, located below the **CTG** drop-down list, displays the following information pertaining to the pair or pairs registered in the selected consistency group.
 - **S-VOL**: Displays the ID (LDKC:CU:LDEV) of the S-VOL of the pair registered in the selected consistency group.

An LDEV number that ends with a pound or gate symbol (#) indicates that the LDEV is an external volume (e.g., 00:00:01#). For details regarding the external volumes, see the *Universal Volume Manager User's Guide*.

- **Status:** Displays the current status of the selected pair.
- **T-VOL:** Displays the ID (LDKC:CU:LDEV) of the S-VOL of the pair registered in the selected consistency group.

An LDEV number that ends with a pound or gate symbol (#) indicates that the LDEV is an external volume (e.g., 00:00:01#). For details regarding the external volumes, see the *Universal Volume Manager User's Guide*.

- **Sync.:** Displays the rate of copying in progress between the selected pair.
 - **Emulation:** Displays the emulation type of the selected pair.
 - **Capacity(Cyl):** Displays the volume capacity by the number of cylinders.
 - **CLPR(S):** The cache logical partition of the S-VOL displays.
 - **CLPR(T):** The cache logical partition of the T-VOL displays.
- The **Close** button closes the CT Group Status dialog box.

Setting the Reserve Attribute of a Consistency Group

To set the reserve attribute of one or more consistency groups:

1. On the CTG window, select the desired consistency group or its status displayed in the Tree.

The consistency group that you have just selected displays in the CTG List.

2. Select the consistency group that you want to set the reserve attribute. Then right-click the selected CTG to make the menu appear, and select the **Add CT Group** command from the menu.
3. Repeat steps 1 and 2 until the CTG List on the CTG window displays all the desired CTG settings.
4. Set the reserve attribute of the selected consistency group by clicking the **Apply** button displayed in the lower part of the CTG window.

The result of the **Add CT Group** command will then be displayed on the CTG window.

Resetting the Reserve Attribute of a Consistency Group

To reset the reserve attribute of one or more consistency groups:

1. On the CTG window, select the desired consistency group displayed under the **Reserved** in the Tree.

The consistency group information that you selected displays in the CTG List.

2. Select the consistency group that you want to reset the reserve attribute. Then right-click the selected CTG to make the command menu appear, and select the **Delete CT Group** command from the menu.
3. Repeat steps 1 and 2 until the CTG List on the CTG window displays all the desired CTG settings.
4. Delete the CTG by clicking the **Apply** button displayed on the lower part of the CTG window.

The result of the **Delete CT Group** command will then be displayed on the CTG window.

Adding Pairs



WARNING: The ShadowImage for z/OS add pair operation overwrites all data on the T-VOLs. The user is responsible for backing up the data on the T-VOLs before adding SIz pairs.

The Add Pair dialog box (see Figure 6-5) allows you to select the T-VOL(s) for each S-VOL, set the copy pace for all pairs being added, and start the Add Pair operation(s).

If you want to add new SIz pairs and then split them immediately so that you can access the T-VOLs as soon as possible, add the pair from the Split Pair Volume dialog box instead of the Add Pair dialog box. For details, see [Performing Pair Addition and Pair Splitting](#).

S-VOL	Status	T-VOL	Emulation	Capacity(Cyl)	CLPR(S)	CLPR(T)
00:10:02	Simplex	---	3390-3	3983	00:CLPR0	---
00:10:03	Simplex	---	3390-3	3983	00:CLPR0	---
00:10:04	Simplex	---	3390-3	3983	00:CLPR0	---

Copy Pace: Medium

Select T-VOL

LDKC: 00
CU: 10

Volume Type:
 Internal VOL
 External VOL

Attribute:
 Reserved
 Not Reserved

Volume	Emulation	Capacity(Cyl)	CLPR
00:10:05	3390-3	3983	00:CLPR0
00:10:06	3390-3	3983	00:CLPR0
00:10:07	3390-3	3983	00:CLPR0
00:10:08	3390-3	3983	00:CLPR0
00:10:09	3390-3	3983	00:CLPR0
00:10:0A	3390-3	3983	00:CLPR0
00:10:0B	3390-3	3983	00:CLPR0
00:10:0C	3390-3	3983	00:CLPR0
00:10:0D	3390-3	3983	00:CLPR0
00:10:0E	3390-3	3983	00:CLPR0

Buttons: Set, Change, OK, Cancel

Figure 6-5 Add Pair Dialog Box

The Add Pair dialog box consists of the following components.

- Add Pair Volume List

The Volume List located on the upper side of the Add Pair dialog box displays the following information pertaining to the P-VOL and S-VOL used for adding a pair:

- **S-VOL**: The LDKC:CU:LDEV of the S-VOL.

An LDEV number that ends with a pound or gate symbol (#) indicates that the LDEV is an external volume (e.g., 00:00:01#). For details regarding the external volumes, see the *Universal Volume Manager User's Guide*.

- **Status**: The pair status.

- **T-VOL**: The LDKC:CU:LDEV of the T-VOL.

An LDEV number that ends with a pound or gate symbol (#) mark indicates that the LDEV is an external volume (e.g., 00:00:01#). For details regarding the external volumes, see the *Universal Volume Manager User's Guide*.

- **Emulation**: The emulation type of the S-VOL and T-VOL.

- **Capacity(Cyl)**: The number of cylinders assigned to the volume.

- **CLPR(S)**: The cache logical partition of the S-VOL.

- **CLPR(T)**: The cache logical partition of the T-VOL.

- The **Copy Pace** drop-down list allows you to select the copy pace (from **Slower**, **Medium**, or **Faster**) for all pairs being added.

- When the **Preview List** already holds some Add Pair operation settings, and you specify a different copy pace for new pairs in the Add Pair dialog box, the copy pace for the existing Add Pair settings displayed in the **Preview List** will be also changed. The latest copy pace specified in the Add Pair dialog box is always reflected to the storage system.

- If you specify **Slower**, the pace of initial copying will be slow, but you can minimize the impact of SIZ operations on storage system I/O performance. If you specify **Faster**, the initial copy operation completes as quickly as possible, but it will cause a large impact on the I/O operation.

- The **Select T-VOL** box allows you to filter the T-VOLs displayed in the **T-VOL List** on the right.

- The **LDKC** drop-down list allows you to select the LDKC of the T-VOL.

- The **CU** drop-down list allows you to select the CU image of the T-VOL.

- The **Volume Type** box:

- The **Internal VOL** check box allows you to select the available T-VOLs that are internal volumes.
- The **External VOL** check box allows you to select the available T-VOLs that are external volumes. You need the Universal Volume Manager features to select the external volumes.

- The **Reserved** check box allows you to display reserved or un-reserved volumes. If you select the **Reserved** check box, only reserved volumes are displayed in the Volume List. If you select the **Not Reserved** check box, only unreserved volumes are displayed.
- The **Previous** button allows you to return to the previous page of the **T-VOL List**. This button is selectable only when the number of volumes defined in the storage system exceeds 1,024 volumes, which is the maximum number of volumes that can be displayed on one page. It remains dimmed when the total number of volumes defined in the storage system is less than 1,024 volumes.
- The **Next** button allows you to turn to the next page of the **T-VOL List**. This button is selectable only when the number of volumes defined in the storage system exceeds 1,024 volumes, which is the maximum number of volumes that can be displayed on one page. It remains dimmed when the total number of volumes defined in the storage system is less than 1,024 volumes.
- The T-VOL List displays the following information related to T-VOLs:
 - **Volume:** The ID (LDKC:CU:LDEV) of the T-VOL.
 - **Emulation:** The emulation type of the T-VOL.
 - **Capacity(Cyl):** The capacity of the T-VOL (the number of cylinders).
 - **CLPR:** The cache logical partition (CLPR) of the T-VOL.
- The **Set** button adds the selected T-VOL and S-VOL to the Add Pair Volume List as a new SIZ pair.
- The **Change** button replaces the T-VOL of the selected pair in the list with the selected T-VOL.
- The **OK** button adds the operation (setting) to add a new pair using the S-VOL and T-VOL you selected in the Add Pair dialog box to the **Preview List** on the Pair Operation window.

To apply all the new pair operation settings displayed in the **Preview List** to the storage system, click **Apply** on the Pair Operation window.

- The **Cancel** button cancels the operations set in the Add Pair dialog box and closes the dialog box.

To add one or more new SIZ pairs:

1. Make sure that the desired T-VOL(s) is/are offline.
Reserved volumes are offline. For information about how to set the reserve attribute to a volume, see Setting the Reserve Attribute.
2. Go to the Pair Operation window, and select the desired CU image or S-VOL in the Tree to filter the volumes displayed in the Volume List.
3. Select and right-click the desired S-VOL(s) for the new pair(s) to display the menu, and then select the **Add Pair** command to open the Add Pair dialog box.

Do not select any reserved volumes as the S-VOL.

4. On the Add Pair dialog box, select from the **Copy Pace** drop-down list, the initial copy pace for all pairs being added.
5. Verify that the Add Pair dialog box displays the desired S-VOL(s).

If you want to remove any volumes from the list, select and right-click the volume(s) to display the menu, and then select the **Delete** command.

6. Select the T-VOL(s) for each S-VOL as follows:
 - a. Select the desired S-VOL from the Add Pair Volume List.
 - b. Select the desired LDKC from the **LDKC** drop-down list, and then select the desired CU image from the **CU** drop-down list in the **Select T-VOL** box.
 - c. Select the **Reserved** check box to display reserved volumes, and then select from the reserved volumes displayed in the T-VOL List, the one that you want to use as the T-VOL of the new SIZ pair.
You can also select an unreserved volume as the T-VOL. When you add the pair, the storage system changes the reserve attribute to "Reserved" automatically.
 - d. Click **Set** to create (add) the T-VOL to the selected S-VOL. The T-VOL will then be displayed next to the selected S-VOL.
 - e. If you want to add a second and/or third T-VOL to the same S-VOL, repeat steps b through d to add each T-VOL to the selected S-VOL.
Each pair to be created displays separately in the Add Pair Volume List.
7. Repeat step 6 until all desired pairs are displayed.

Use the **Change** button to replace a T-VOL. Use the **Set** button to add a T-VOL. To remove pairs from the Add Pair dialog box, select the **Delete** command from the menu that appears when you right-click the pair that you want to remove pair.

8. When the Add Pair dialog box displays the desired new pair(s), click **OK** to reflect all pairs (settings) in the Add Pair Volume List to the **Preview List** on the Pair Operation window.
9. On the Pair Operation window, click **Apply** to apply the operation(s) set in the Add Pair dialog box to the storage system.

When the initial copy operation(s) start, the Pair Operation window shows the new pairs with *pending* status and the progress (%) of the initial copy operation(s).

Table 6-1 describes the relationship between the pair status and the availability of Siz pair operations on the pairs. (CMD RJT = command rejected.)

Table 6-1 Relationship between the Pair Status and the Pair Operations

Pair Status	Pair Operations				
	Add Pair	Split Volume Pair	Resynchronize Volume Pair	Suspend Volume Pair	Delete Pair
Pending	NO (CMD RJT) *	OK	NO (CMD RJT)	OK	OK
Duplex	NO (CMD RJT) *	OK	NO (CMD RJT)	OK	OK
SP-Pend	NO (CMD RJT) *	NO (CMD RJT) *	NO (CMD RJT)	OK	OK
V-Split	NO (CMD RJT) *	NO (CMD RJT) *	OK	OK	NO (CMD RJT)
Split	NO (CMD RJT) *	NO (CMD RJT) *	OK	OK	OK
Resync	NO (CMD RJT) *	NO (CMD RJT) *	NO (CMD RJT)	OK	OK
Resync-R	NO (CMD RJT) *	NO (CMD RJT) *	NO (CMD RJT)	OK	OK
Suspend	NO (CMD RJT) *	NO (CMD RJT) *	OK	NO (CMD RJT)	OK

* The operation to the S-VOL is available.

Splitting Pairs

The Split Volume Pair dialog box (see Figure 6-6) allows you to split existing ShadowImage for z/OS pairs. The Split Volume Pair dialog box can also be used to simultaneously add and split new SIz pairs.

For information about how to split pairs, see [Performing Only Pair Splitting](#). For information about how to create and split pairs, see [Performing Pair Addition and Pair Splitting](#). In addition, you can split multiple pairs at the same specified time by using Business Continuity Manager. For details, see [Performing At-Time Split Operation \(Multiple Pair Splitting\)](#).

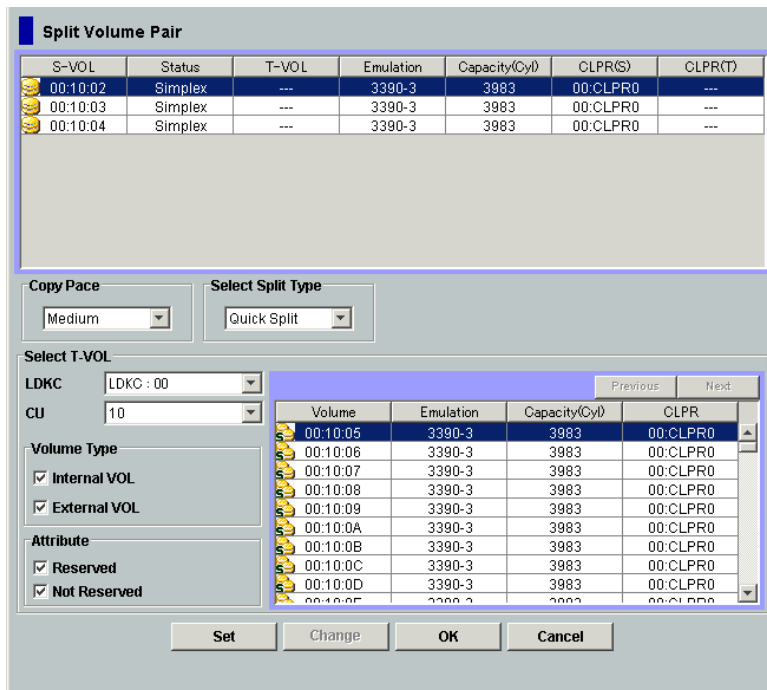


Figure 6-6 Split Volume Pair Dialog Box

The Split Volume Pair dialog box consists of the following components.

- **Split Volume Pair Volume List**
The Volume List located on the upper side of the Split Volume Pair panel displays the following information pertaining to the S-VOL and T-VOL of the pair that you want to split:
 - **S-VOL:** The LDKC:CU:LDEV of the S-VOL.
An LDEV number that ends with a pound or gate symbol (#) indicates that the LDEV is an external volume (e.g., 00:00:01#). For details regarding the external volumes, see the *Universal Volume Manager User's Guide*.
 - **Status:** The pair status.

- **T-VOL:** The LDKC:CU:LDEV of the T-VOL.
An LDEV number that ends with a pound or gate symbol (#) indicates that the LDEV is an external volume (e.g., 00:00:01#). For details regarding the external volumes, see the *Universal Volume Manager User's Guide*.
- **Emulation:** The emulation type of the S-VOL and T-VOL.
- **Capacity(Cyl):** The number of cylinders assigned to the volume.
- **CLPR(S):** The cache logical partition of the S-VOL.
- **CLPR(T):** The cache logical partition of the T-VOL.
- The **Copy Pace** drop-down list allows you to select the copy pace (from **Slower**, **Medium**, or **Faster**) for all the pairs that you are splitting.
 - When the **Preview List** already holds some Split Volume Pair operation settings, and if you specify a different copy pace for new pairs in the Split Volume Pair dialog box, the copy pace for the existing Split Volume Pair operation settings displayed in the **Preview List** also will be changed. The latest copy pace specified in the Split Volume Pair dialog box is always reflected to the storage system.
 - If you specify **Slower**, the pace of copying will be slow, but you can minimize the impact of Siz operations on storage system I/O performance. If you specify **Faster**, the copy operation completes as quickly as possible, but it will cause a large impact on the I/O operation.
- The **Select Split Type** drop-down list allows you to select the split type (from **Quick Split** or **Steady Split**) for all the pairs that you are splitting. Table 6-2 lists read/write operations from the host servers to the volumes during the split pair operation.

Table 6-2 Operations from the Host Servers during the Split Pair Operation

Operations	Volumes	Quick Split	Steady Split
Read	S-VOL	Both areas which are not copied and areas which are already copied can be read as usual.	
	T-VOL	<p>The areas which are already copied can be read as usual.</p> <p>If the host server tries to read the area which is not copied yet, firstly ShadowImage for z/OS copies that area from the S-VOL, and then the host server will read the area after the copy operation completes. Therefore, the result will be the same as when the host server reads the area which is already copied.</p>	Cannot be read. Read processing will finish abnormally.

Operations	Volumes	Quick Split	Steady Split
Write	S-VOL	Write operation for the area which is already copied to the T-VOL is performed normally. If the host server tries to write data to the area which is not copied yet, new data will be written after the old data is copied to the T-VOL. S-VOL data during the split operation will therefore be copied to the T-VOL for sure.	
	T-VOL	The areas which are already copied can be written as usual. If the host server tries to write data to the area which is not copied yet, firstly ShadowImage for z/OS copies that area from the S-VOL, and then the host server will write data to the area after the copy operation completes. Therefore, the result will be the same as when the host server writes data to the area which is already copied.	Cannot be written. Write processing will finish abnormally.

- The **Select T-VOL** box allows you to filter the T-VOLs displayed in the T-VOL List on the right.
 - The **LDKC** drop-down list allows you to select the LDKC of the T-VOL.
 - The **CU** drop-down list allows you to select the CU image of the T-VOL.
 - The **Volume Type** box:
 - The **Internal VOL** check box allows you to select the available T-VOLs that are internal volumes.
 - The **External VOL** check box allows you to select the available T-VOLs that are external volumes. You need the Universal Volume Manager features to select the external volumes.
 - The **Reserved** check box allows you to display reserved or un-reserved volumes. If you select the **Reserved** check box, only reserved volumes are displayed in the **Volume List**. If you select the **Not Reserved** check box, only un-reserved volumes are displayed.

The number of secondary volumes that can be displayed in the T-VOL List at a time is limited to 1,024 volumes. In case the number of volumes defined in the storage system exceeds this limit, use the **Previous** and **Next** buttons on the upper right of the T-VOL List to turn the pages of the T-VOL List and see the entire list.

- The **Previous** button allows you to return to the previous page of the T-VOL List. This button is selectable only when the number of volumes defined in the storage system exceeds 1,024 volumes, which is the maximum number of volumes that can be displayed on one page. It remains dimmed when the total number of volumes defined in the storage system is less than 1,024 volumes.

- The **Next** button allows you to turn to the next page of the T-VOL List. This button is selectable only when the number of volumes defined in the storage system exceeds 1,024 volumes, which is the maximum number of volumes that can be displayed on one page. It remains dimmed when the total number of volumes defined in the storage system is less than 1,024 volumes.
- The T-VOL List displays the following information related to T-VOLs:
 - **Volume:** The ID (LDKC:CU:LDEV) of the T-VOL.
 - **Emulation:** The emulation type of the T-VOL.
 - **Capacity(Cyl):** The capacity of the T-VOL (the number of cylinders).
 - **CLPR:** The cache logical partition (CLPR) of the T-VOL.
- The **Set** button adds the information of the pair you intend to split to the Split Volume Pair Volume List.
- The **Change** button replaces the T-VOL of the selected pair displayed in the Split Volume Pair Volume List with the selected T-VOL.
- The **OK** button adds the operation (setting) to split the pair composed of the S-VOL and T-VOL you selected in the Split Volume Pair dialog box to the **Preview List** on the Pair Operation window.
To apply all the new pair operation settings displayed in the **Preview List** to the storage system, click **Apply** on the Pair Operation window.
- The **Cancel** button cancels the operations set in the Split Volume Pair dialog box and closes the dialog box.

Performing Only Pair Splitting



Caution: If you want the T-VOLs you are intending to split to be identical to the S-VOLs, stop all write operations to the S-VOLs before splitting the pairs. This ensures that there are no updates to the S-VOLs while the split operations are synchronizing the T-VOLs to the S-VOLs.

The S-VOL and T-VOL are synchronized only when the pair status changes from *SP-Pend* or *V-Split* to *Split*. Due to the SIZ asynchronous update copy operations, this status transition can take several minutes.

To split one or more existing SIZ pairs:

1. Go to the Pair Operation window, and select the desired CU image or S-VOL in the Tree to filter the volumes displayed in the Volume List.
2. Select and right-click the pair(s) you want to split (other than the suspended pairs) to display the menu, and then select the **Split Pair** command to open the Split Volume Pair dialog box.
3. On the Split Volume Pair dialog box, select from the **Copy Pace** drop-down list, the copy pace for all pairs being split.

The copy pace is set for all pairs being split. If you change the setting, the last setting will become effective.

4. Select from the **Select Split Type** drop-down list, the split type for all pairs being split.

The split type is set for all pairs being split. If you change the setting, the latest setting is applied to all pairs.

5. When the Split Volume Pair dialog box displays the desired pair(s), click **OK** to reflect all pairs to the **Preview List** on the Pair Operation window.

Use the **Delete** command selected from the menu (that will be displayed by right-clicking) to remove any pairs from the Split Volume Pair Volume List.

6. On the Pair Operation window, click **Apply** to apply the Split Volume Pair operation(s) set in the Split Volume Pair dialog box to the storage system.

When the Split Volume Pair operation(s) start, the Pair Operation window shows the new pairs with *SP-Pend* or *V-Split* status and the progress (%) of the update copy operation(s). The *Split* status displays immediately if there were no pending update copy operations.

Performing Pair Addition and Pair Splitting

The Split Volume Pair dialog box can also be used to simultaneously add and split new SIZ pairs.



Caution: If you want the T-VOLs you are intending to split to be identical to the S-VOLs, stop all write operations to the S-VOLs before splitting the pairs. This ensures that there are no updates to the S-VOLs while the split operations are synchronizing the T-VOLs to the S-VOLs.

The S-VOL and T-VOL are synchronized only when the pair status changes from *SP-Pend* or *V-Split* to *Split*. Due to the SIZ asynchronous update copy operations, this status transition can take several minutes.

To simultaneously add and split one or more new SIZ pairs:

1. Go to the Pair Operation window, and select the desired CU image or S-VOL in the Tree to filter the pairs displayed in the Volume List.
2. Select the Simplex volume(s) that will be the S-VOL(s) of the new pairs to be added and split, right-click the selected S-VOL(s) to display the menu, and then select the **Split Pair** command to open the Split Volume Pair dialog box.
3. On the Split Volume Pair dialog box, select the copy pace from the **Copy Pace** drop-down list.
4. Select the split type for all pairs being added and split from the **Select Split Type** drop-down list.
5. Specify the T-VOL(s) you want to pair up with each S-VOL by following the steps below:
 - a. From the Split Volume Pair Volume List, select the desired S-VOL.
 - b. From the **LDKC** drop-down list, select the desired LDKC, and from the **CU** drop-down list, select the desired CU image.
 - c. Select the **Reserved** checkbox to make the reserved volumes appear on the T-VOL List.

Reserved volumes are displayed on the T-VOL List.
 - d. From the T-VOL List, select the desired T-VOL.

You can also select the T-VOL from unreserved volumes, because once you select an unreserved volume, the storage system will automatically set its reserve attribute and make it a reserved volume.
 - e. Click **Set**.

The T-VOL will be displayed below the selected S-VOL in the Split Volume Pair Volume List.
 - f. If you want to add and split another T-VOL to and from the same S-VOL, repeat steps b through 0. Each pair to be added and split will be displayed separately in the Volume List.

6. Repeat step 4 until the desired pair(s) display.
Use the **Change** button to replace T-VOLs, the **Set** button to add T-VOLs, and the **Delete** command in the menu to remove pairs from the Split Volume Pair Volume List.
7. Click **OK** to reflect the settings in the Split Volume Pair dialog box to the **Preview List** on the Pair Operation window.
8. On the Pair Operation window, click **Apply** to apply the operation settings in the **Preview List** to the storage system.

The pair(s) will then be created and split according to the operations set in the Split Volume Pair dialog box. When the add & split operation(s) start, the Pair Operation window will show the new pairs with *SP-Pend* or *V-Split* status and the progress (%) of the ongoing update copy operation(s). The *Split* status displays immediately if there were no pending update copy operations.

Performing At-Time Split Operation (Multiple Pair Splitting)

By using Business Continuity Manager, you can split the multiple SIz pairs in the same consistency group at once. For details on adding, deleting, and viewing the SIz consistency groups, see Configuring Consistency Groups. Table 2-2 lists the SIz consistency groups restrictions:

Table 6-3 Specifications of Consistency Groups

Items	Descriptions
Consistency group number	A number (0–127) is assigned to each consistency group. You can specify a consistency group number when you create SIz pairs. You can view the ID of the consistency groups used as the pair unit via the CTG window or by using a mainframe host. You can configure up to 128 consistency groups in a storage system, including ShadowImage consistency groups and Copy-on-Write Snapshot consistency groups.
Number of pairs	You can define up to 8,192 SIz pairs in a consistency group. Note that SIz pairs, ShadowImage pairs, and Copy-on-Write Snapshot pairs cannot co-exist in the same consistency group.

This section describes the overview procedure of splitting pairs by At-Time Split, using Business Continuity Manager. For detailed instructions on using Business Continuity Manager, see the *Business Continuity Manager User and Reference Guide*.

1. Define the SIz pairs in the same consistency group.
2. Specify the consistency group as the copy group of Business Continuity Manager, or register the split time.
3. When you specify the copy group, select the split type: Quick Split or Steady Split.

When you register the split time, the split type will be Quick Split.

4. Perform the pair create operation.
5. Perform the pair split operation on the SIz pairs that are created for At-Time Split function.

The At-Time Split option is enabled, and data in all S-VOLs in the same consistency group is created in the corresponding T-VOLs at the time when the pairsplit request is received by the storage system.



Cautions: on executing the At-Time Split function:

- Change the status of pairs in the same consistency group according to the copy group.
- If you are going to execute the At-Time Split function successively, before you execute the function for the second time, verify that status of all the pairs in the same consistency group is changed to the status which is specified by the YKEWAIT command. For detailed information about the YKEWAIT command, see the *Business Continuity Manager User's Guide*.

If you do not follow the abovementioned caution, the data in the S-VOL when the Split operation is performed by the At-Time Split function may not be copied to the T-VOL.

On registering the split time:

- For the pairs in the consistency group to which you registered the Split time, you can only perform Suspend Pair operations or Delete Pair operations. If you perform Add Pair, Split or Pair Resync operation, registration of the Split time will be rejected. If you want to perform Add Pair, Split or Pair Resync operation, you must first reset the registration of the Split time.
- The specified Split time will be reset by switching off the power supply.
- If the Split time is registered, the Split operation is performed at the time of reception of the read/write request with a time stamp that has passed the time specified as the Split time. The Split operation may be delayed in case no read/write request is issued and the Split operation, as a result, is performed as a result of timeout of the storage system timer.
- If the Split time is registered, and if there is a pair in the consistency group that cannot be split completely during the Split operation, the status of this pair will remain the same as before the Split operation.

Using PPRC Commands to Split, Resynchronize and Delete Pairs in a Consistency Group

By using a PPRC command, you can split, resynchronize, and delete all SIZ pairs in the same consistency group at once. For specifications of consistency groups, see *Performing At-Time Split Operation (Multiple Pair Splitting)*. For details on how to set, reset, and reference consistency groups, see *Configuring Consistency Groups*.

The following explains how to use PPRC commands to manipulate consistency groups:

- Preparation for consistency group
 1. Start up ShadowImage for Mainframe from Storage Navigator, and reserve consistency group.
 2. Create SIZ pairs by using the CESTPAIR command of PPRC or the PPRCOPY ESTPAIR command.
 3. In the CTG dialog box, make sure that SIZ pairs have been made in the consistency group as expected.
- To split all pairs in the same consistency group
 1. Execute the CSUSPEND command of PPRC or the PPRCOPY SUSPEND command.

If you perform the CSUSPEND command or the PPRCOPY SUSPEND command on a pair in a consistency group, the command takes effect on all the pairs in the consistency group.
If you perform the command on a pair which has already been split, errors will not occur.
 2. Make sure that the pair status is Split by using the CQUERY command or the PPRCOPY QUERY command.
 3. Hosts can access the data in the SIZ T-VOLs.
- To resynchronize pairs in the same consistency group
 1. Resynchronize SIZ pairs by using the CESTPAIR command of PPRC or the PPRCOPY ESTPAIR command.

If you perform the CESTPAIR command or the PPRCOPY ESTPAIR command on a pair in a consistency group, the command takes effect on all the pairs in the consistency group.
If you perform the command on a pair which has not been split, errors will not occur.
 2. Use the CQUERY command or the PPRCOPY QUERY command to make sure that the pair status is Pending or Duplex.

- To delete pairs in the same consistency group
 1. Delete SIZ pairs by using the CDELP AIR command of PPRC or the PPRCOPY DELPAIR command.
If you perform the CDELP AIR command or the PPRCOPY DELPAIR command on a pair in a consistency group, the command takes effect on all the pairs in the consistency group.
 2. Use the CQUERY command or the PPRCOPY QUERY command to make sure that the pair status is Simplex.

Suspending Pairs

The Suspend Volume Pair dialog box (see Figure 6-7) allows you to suspend the pair(s).

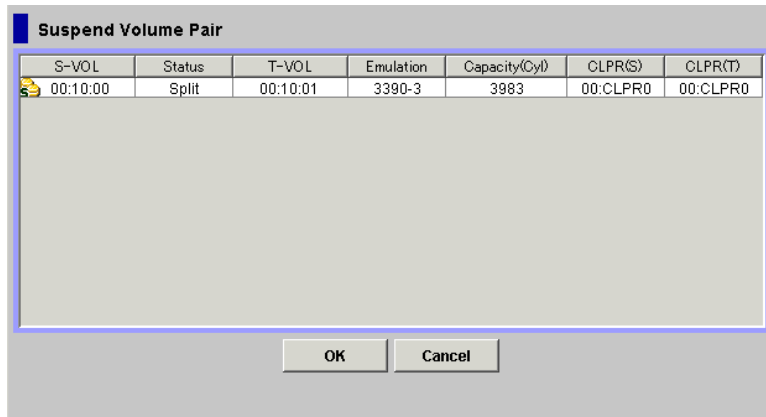


Figure 6-7 Suspend Volume Pair Dialog Box

The Suspend Volume Pair dialog box consists of the following components.

- **Suspend Volume Pair Volume List**

The **Volume List** located on the upper side of the Suspend Volume Pair panel displays the following information pertaining to the S-VOL and T-VOL of the pair you want to suspend:

 - **S-VOL:** The LDKC:CU:LDEV of the S-VOL.

An LDEV number that ends with a pound or gate symbol (#) indicates that the LDEV is an external volume (e.g., 00:00:01#). For details regarding the external volumes, see the *Universal Volume Manager User's Guide*.
 - **Status:** The pair status displays.
 - **T-VOL:** The LDKC:CU:LDEV of the T-VOL.

An LDEV number that ends with a pound or gate symbol (#) indicates that the LDEV is an external volume (e.g., 00:00:01#). For details regarding the external volumes, see the *Universal Volume Manager User's Guide*.
 - **Emulation:** The emulation type of the S-VOL and T-VOL.
 - **Capacity(Cyl):** The number of cylinders assigned to the volume.
 - **CLPR(S):** The cache logical partition of the S-VOL.
 - **CLPR(T):** The cache logical partition of the T-VOL.
- The **OK** button adds the operation setting(s) to suspend the selected pair(s) displayed in the Suspend Volume Pair Volume List to the **Preview List** on the Pair Operation window.

You must click **Apply** on the Pair Operation window to apply the Suspend Volume Pair operation setting(s) displayed in the **Preview List** to the storage system.

- The **Cancel** button cancels the operations set in the Suspend Volume Pair dialog box and closes the dialog box.

To suspend one or more SIZ pairs:

1. Go to the Pair Operation window, and select the desired CU image or S-VOL in the Tree to filter the volumes displayed in the Volume List.
2. Select the pair(s) that you want to suspend (or the volume(s) whose pairs you want to suspend), right-click the selected pairs to display the menu, and then select the **Suspend Pair** command to open the Suspend Volume Pair dialog box.
3. On the Suspend Volume Pair dialog box, select the pair(s) you want to suspend, and click **OK** to reflect the settings to the **Preview List** on the Pair Operation window.

To remove pair(s) from the list, select the unnecessary SIZ pair(s), right-click while selecting the pair(s), and then select the **Delete** command from the menu that will be displayed by right-clicking.

4. Repeat steps 2 and 2 to suspend additional pairs in the Suspend Volume Pair Volume List.
5. On the Pair Operation window, click **Apply** to suspend the specified pair(s). The Pair Operation window will then display the result(s) of the suspend operation(s) (i.e., pair status changed to *Suspend*).

Resynchronizing Pairs

The Resynchronize Volume Pair dialog box (see Figure 6-8) allows you to resynchronize the pair(s) in Split, V-Split, or Suspend status.

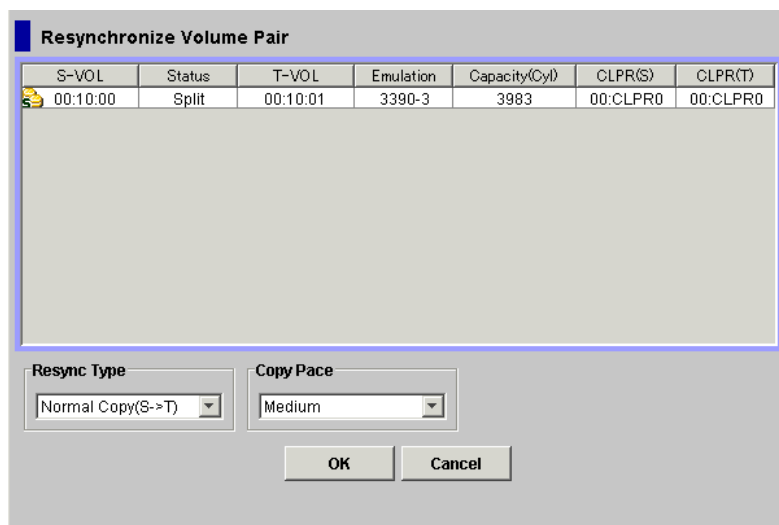


Figure 6-8 Resynchronize Volume Pair Dialog Box

The Resynchronize Volume Pair dialog box consists of the following components.

- Resynchronize Volume Pair Volume List

The Volume List located on the upper side of the Resynchronize Volume Pair dialog box displays the following information pertaining to the S-VOL and T-VOL of the pair you want to resynchronize:

- **S-VOL:** The LDKC:CU:LDEV of the S-VOL.

An LDEV number that ends with a pound or gate symbol (#) indicates that the LDEV is an external volume (e.g., 00:00:01#). For details regarding the external volumes, see the *Universal Volume Manager User's Guide*.

- **Status:** The pair status displays.
- **T-VOL:** The LDKC:CU:LDEV of the T-VOL.

An LDEV number that ends with a pound or gate symbol (#) indicates that the LDEV is an external volume (e.g., 00:00:01#). For details regarding the external volumes, see the *Universal Volume Manager User's Guide*.

- **Emulation:** The emulation type of the S-VOL and T-VOL.
- **Capacity(Cyl):** The number of cylinders assigned to the volume.
- **CLPR(S):** The cache logical partition of the S-VOL.
- **CLPR(T):** The cache logical partition of the T-VOL.

- The **Resync Type** drop-down list allows you to select the resync type for the pairs being resynchronized (from **Normal Copy(S->T)**, **Quick Resync(S->T)**, **Reverse Copy(T->S)**, or **Quick Restore(T->S)**). Before selecting **Reverse Copy(T->S)** or **Quick Restore(T->S)**, make sure that the selected pair meets the requirements listed in Table 6-4.

Table 6-4 Requirements for Selecting Reverse Copy(T->S) or Quick Restore(T->S)

Parameter	Requirement(s)
Pair status	The specified pair must be in the <i>split</i> state. All other pairs that share the same S-VOL as the specified pair must also be in the <i>split</i> or <i>suspended</i> state.
Pair type	You cannot perform the quick restore pairresync command on a pair that consists of VLL and normal volumes. The specified pair must not be a Cross-OS File Exchange volume pair.
Shared SIz/TCz volume.	If the SIz and TCz pairs share the same volume (S-VOL = M-VOL, T-VOL = M-VOL, or S-VOL = R-VOL), and the TCz pair is not in the <i>suspend</i> status, the reverse copy and quick restore operations cannot be performed. When the shared SIz/TCz volume is paired with an external volume, the quick restore pairresync operation cannot be performed.
Shared SIz/URz volume.	If the SIz and URz pairs share the same volume, and the URz pair is not in the <i>suspend</i> status, the reverse copy and quick restore operations cannot be performed. When the shared SIz/URz volume is paired with an external volume, the quick restore pairresync operation cannot be performed.

During the reverse copy or quick restore operation, a TCz pair or an URz pair cannot be created. The TCz add pair command and URz add pair command will be rejected when the SIz pair status is *resync-r*.

- The **Copy Pace** drop-down list allows you to select the copy pace (from **Slower**, **Medium**, or **Faster**) for all the pairs that you are re-synchronizing.

Slower minimizes the impact of SIz operations on storage system I/O performance. **Faster** quickly completes the copy operation, but it may affect the storage system I/O performance.

- The **OK** button adds the operation setting displayed in the Resynchronize Volume Pair Volume List for re-synchronizing the specified pair(s) to the **Preview List** on the Pair Operation window.

You must click **Apply** on the Pair Operation window to start the Resync Pair operation for the specified pair(s).

- The **Cancel** button cancels the operations set in the Resynchronize Volume Pair dialog box and closes the dialog box.

To resynchronize one or more SIz pairs that have been split or suspended:

1. From the host, set the split T-VOL(s) offline before starting the Resync Pair operation.

When the Resync Pair operation starts, the storage system will stop accepting write I/Os to the T-VOL.

2. Go to the Pair Operation window, and select the desired CU image or S-VOL in the Tree to filter the volumes displayed in the Volume List.
3. Select the pair(s) in Split, V-Split, or Suspend status, right-click the selected pair(s) to display the menu, and then select the **Resync Pair** command to open the Resynchronize Volume Pair dialog box.
4. On the Resynchronize Volume Pair dialog box, select the pair(s) you want to resynchronize.
To remove the pair(s) in the Resynchronize Volume Pair Volume List, select and right-click the pair, and then select the **Delete** command in the menu.
5. Select the desired copy pace from the **Copy Pace** drop-down list.
6. Select the resync type for each pair from the **Resync Type** drop-down list.



WARNING: Make sure to select the correct resync direction.



Cautions:

- If you do not want to resynchronize the S-VOL and T-VOL after the quick restore operation, you must set the Swap&Freeze option before performing the quick restore operation (see Swap&Freeze Option and Setting Options).
 - If the reverse copy or quick restore operation is performed on one Siz pair in a 1-to-n configuration ($n > 1$), the S-VOL and the other T-VOLs are no longer synchronized.
-
- Reverse and quick restore operations cannot be performed on pairs in the *V-Split* or Suspended status.
 - When a quick restore operation is in progress, the Storage Navigator window may display old configuration information on components such as volumes. The window may display configurations before the quick operation is performed. To update configuration information on the Storage Navigator window, wait until the quick restore operation completes and then click **File** and then **Refresh** on the menu bar of the window.
7. Click **OK** to reflect the settings to the **Preview List** on the Pair Operation window.
If you try to perform the quick restore operation to the pair you select from the Resynchronize Volume Pair Volume List that is composed of volumes stored in multiple cache logical partitions (CLPRs), a message asking you whether you want to click **OK** and continue the operation will appear. Click **OK** if you do, or click **Cancel** if you wish to discontinue the quick restore operation.
 8. Repeat steps 6 through 7 until the **Preview List** on the Pair Operation window displays the desired pairs (settings).

9. Confirm that the T-VOL(s) are offline before starting resync operations.
10. On the Pair Operation window, click **Apply** to resynchronize the specified pair(s).

The Pair Operation window will then display the result(s) of the Resync Pair operation(s) (i.e., pair status changed to *resync* or *resync-R*, and then to *duplex*) and the progress (%) of the update copy operation. The pair status will change to *duplex* right away, if the update copy operation is not necessary.



Cautions:

- When reverse or quick restore resync operation ends abnormally, or, Suspend pair is requested during reverse copy or quick restore, the pair status changes to *suspended*. The S-VOL of the *suspended* pair is read/write-enabled for all hosts; however, the data on the S-VOL is not guaranteed. The T-VOL of the suspended pair remains read/write-disabled.
 - Even when reverse or quick restore resync operation ends abnormally, or, Suspend pair is requested during reverse copy or quick restore, the status of other SIz pairs which share the same S-VOL does not change.
 - After a SIz reverse copy or quick restore operation is performed, make sure that the pair status changes to *duplex* before performing a TCz resume pair operation. If you perform the TCz resume pair operation before the pair status changes to *duplex*, the command (resume pair operation) will be rejected.
-

Deleting Pairs

The Delete Volume Pair dialog box (see Figure 6-9) allows you to delete the pair(s). The deleting pair is an operation to stop copying data into the T-VOL of a Siz pair, and set the status of the S-VOL and T-VOL back to Simplex.

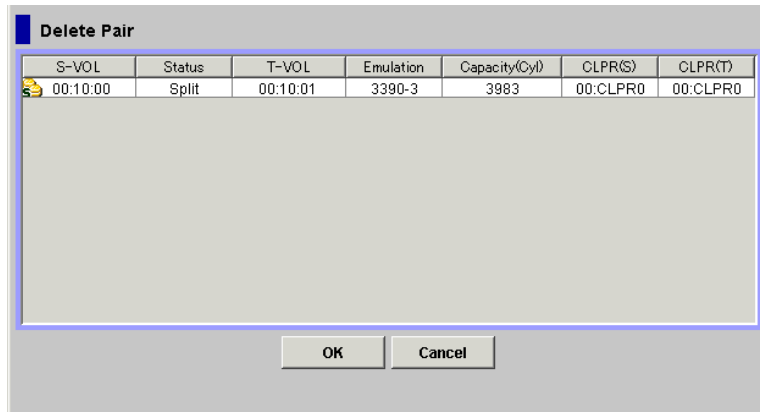


Figure 6-9 Delete Pair Dialog Box

The Delete Pair dialog box consists of the following components.

- Delete Pair Volume List

The Volume List located on the upper side of the Delete Pair dialog box displays the following information pertaining to the S-VOL and T-VOL of the pair you want to delete:

- **S-VOL:** The LDKC:CU:LDEV of the S-VOL.

An LDEV number that ends with a pound or gate symbol (#) indicates that the LDEV is an external volume (e.g., 00:00:01#). For details regarding the external volumes, see the *Universal Volume Manager User's Guide*.

- **Status:** The pair status displays.
- **T-VOL:** The LDKC:CU:LDEV of the T-VOL.

An LDEV number that ends with a pound or gate symbol (#) indicates that the LDEV is an external volume (e.g., 00:00:01#). For details regarding the external volumes, see the *Universal Volume Manager User's Guide*.

- **Emulation:** The emulation type of the S-VOL and T-VOL.
- **Capacity(Cyl):** The number of cylinders assigned to the volume.
- **CLPR(S):** The cache logical partition of the S-VOL.
- **CLPR(T):** The cache logical partition of the T-VOL.

- The **OK** button adds the operation setting(s) to delete the selected pair(s) displayed in the Delete Volume Pair Volume List to the **Preview List** on the Pair Operation window.

You must click **Apply** on the Pair Operation window to apply the Delete Volume Pair operation setting(s) displayed in the **Preview List** to the storage system.

- The **Cancel** button cancels the operations set in the Delete Pair dialog box and closes the dialog box.

To delete one or more SIZ pairs, follow the procedure below:

1. If you want to synchronize the S-VOL and T-VOL before deleting the pair:
 - a. Wait until all write I/Os from the host to the S-VOL are complete.
 - b. Set the S-VOL offline from the host to prevent the S-VOL from being updated during or after the Delete Volume Pair operation.
 - c. After the S-VOL is offline, suspend the pair to copy all pending updates to the T-VOL.

When the pair status changes to *Split*, the S-VOL and T-VOL are synchronized.

2. Go to the Pair Operation window, and select the desired CU image or S-VOL in the Tree to filter the volumes displayed in the Volume List.
3. Select the pair(s) that you want to delete (or the volume(s) whose pairs you want to delete), right-click while selecting the pair(s), and then select the **Delete Pair** command from the menu that appears by right-clicking.

The Delete Pair dialog box will be displayed.

4. On the Delete Pair dialog box, select the pair(s) you want to delete, and click **OK** to reflect the settings to the **Preview List** on the Pair Operation window.

To remove a pair in the Delete Volume Pair Volume List, select and right-click the pair you want to delete, and then select the Delete command in the menu.

5. On the Pair Operation window, click **Apply** to delete the specified pair(s) or volume(s).

The operation settings displayed in the Delete Pair dialog box will be applied to the system and the Pair Operation window will display the result(s) of the Delete Pair operation(s).

Viewing Detailed Volume and Pair Information

The Detail dialog box (see Figure 6-10) displays information for the selected volume or pair.

To display the Detail dialog box:

1. Select a volume or a SIz pair from the Volume List of the Pair Operation window.
2. Right-click the selected volume or pair.
A menu will be displayed.
3. Select the **Detail** command from the menu.
The Detail dialog box displays.

If the S-VOL of the selected pair has two or three T-VOLs that share the same S-VOL, all T-VOLs are displayed on the Detail dialog box.

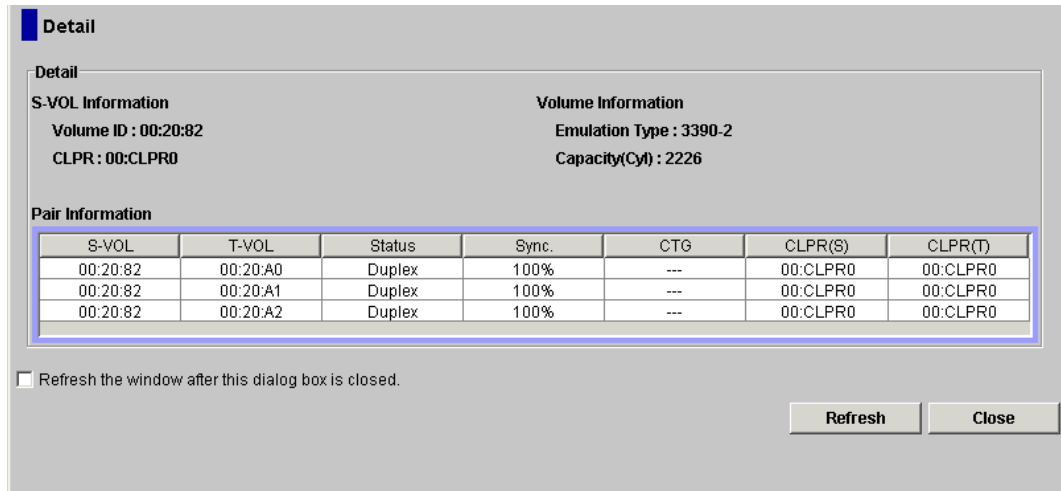


Figure 6-10 Detail Dialog Box

The **Detail** box in the Detail dialog box has the following features:

- The **S-VOL Information** displays the following information:
 - **Volume ID:** The information of the S-VOL displays in XX:YY:ZZ (LDKC number: CU number: LDEV number) format.
An LDEV number that ends with a pound or gate symbol (#) indicates that the LDEV is an external volume (e.g., 00:00:01#). For details regarding the external volumes, see the *Universal Volume Manager User's Guide*.
 - **CLPR:** The cache logical partition of the S-VOL displays.

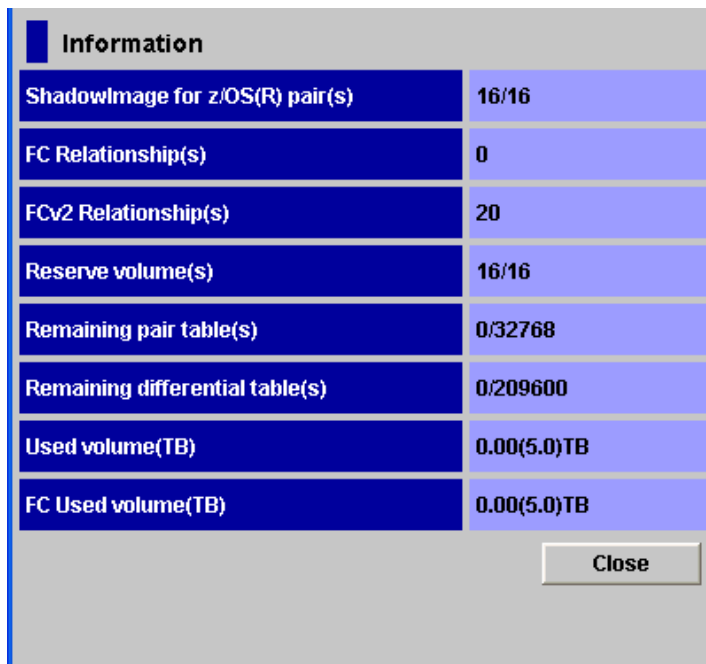
- The **Volume Information** displays the following information:
 - **Emulation Type:** The emulation type of the volume displays.
 - **Capacity(Cyl):** The volume capacity in cylinders displays.
- The **Pair Information** box displays the following information:
 - **S-VOL:** The S-VOL information displays in *XX:YY:ZZ* (LDKC number: CU number: LDEV number) format.
 - **T-VOL:** The T-VOL information displays in *XX:YY:ZZ* (LDKC number: CU number: LDEV number) format.
 - **Status:** The status of the pair displays. For detailed information about the pair status, see Table 2-2.
 - **Sync.:** The rate of synchronization of the S-VOL and the T-VOL.
 - **CTG:** The consistency group ID displays when the pair is registered to the consistency group. If the pair is not registered in the consistency group, dashes (---) display.
 - **CLPR(S):** The information of the CLPR where the S-VOL belongs displays in *AA:BBB* (CLPR number: CLPR name) format.
 - **CLPR(T):** The information of the CLPR where the T-VOL belongs displays in *AA:BBB* (CLPR number: CLPR name) format.
- **Refresh the window after this dialog box is closed.** check box: If you select the check box, the information displayed in the Pair Operation window will be updated after the Detail dialog box closes. If you do not select the check box, the information in the Pair Operation window will be the same before and after you close the Detail dialog box.
- The **Refresh** button updates the setting to the latest information displayed on the Detail dialog box.
- The **Close** button closes the Detail dialog box.

Viewing the Number of Pairs and License Information

The Information dialog box displays information such as the number of pairs in the storage system, the number of reserved volumes, and the license capacity.

To display the Information dialog box:

1. Right-click anywhere on the volume list of the Pair Operation window.
A menu will be displayed.
2. Click the **Information** command in the menu.
The Information dialog box displays (see Figure 6-11).



Information	
ShadowImage for z/OS(R) pair(s)	16/16
FC Relationship(s)	0
FCv2 Relationship(s)	20
Reserve volume(s)	16/16
Remaining pair table(s)	0/32768
Remaining differential table(s)	0/209600
Used volume(TB)	0.00(5.0)TB
FC Used volume(TB)	0.00(5.0)TB

Close

Figure 6-11 Information Dialog Box

The following information displays in the Information dialog box:

- **ShadowImage for z/OS(R) pair(s)**

The number of SIz pairs displays in the format of XXXX / YYYY. XXXX indicates the number of SIz pairs, and YYYY indicates the total number of SIz pair tables, and ShadowImage pair tables.

- The maximum number of pairs that can be created in one storage system is 16,384, including migration plans and relationships. Therefore, if Copy-on-Write Snapshot pairs, migration plans of Volume Migration, and relationships of Compatible Mirroring for IBM FlashCopy Version 1 and Compatible Mirroring for IBM FlashCopy Version 2 are created in the same storage system, the maximum number of pairs that you can create may be less than 16,384 minus YYYY.

- When the volume size is large, ShadowImage for z/OS uses multiple pair tables per one pair. Therefore, sometimes you cannot create 16,384 pairs. For information about the number of pairs and the pair tables, see Calculating Maximum Number of Pairs.
- **FC Relationship(s)**
The number of Compatible Mirroring for IBM FlashCopy Version 1 relationships displays.
- **FCv2 Relationship(s)**
The number of Compatible Mirroring for IBM FlashCopy Version 2 relationships displays.
- **Reserved volume(s)**
The number of reserved volumes of ShadowImage for z/OS will be displayed in the format of XXXX / YYYY. XXXX indicates the number of reserved volumes of ShadowImage for z/OS, YYYY indicates the total number of reserved volumes of ShadowImage for z/OS and ShadowImage. Reserved volumes include T-VOLs of ShadowImage for z/OS and ShadowImage pairs.
- **Remaining pair table(s)**
The number of remaining pair tables in the disk subsystem displays on the left side of the slash (/). The total number of pair tables in the disk subsystem will be displayed on the right side of the slash (/). For information about the total number of pair tables in the disk subsystem, see Calculating Maximum Number of Pairs.
- **Remaining differential table(s)**
The number of remaining differential tables in the disk subsystem will be displayed on the left side of the slash (/). The total number of differential tables in the disk subsystem displays on the right side of the slash (/). For information about the total number of differential tables in the disk subsystem, see Calculating Maximum Number of Pairs.
- **Used volume (TB)**
License information of ShadowImage for z/OS will be indicated in the format of X(Y). X indicates license capacity used by ShadowImage for z/OS, and Y indicates total license capacity reserved for ShadowImage for z/OS. **Unlimited** displays when there is no limited license capacity for ShadowImage for z/OS.
- **FC Used volume (TB)**
License information of Compatible FlashCopy Version 1 displays. For details, see the *Compatible Mirroring for IBM FlashCopy User's Guide*.
- **Close button**
Closes the Information dialog box.

Viewing Pair Operations History

The History window (Figure 5-4) displays history of SIz operations.

To see the history:

1. Display the History window.
 - If you are already displaying the other window shown by a tab, click the **History** tab. For information about how to display the History window by starting up Storage Navigator, see Starting ShadowImage for z/OS.
 - If some of the pairs include LUSE volumes, or if the total number of the following pairs and migration plans is 500 or more in the storage system, you may need to wait for a while until the History window displays operation history.
 - ShadowImage for z/OS pairs
 - Compatible Mirroring for IBM FlashCopy Version 1 relationships
 - Compatible Mirroring for IBM FlashCopy Version 2 relationships
 - ShadowImage pairs
 - Copy-on-Write Snapshot pairs
 - Migration plans of Volume Migration
2. Refer to the **ShadowImage for z/OS(R) History** list in the upper area of the History window.
3. To change the displaying order, click a column title in the list. The list will be sorted based on the items in the clicked column.
 - If there are more than 16,384 records of operations, the list will be divided into multiple pages and only the list which is currently displayed will be sorted.
 - If you click the same column title again, you can switch the sorting order (Ascending or Descending).
4. If the information on the list is not updated, click **File**, and then **Refresh** on the menu bar of the Storage Navigator main window. The list will be updated to the latest information.

For operations involving the copying process, the History window does not display information about the operations until the copying process starts. If you perform an operation on a pair before the copying process starts, the History window will not display information about the operation.

If there are many records of operations, click the scroll button.

5. The list will scroll and you will be able to see the operation history that has not been displayed.

If you click and drag down the frame border which divides the History window into upper and lower panes, you can expand the display area of the list.
6. If there are more than 16,384 records of operations, click **Next**.

The list displays subsequent records of operations.

- If you click **Previous**, the list switches to the previous page.
- If there are 16,384 or fewer records of operations, you cannot click **Previous** and **Next**.
- The storage system saves up to 524,288 records of latest operations.

Using Hitachi Business Continuity Manager

This chapter provides a brief description of using Hitachi Business Continuity Manager to perform ShadowImage for z/OS pair operations.

- [Command Device for Business Continuity Manager](#)
- [Business Continuity Manager CLI Commands that Correspond to the PPRC Commands](#)

Business Continuity Manager and PPRC can both be used to perform the same SIz pair operations. However, since Business Continuity Manager and PPRC are independent functions, do not use them in combination to perform the SIz pair operations.

Command Device for Business Continuity Manager

ShadowImage for z/OS supports Business Continuity Manager CLI commands to enable you to perform ShadowImage pair operations and view ShadowImage pair status. For detailed information on using Business Continuity Manager features, see the user documentation for Business Continuity Manager.

To use the Business Continuity Manager CLI commands, you need to assign a volume as the command device for Business Continuity Manager separately from the command device used for the open system. The volume used as the command device for Business Continuity Manager can only be assigned by employing relevant Business Continuity Manager features. For further information about the command device used for Business Continuity Manager, see the *Business Continuity Manager User and Reference Guide*.

Business Continuity Manager CLI Commands that Correspond to the PPRC Commands

Table 7-1 lists the Business Continuity Manager CLI commands that correspond to the PPRC commands that can be used to perform the SIZ pair operations. For further information on the PPRC commands, see Chapter 7. For further information on Business Continuity Manager, see the *Business Continuity Manager User and Reference Guide*.

Table 7-1 Business Continuity Manager CLI Commands Corresponding to the PPRC Commands

PPRC Commands	Parameter	Business Continuity Manager Commands	Support Method (parameter/config)
CESTPAIR	DEVN	YKMAKE/ YKRESYNC	config
	PRIM		config
	SEC		config
	MODE		The command used for add pair operation differs from the one used for resync pair operation.
	PACE		config (CopyPace)
	MSGREQ		Not supported
	ONLINSEC		Not supported
CSUSPEND	DEVN	YKSUSPND	config
	PRIM		config
	SEC		config
	QUIESCE		Not supported
CDELPAIR	DEVN	YKDELETE	config
	PRIM		config
	SEC		config
CQUERY	DEVN	YKQUERY	config



Performing ShadowImage for z/OS Pair Operations Using PPRC

This chapter provides instructions for performing ShadowImage for z/OS operations issuing TSO PPRC and ICKDSF PPRCOPY commands to the USP V/VM from the mainframe host.

- [PPRC Command Support](#)
- [PPRC Command Requirements](#)
- [PSF and DEVSERV Commands](#)
- [Adding Pairs Using PPRC Commands](#)
- [Splitting Pairs Using PPRC Commands](#)
- [Resynchronizing Pairs Using PPRC Commands](#)
- [Deleting Pairs Using PPRC Commands](#)
- [Displaying Pair Status Using PPRC Commands](#)

This document does not provide complete instructions for using the PPRC commands. For detailed information on using the PPRC TSO and ICKDSF commands, please see the IBM user documents.

This document call TSO PPRC command and ICKDSF PPRCOPY command “PPRC command”.

PPRC Command Support

Table 8-1 lists and describes the PPRC commands supported by ShadowImage for z/OS.

Table 8-1 PPRC Commands Available for Siz

TSO Command	ICKDSF Command	Function	Specified Volume
CESTPAIR	PPRCOPY ESTPAIR	Adds a pair, starts initial copy operation, and changes status to duplex.	<i>Simplex</i> volume that to be the S-VOL.
CESTPAIR	PPRCOPY ESTPAIR	Adds and simultaneously splits a pair.	<i>Simplex</i> volume that to be the S-VOL.
CSUSPEND	PPRCOPY SUSPEND	Splits a pair, starts quick split operation.	<i>Duplex or pending S-VOL.</i>
CSUSPEND	PPRCOPY SUSPEND	Splits a pair, starts steady split operation.	<i>Duplex or pending S-VOL.</i>
CESTPAIR	PPRCOPY ESTPAIR	Resynchronizes a pair, starts normal resync.	<i>Split, V-split or suspended S-VOL.</i>
CESTPAIR	PPRCOPY ESTPAIR	Resynchronizes a pair, starts quick resync.	<i>Split, V-split or suspended S-VOL.</i>
CESTPAIR	PPRCOPY ESTPAIR	Resynchronizes a pair, starts reverse copy.	<i>Split S-VOL.</i>
CESTPAIR	PPRCOPY ESTPAIR	Resynchronizes a pair, starts quick restore.	<i>Split S-VOL.</i>
CDELPAIR	PPRCOPY DELPAIR	Deletes a pair, changes status to simplex.	Other than <i>simplex S-VOL.</i>
CQUERY	PPRCOPY QUERY	Displays detailed pair status information.	Any volume status is OK.

- You cannot set or reset the reserve attribute by using the PPRC commands. To set or reset the reserve attribute, use the Storage Navigator computer.
- The ShadowImage for z/OS suspend operations cannot be requested using the PPRC commands. The CSUSPEND/PPRCOPY SUSPEND commands execute split operations on ShadowImage for z/OS pairs. Use the Storage Navigator computer to suspend SIZ pairs.
- If you issue the ESTPAIR or the SUSPEND command to a Pending volume, the command will abnormally end by reporting CC = 12.
- CRECOVER command is not supported by ShadowImage for z/OS. When you try to execute the CRECOVER command on the SIZ S-VOL, the command ends normally and the SIZ pair will be deleted. If you execute the command on the SIZ T-VOL, the command will be rejected and end abnormally by reporting CC = 8.
- CGROUP command is not used for ShadowImage for z/OS. For information on the CGROUP command, see the TrueCopy for IBM z/OS User's Guide.
- PPRCOPY RECOVER command is not supported by ShadowImage for z/OS. If you execute the command on the SIZ volume, the command will be rejected and end by reporting CC = 8.

PPRC Command Requirements

To perform the PPRC commands on SIZ pairs, all of the following conditions must be met. Since both ShadowImage for z/OS and TrueCopy for z/OS support the PPRC commands, if any of these conditions is not met, the PPRC command will be executed by TrueCopy for z/OS against TCz pairs.

- The ShadowImage for z/OS feature and software must be installed and enabled on the USP V/VM storage system.
- The serial numbers of the S-VOL and the T-VOL must be defined according to either of the following:
 - Enter the same serial number for both S-VOL and T-VOL.
 - Enter an additional parameter instead of the serial number for the S-VOL, and enter the serial number for the T-VOL.

PSF and DEVSERV Commands

The perform storage system function (PSF) commands key the USP V/VM storage system to accept commands and requests from the user. Table 8-2 describes the operability of the PSF commands on SIz volumes.

Table 8-2 PSF Command Operability for ShadowImage for z/OS Volumes

Item	Operability for ShadowImage for z/OS
Device pair status.	See Table 8-3.
Percent completion of the copy operation.	Not available for ShadowImage for z/OS, because the SIz differential bitmap format is different than the TCz differential bitmap format.
S-VOL with 2 or more T-VOLs.	Displays information for the pair having the T-VOL with the lowest LDEV ID.
Path status.	Active.
Path number.	If the volume does not also belong to a TCz pair, 1 is displayed with TCz info.

Table 8-3 describes the PSF Read Subsystem Data and DEVSERV Sense Subsystem Status results for SIz volumes.

Table 8-3 PSF and DEVSERV Results for ShadowImage for z/OS Volumes

Pair Status	PSF Read Subsystem Data		DEVSERV Sense Subsystem Status	
	S-VOL	T-VOL	S-VOL	T-VOL
Pending	PPRI-PNDG	PSEC-PNDG	PPRI-PNDG	PSEC-PNDG
Duplex	PPRIMARY	PSECONDRY	PPRIMARY	PSECONDRY
SP-Pend	PPRI-PNDG	PSEC-PNDG	PPRI-PNDG	PSEC-PNDG
V-Split	PPRI-SUSP	PSEC-SUSP	PPRI-SUSP	SIMPLEX
Split	PPRI-SUSP	PSEC-SUSP	PPRI-SUSP	SIMPLEX
Suspend	PPRI-SUSP	PSEC-SUSP	PPRI-SUSP	PSEC-SUSP
Resync	PPRI-PNDG	PSEC-PNDG	PPRI-PNDG	PSEC-PNDG

Note: PPRIMARY and PSECONDRY indicate that the volume is in the *duplex* state.

Figure 8-1 shows an example of the DEVSERV command.

```

97244 13:04:37.39      DS P,DE80,1
97244 13:04:38.57      IEE459I 13.04.37 DEVSERV PATHS 692
                          692 UNIT DTYPE M CNT VOLSER CHPID=PATH STATUS
                          692          RTYPE  SSID CFW TC DFW PIN DC-STATE CCA DCA
                          692 DE80,33903 ,0,000,DKDE80,54=+ 1C=+ D4=+ 9C=+
                          692                               0080 Y YY. YY. N PPRIMARY 00 00
  
```

Figure 8-1 DEVSERV Command

Adding Pairs Using PPRC Commands

The CESTPAIR and PPRCOPY ESTPAIR commands are equivalent to the SIZ add pair operation. The CESTPAIR and PPRCOPY ESTPAIR commands must be issued to the S-VOL of the pair being created, and the T-VOL must be offline to the host before these commands are issued.

This section describes the parameters and examples of the CESTPAIR and the PPRCOPY ESTPAIR command.

CESTPAIR (Adding Pairs)

Table 8-4 lists and describes the CESTPAIR command parameters that can be used when you create SIZ pairs.

Table 8-4 CESTPAIR Command Parameters (Adding Pairs)

Parameter	Value	Description
DEVN	Device number.	
PRIM	Primary volume (S-VOL): SSID, serial number, channel connection address, and CU number ^{*1} . You must set MSFOO instead of a serial number if you want to request the Add and Split operation. This parameter is valid for MODE(COPY) or MODE(NOCOPY) only. You must set MAnnO instead of a serial number if you create SIZ pairs in the consistency group. nn is a CTG ID.	If you set a parameter other than the parameters on the left, the command will be rejected.
SEC	Secondary volume (T-VOL): SSID, serial number, channel connection address, and CU number ^{*1} .	
MODE	COPY NOCOPY	When you perform CESTPAIR command on SIZ, no matter whether you specify COPY or NOCOPY for the MODE parameter, the storage system recognizes it as COPY mode. Therefore, initial full-volume copy will be performed.

Parameter	Value	Description
PACE	1	Copy speed will be slow, except when the DKC emulation type is 2105 or 2107. When the DKC emulation type is 2105 or 2107, the copy speed is always medium regardless what you specify for the PACE parameter.
	other than 1	Copy speed will be medium.
CRIT	Not applicable.	SIz does not use this parameter. SIz ignores it.
MSGREQ	YES	MSGREQ function is applicable. Note that you cannot use the MSGREQ function when the Add and Split operation is required. If you specify YES for this parameter when the Add and Split operation is required, the command will be rejected and end abnormally by reporting CC = 8.
	NO	MSGREQ function is not applicable.
ONLINSEC ^{*2*} ₃	YES	Pair create operation will be performed whether the T-VOL is online or not.
	NO	Pair create operation will not be performed if the T-VOL is online.
<p>*1: CU number is valid only for the DKC emulation type 2105 or 2107.</p> <p>*2: When you do not specify the parameter, the result is same as when you specify NO for this parameter.</p> <p>*3: The ONLINSEC parameter is valid only for the DKC emulation type 2105 or 2107.</p>		

If you specify NOCOPY for the MODE parameter and YES for the MSGREQ parameter, the CESTPAIR command will end before the copying operation is completed.

Figure 8-2 shows an example of the CESTPAIR command.

```
CESTPAIR  DEVN (X 'DE80' )  PRIM (X '0080' ,30158,X '00' )  SEC (X '0080' ,30158,X '01' )
          MODE (COPY)  PACE (15)
```

Figure 8-2 CESTPAIR Command

ESTPAIR (Adding Pairs)

Table 8-5 lists and describes the ESTPAIR command parameters that can be used when you create SIZ pairs.

Table 8-5 ESTPAIR Command Parameters (Adding Pairs)

Parameter	Value	Description
DDNAME, SYSNAME, or UNITADDRESS	DDNAME = <i>dname</i> = JCL statement identifying the volume. SYSNAME = <i>sysxxx</i> = SYSNAME in the ASSGN system control statement. UNITADDRESS = <i>ccuu</i> = device number.	You should specify only one parameter of the three parameters. The italic part on the left means that it is the arbitrary name. For example, <i>dname</i> means the arbitrary unique name of the JCL statement which identifies the volume.
PRI	Primary volume (S-VOL): SSID, serial number, and channel connection address. You must set MSFOO instead of a serial number if you want to request the Add and Split operation. This parameter is valid for MODE(COPY) or MODE(NOCOPY) only. You must set MAnnO instead of a serial number if you create SIZ pairs in the consistency group. nn is a CTG ID.	If you set a parameter other than the parameters on the left, the command will be rejected.
SEC	Secondary volume (T-VOL): SSID, serial number, and channel connection address.	
MODE	COPY NOCOPY	When you perform ESTPAIR command on SIZ, no matter whether you specify COPY or NOCOPY for the MODE parameter, the storage system recognizes it as COPY mode. Therefore, initial full-volume copy will be performed.
PACE	1	Copy speed will be slow, except when the DKC emulation type is 2105 or 2107. When the DKC emulation type is 2105 or 2107, the copy speed is always medium regardless what you specify for the PACE parameter.
	Other than 1	Copy speed will be medium.
CRIT	Not applicable.	SIZ does not use this parameter. SIZ ignores it.
MSGREQ	YES	If you specify this parameter when MODE(RESYNC) is set, the command ends abnormally by reporting CC = 12. So, please do not specify this parameter when MODE(RESYNC) is set.
	NO	
LSS	Primary volume CU number ^{*1} , or secondary volume CU number ^{*1} .	
ONLINSEC ^{*2}	YES	Pair create operation will be performed whether the T-VOL is online or not.

Parameter	Value	Description
	NO	Pair create operation will not be performed if the T-VOL is online.
<p>*1: CU number or the parameter is valid only for the DKC emulation type 2105 or 2107.</p> <p>*2: When you do not specify the parameter, the result is same as when you specify NO for this parameter.</p>		

Figure 8-3 shows an example of the PPRCOPY ESTPAIR command.

```
//EPAIR      JOB
//           EXEC  PGM=ICKDSF
//SYSPRINT   DD  SYSOUT=*
//DD1        DD  UNIT=SYSDA,DISP=SHR,VOL=SER=DKDE80
//SYSIN      DD  *
PPRCOPY     ESTPAIR DDNAME(DD1) PRI(X'0080',30158,X'00') SEC(X'0080',30158,X'01')
              MODE(COPY) PACE(15)
/*
//
```

Figure 8-3 PPRCOPY ESTPAIR Command

Splitting Pairs Using PPRC Commands

The CSUSPEND and PPRCOPY SUSPEND commands are equivalent to the ShadowImage for z/OS split pair operation. The CSUSPEND and the PPRCOPY SUSPEND commands must be issued to the S-VOL, and the pair status must be *duplex*.

This section describes the parameters and examples of the CSUSPEND and the PPRCOPY SUSPEND command.

CSUSPEND

Table 8-6 lists and describes the CSUSPEND command parameters that can be used when you split SIZ pairs.

Table 8-6 CSUSPEND Command Parameters

Parameter	Value	Description
DEVN	Device number.	
PRIM	Primary volume (S-VOL): SSID, serial number, channel connection address, and CU number ^{*1} . You can set MPS00 or MAnn0 instead of a serial number. nn is a CTG ID.	The parameter MPS00 is for a steady split request. The parameter MAnn0 is for a quick split request on all pairs in a consistency group. If you set a parameter other than the serial number, MPS00 or MAnn0 , the command will be rejected.
SEC	Secondary volume (T-VOL): SSID, serial number, channel connection address, and CU number ^{*1} .	
PRIMARY	Not applicable.	SIZ does not use this parameter. SIZ ignores it.
QUIESCE ^{*2}	See ^{*3}	See ^{*3} , however, see the IBM document for important information.
<p>^{*1}: The CU number or the parameter is valid only for the DKC emulation type 2105 or 2107. ^{*2}: The parameter is valid only for the DKC emulation type 3390. If the DKC emulation type is 2105 or 2107, the TSO command ignores the parameter and the ICKDSF job ends abnormally (CC = 12). ^{*3}: The CSUSPEND QUIESCE option has been disabled by APAR OW15247 or APAR OW15248. See either of these APARs and the latest IBM PPRC documentation for detailed information on the QUIESCE option. Please check with your Hitachi account team before using the QUIESCE option with the USP V/VM storage system. If the QUIESCE option is issued to certain volumes (e.g., active SPOOL, PAGE, or CATALOG datasets, active SYSRES volume), the attached host(s) may enter a deadlock condition and may require a storage control IML to correct the condition.</p>		

The QUIESCE parameter is used to modify the functionality of the CSUSPEND TSO command. For example, if the QUIESCE parameter is specified, the pair will be quiescent and subsequent write requests to the S-VOL will be suspended by the host until the QUIESCE condition is released.

You can use QUIESCE parameter to the SIZ pairs only when the pair status is *duplex*. If a SIZ S-VOL has more than one T-VOL, the QUIESCE parameter is effective if at least one pair is specified. Write requests at the S-VOL will start when all QUIESCE conditions are released. The following conditions cause the USP V/VM storage system to automatically release the QUIESCE condition:

- A CSUSPEND TSO command without the QUIESCE parameter is accepted.
- A CDELPAIR TSO command is accepted.
- A Delete, Suspend, or Split Pair command (from the Storage Navigator computer) is accepted.
- Storage system power-on-reset is executed.

If a ShadowImage for z/OS pair is suspended because of an internal storage system error condition, the QUIESCE option is applied. In this case, release the QUIESCE condition by deleting the pair.

SIZ and TCz are processed independently. The CSUSPEND/QUIESCE command is effective for either the SIZ or TCz pair specified in the command.

Figure 8-4 shows an example of the CSUSPEND command.

```
CSUSPEND DEVN (X 'DE80' ) PRIM (X '0080' ,30158,X '00' ) SEC (X '0080' ,30158,X '01' )
```

Figure 8-4 CSUSPEND Command

SUSPEND

Table 8-7 lists and describes the SUSPEND command parameters that can be used when you split SIZ pairs.

Table 8-7 SUSPEND Command Parameters

Parameter	Value	Description
DDNAME, SYSNAME, or UNITADDRESS	DDNAME = <i>dname</i> = JCL statement identifying the volume. SYSNAME = <i>sysxxx</i> = SYSNAME in the ASSGN system control statement. UNITADDRESS = <i>ccuu</i> = device number.	You should specify only one parameter of the three parameters. The italic part on the left means that it is the arbitrary name. For example, <i>dname</i> means the arbitrary unique name of the JCL statement which identifies the volume.
PRI	Primary volume (S-VOL): SSID, serial number, and channel connection address. You can set MPS00 or MAnn0 instead of a serial number. nn is a CTG ID.	The parameter MPS00 is for a steady split request. The parameter MAnn0 is for a quick split request on all pairs in a consistency group.*4 If you set a parameter other than the serial number, MPS00 or MAnn0 , the command will be rejected.

Parameter	Value	Description
SEC	Secondary volume (T-VOL): SSID, serial number, and channel connection address.	
PRIMA	Not applicable.	Siz does not use this parameter. Siz ignores it.
QUIESCE*2	See *3.	See *3. However, see the IBM document for important information.
LSS	Primary volume CU number and secondary volume CU number*1.	

*1: CU number or the parameter is valid only for the DKC emulation type 2105 or 2107.

*2: The parameter is valid only for the DKC emulation type 3390. If the DKC emulation type is 2105 or 2107, the TSO command ignores the parameter and the ICKDSF job ends abnormally (CC = 12).

*3: The CSUSPEND QUIESCE option has been disabled by APAR OW15247 or APAR OW15248. See either of these APARs and the latest IBM PPRC documentation for detailed information on the QUIESCE option. Please check with your Hitachi account team before using the QUIESCE option with the USP V/VM storage system. If the QUIESCE option is issued to certain volumes (e.g., active SPOOL, PAGE, or CATALOG datasets, active SYSRES volume), the attached host(s) may enter a deadlock condition and may require a storage control IML to correct the condition.

*4: If you perform a quick split request on all pairs in a consistency group, confirm that the status of all pairs in the group is DUPLEX. If there are one more pairs whose statuses are PENDING in the group, the quick split operation sometimes ends abnormally (CC = 12). If this occurs, wait until the copy operation for the pair ends.

Figure 8-5 shows an example of the PPRCOPY SUSPEND command.

```
//EPAIR      JOB
//          EXEC  PGM=ICKDSF
//SYSPRINT DD  SYSOUT=*
//DD1      DD  UNIT=SYSDA,DISP=SHR,VOL=SER=DKDE80
//SYSIN    DD  *
PPRCOPY   SUSPEND DDNAME(DD1) PRI(X'0080',30158,X'00') SEC(X'0080',30158,X'01')
/*
//
```

Figure 8-5 PPRCOPY SUSPEND Command

Resynchronizing Pairs Using PPRC Commands

The CESTPAIR and PPRCOPY ESTPAIR commands is equivalent to the ShadowImage for z/OS normal resync operation. The CESTPAIR and PPRCOPY ESTPAIR commands must be issued to the S-VOL, and the pair status must be *split* or *suspend* when you resynchronize pairs.

CESTPAIR (Resynchronizing Pairs)

Table 8-8 lists and describes the CESTPAIR command parameters that can be used when you resynchronize SIZ pairs.

Table 8-8 CESTPAIR Command Parameters (Resynchronizing Pairs)

Parameter	Value	Description
DEVN	Device number.	
PRIM	<p>Primary volume (S-VOL): SSID, serial number, channel connection address, and CU number*¹.</p> <p>You can set an additional parameter corresponding to each request instead of a serial number.</p> <p>For a Quick Resync request, set MRFOO. This parameter is valid for MODE(RESYNC) only.</p> <p>For a Quick Restore request, set MRQOO. This parameter is valid for MODE(RESYNC) only.</p> <p>For a Reverse Copy request, set MRR00. This parameter is valid for MODE(RESYNC) only.</p> <p>For a Resync request on all pairs in a consistency group, set MAnn0. nn is a CTG ID. This request triggers a normal Resync operation.</p>	<p>If you set a parameter other than the parameters on the left, the command will be rejected.</p>
SEC	Secondary volume (T-VOL): SSID, serial number, channel connection address, and CU number* ¹ .	
MODE	RESYNC	Re-establish a split or suspended volume pair. This parameter is required.
PACE	1	Copy speed of resynchronization will be slow, except when the DKC emulation type is 2105 or 2107. When the DKC emulation type is 2105 or 2107, the copy speed of resynchronization is always medium regardless what you specify for the PACE parameter.
	Other than 1	Copy speed of resynchronization will be medium.
CRIT	Not applicable.	SIZ does not use this parameter. SIZ ignores it.

Parameter	Value	Description
MSGREQ	YES	MSGREQ function is applicable. For a Resync request on all pairs in a consistency group, do not use the MSGREQ function. If you use the MSGREQ function, the job will end abnormally and "CC = 8" will be reported.
	NO	MSGREQ function is not applicable.
ONLINSEC ^{*1*} ₂	YES	Pair resynchronize operation (forward) will be performed whether the T-VOL is online or not. Pair resynchronize operation (backward) will be performed whether the S-VOL and T-VOL are online or not.
	NO	Pair resynchronize operation (forward) will not be performed if the T-VOL is online . Pair resynchronize operation (backward) will not be performed if the S-VOL and T-VOL are online.
<p>*1: CU number or the parameter is valid only for the DKC emulation type 2105 or 2107.</p> <p>*2: When you do not specify the parameter, the result is same as when you specify NO for this parameter.</p>		

Figure 8-6 shows an example of the CESTPAIR command with the MODE(RESYNC) parameter.

```
CESTPAIR  DEVN (X 'DE80' ) PRIM (X '0080' ,30158,X '00' ) SEC (X '0080' ,30158,X '01' )
          MODE (RESYNC) PACE (15)
```

Figure 8-6 CESTPAIR with MODE(RESYNC) Parameter

ESTPAIR (Resynchronizing Pairs)

Table 8-9 lists and describes the ESTPAIR command parameters that can be used when you resynchronize SIZ pairs.

Table 8-9 ESTPAIR Command Parameters (Resynchronizing Pairs)

Parameter	Value	Description
DDNAME, SYSNAME, or UNITADDRESS	DDNAME = <i>dname</i> = JCL statement identifying the volume. SYSNAME = <i>sysxxx</i> = SYSNAME in the ASSGN system control statement. UNITADDRESS = <i>ccuu</i> = device number.	You should specify only one parameter of the three parameters. The italic part on the left means that it is the arbitrary name. For example, <i>dname</i> means the arbitrary unique name of the JCL statement which identifies the volume.
PRI	Primary volume (S-VOL): SSID, serial number, and channel connection address. You can set an additional parameter corresponding to each request instead of a serial number. For a Quick Resync request, set MRFOO . This parameter is valid for MODE(RESYNC) only. For a Quick Restore request, set MRQOO . This parameter is valid for MODE(RESYNC) only. For a Reverse Copy request, set MRROO . This parameter is valid for MODE (RESYNC) only. For a Resync request on all pairs in a consistency group, set MAnnO . <i>nn</i> is a CTG ID. This request triggers a normal Resync operation.	If you set a parameter other than the parameters on the left, the command will be rejected. Caution: When a Quick Restore operation or a Reverse Copy operation is required and if you specify NO for the ONLINSEC parameter, the job will end abnormally by reporting CC = 12. If you specify YES for the ONLINSEC parameter, you may execute the job. However, note that the copying operation is performed without any online check.
SEC	Secondary volume (T-VOL): SSID, serial number, and channel connection address.	
MODE	RESYNC	Re-establish a split or suspended volume pair.
PACE	1	Copy speed of resynchronization will be slow, except when the DKC emulation type is 2105 or 2107. When the DKC emulation type is 2105 or 2107, the copy speed of resynchronization is always medium regardless what you specify for the PACE parameter.
	other than 1	Copy speed of resynchronization will be medium.
CRIT	Not applicable.	SIZ does not use this parameter. SIZ ignores it.
MSGREQ	YES	If you specify this parameter when MODE(RESYNC) is set, the command ends abnormally by reporting CC = 12. So, please do not specify this parameter when MODE(RESYNC) is set.
	NO	

Parameter	Value	Description
LSS	Primary volume CU number*1, or secondary volume CU number*1.	
ONLINESEC*2	YES	Pair resynchronize operation (forward) will be performed whether the T-VOL is online or not. Pair resynchronize operation (backward) will be performed whether the S-VOL and T-VOL are online or not.
	NO	Pair resynchronize operation (forward) will not be performed if the T-VOL is online . Pair resynchronize operation (backward) will not be performed when the status of the volumes are online or offline. The ICKDSF job ends abnormally (CC = 12). Although no error occurs when you specify YES for this parameter, note that the copying operation is performed without any online check.
<p>*1: CU number or the parameter is valid only for the DKC emulation type 2105 or 2107.</p> <p>*2: When you do not specify the parameter, the result is same as when you specify NO for this parameter.</p>		

Figure 8-7 shows an example of the PPRCOPY ESTPAIR command with the MODE(RESYNC) parameter.

```
//EPAIR      JOB
//          EXEC  PGM=ICKDSF
//SYSPRINT  DD  SYSOUT=*
//DD1      DD  UNIT=SYSDA,DISP=SHR,VOL=SER=DKDE80
//SYSIN    DD  *
PPRCOPY   ESTPAIR DDNAME(DD1) PRI(X'0080',30158,X'00') SEC(X'0080',30158,X'01')
          MODE(RESYNC) PACE(15)
/*
//
```

Figure 8-7 PPRCOPY ESTPAIR with MODE(RESYNC) Parameter

Deleting Pairs Using PPRC Commands

The CDELPAIR and PPRCOPY DELPAIR commands are equivalent to the ShadowImage for z/OS delete pair operation. The CDELPAIR and PPRCOPY DELPAIR commands must be issued to the S-VOL.

A DELPAIR command performed when pair status is *split* enables the T-VOL to be accessed by the host. A DELPAIR command performed when pair status is other than *split* allows non-reserved T-VOLs to be accessed by the host. Reserved *simplex* volumes cannot be accessed.



WARNING: For *duplex* SIZ pairs, the S-VOL and its associated T-VOL(s) are usually not identical, because SIZ update copy operations are asynchronous. Therefore, if a pair is deleted with status other than *split*, the data integrity of the T-VOL cannot be guaranteed.

CDELPAIR

Table 8-10 lists and describes the CDELPAIR command parameters that can be used when you delete SIZ pairs.

Table 8-10 CDELPAIR Command Parameters

Parameter	Value	Description
DEVN	Device number.	
PRIM	Primary volume (S-VOL): SSID, serial number, channel connection address, and CU number*. You must set MAnnO instead of a serial number if you delete all SIZ pairs in the consistency group. nn is a CTG ID.	If you set a parameter other than the parameters on the left, the command will be rejected.
SEC	Secondary volume (T-VOL): SSID, serial number, channel connection address, and CU number*.	

*: CU number or the parameter is only valid for the DKC emulation type 2105 or 2107.

Figure 8-8 shows an example of the CDELPAIR command.

```
CDELPAIR  DEVN (X 'DE80' ) PRIM (X '0080' ,30158,X '00' ) SEC (X '0080' ,30158,X '01' )
```

Figure 8-8 TSO Delete Command

DELPAIR

Table 8-11 lists and describes the DELPAIR command parameters that can be used when you delete SIZ pairs.

Table 8-11 DELPAIR Command Parameters

Parameter	Value	Description
DDNAME, SYSNAME, or UNITADDRESS	DDNAME = <i>dname</i> = JCL statement identifying the volume. SYSNAME = <i>sysxxx</i> = SYSNAME in the ASSGN system control statement. UNITADDRESS = <i>ccuu</i> = device number.	You should specify only one parameter of the three parameters. The italic part on the left means that it is the arbitrary name. For example, <i>dname</i> means the arbitrary unique name of the JCL statement which identifies the volume.
PRI	Primary volume (S-VOL): SSID, serial number, and channel connection address. You must set MAnnO instead of a serial number if you delete all SIZ pairs in the consistency group. nn is a CTG ID.	If you set a parameter other than the parameters on the left, the command will be rejected.
SEC	Secondary volume (T-VOL): SSID, serial number, and channel connection address.	
LSS	Primary volume CU number*, and secondary volume CU number*.	
*: CU number or the parameter is valid only for the DKC emulation type 2105 or 2107.		

Figure 8-9 shows an example of the PPRCOPY DELPAIR command.

```
//EPAIR      JOB
//          EXEC  PGM=ICKDSF
//SYSPRINT  DD  SYSOUT=*
//DD1      DD  UNIT=SYSDA,DISP=SHR,VOL=SER=DKDE80
//SYSIN    DD  *
PPRCOPY   DELPAIR DDNAME(DD1) PRI(X'0080',30158,X'00') SEC(X'0080',30158,X'01')
/*
//
```

Figure 8-9 ICKDSF Delete Command

Displaying Pair Status Using PPRC Commands

The CQUERY TSO and PPRCOPY QUERY ICKDSF commands are equivalent to the SIZ pair status display and status and history functions.

ShadowImage for z/OS supports multiple T-VOLs for an S-VOL, and SIZ and TCz can both be defined for the same volume. When multiple pairs exist on one volume, the CQUERY and the PPRCOPY QUERY commands can only report the status of one pair. Table 8-12 lists the status displayed by the host for the SIZ and/or TCz volume pair configurations.

- If the USP V/VM contains only ShadowImage for z/OS pairs, the CQUERY and the PPRCOPY QUERY commands will report the ShadowImage for z/OS pair status.
- If the USP V/VM contains only TrueCopy for z/OS pairs, the CQUERY and the PPRCOPY QUERY commands will report the TCz pair status.
- If the USP V/VM contains both ShadowImage for z/OS and TrueCopy for z/OS pairs, the CQUERY and the PPRCOPY QUERY commands will report the TCz pair status.

To obtain the SIZ pair status, issue the status command to the SIZ T-VOL or use the ShadowImage for z/OS remote console software to view the SIZ pair status.

- If an S-VOL has multiple T-VOLs, the status command will report pair status for the pair whose T-VOL has the lowest LDEV ID. To obtain the status of a ShadowImage for z/OS pair with one of the other T-VOLs, issue the status command to the desired T-VOL (see Table 8-12 and Table 8-13).

Table 8-12 Pair Status Reported by the Host for Volumes in Multiple Pairs

Number of SIZ Pairs	Number of TCz Pairs	Status Displayed by Host
0	0	SIMPLEX
1	0	SIZ pair status
2 or more	0	SIZ pair whose T-VOL has the lowest LDEV ID
0	1	TCz pair status
1	1	TCz pair status
2 or more	1	TCz pair status

Table 8-13 Path Status Displayed by the CQUERY TSO and PPRCOPY QUERY DSF Commands

SIz	TCz	CQUERY TSO Command		PPRCOPY QUERY DSF Command	
		TCz path exists.	No TCz path exists.	TCz path exists.	No TCz path exists.
S-VOL	S-VOL	Displays TCz path	–	Displays TCz path	–
	T-VOL	–	---- ----	–	---- ----
	No volume	–	FFFF FFFF	–	FFFF FFFF
T-VOL	S-VOL	Displays TCz path	–	Displays TCz path	–
	T-VOL	–	–	–	–
	No volume	–	---- ----	–	FFFF FFFF

Note: The symbol dash (–) indicates that the combination is impossible.

Table 8-14 lists the items and contents that will be displayed when you execute the CQUERY command or the QUERY command on a SIz pair.

Table 8-14 Contents that Display when Issuing the CQUERY or the QUERY Command on SIz Pairs

Item	Content
DEVICE	Device number of the volume on which the CQUERY command is issued.
LEVEL	PRIMARY indicates that the volume is an S-VOL. SECONDARY indicates that the volume is a T-VOL.
STATE	Pair status.
PATH STATUS	Since this item is invalid for SIz pairs, "ACTIVE" is always displayed.
CRIT	Since this item is invalid for SIz pairs, "NO" is always displayed.
CGRPLB	Since this item is invalid for SIz pairs, "NO" is always displayed.
PRIMARY-SSID	SSID of the CU where the S-VOL belongs.
PRIMARY-CCA	LDEV number of the S-VOL.
PRIMARY-LSS	CU number of the S-VOL.
PRIMARY-SERIAL	Serial number of the S-VOL.
SECONDARY-SSID	SSID of the CU where the T-VOL belongs.
SECONDARY-CCA	LDEV number of the T-VOL.
SECONDARY-LSS	CU number of the T-VOL.

Item	Content
SECONDARY-SERIAL	<p>Serial number of the T-VOL.</p> <p>If you perform the CQUERY TSO command for the T-VOL, the following information is displayed as well as the serial number of the T-VOL.</p> <p>00ab000nnnnn</p> <p>a:</p> <ul style="list-style-type: none"> ▪ S: This pair is defined as a consistency group. ▪ 0: Other than listed above. <p>b:</p> <ul style="list-style-type: none"> ▪ @: This pair was split by using the At-Time Split function. ▪ 0: Other than listed above. <p>nnnnn: Serial number of the T-VOL.</p>
PATHS	Since this item is invalid for SIz pairs, "1" is always displayed. *
SAID DEST STATUS	Since this item is invalid for SIz pairs, "FFFF FFFF" is always displayed. *
DESCRIPTION	Since this item is invalid for SIz pairs, "PATH ESTABLISH" is always displayed. *
PERCENT OF COPY COMPLETE	Since this item is invalid for SIz pairs, "100%" is always displayed. *
SUBSYSTEM	Since this item is invalid for SIz pairs, the content of this item is also invalid.
WWN	Since this item is invalid for SIz pairs, the content of this item is also invalid.
LIC LEVEL	Since this item is invalid for SIz pairs, the content of this item is also invalid.
<p>* When the MCU-RCU path for TCz is created on the CU where the SIz pair is created, the information about the MCU-RCU path will be displayed. For detailed information about the MCU-RCU path, see the <i>TrueCopy for IBM z/OS User's Guide</i>.</p>	

CQUERY

Table 8-15 lists and describes the CQUERY command parameters that can be used when you refer to the status of SIZ pairs.

Table 8-15 CQUERY Command Parameters

Parameter	Value
DEVN	Device number.

Figure 8-10 shows an example of the CQUERY command.

```

14.27.58 JOB04573 ANTP8802I CQUERY DEVN(6400)
14.27.58 JOB04573 ANTP0090I CQUERY FORMATTED LVL 4 220
220          VOLUME REPORT
220          ***** PPRC REMOTE COPY CQUERY - VOLUME *****
220          *                                     (PRIMARY) (SECONDARY) *
220          *                                     SSID CCA LSS SSID CCA LSS*
220          *DEVICE   LEVEL       STATE     PATH STATUS  SERIAL#    SERIAL#    *
220          *-----  -
220          * 6400  PRIMARY..  DUPLEX...  ACTIVE..   2700 00 00  2700 01 00 *
220          *          CRIT(NO).....  CGRPLB(NO). 000000063515 000000063515*
220          *          INCRS(NO).
220          * PATHS SAID DEST STATUS: DESCRIPTION
220          * -----
220          * 1  FFFF FFFF  01  PATH ESTABLISHED...
220          *          ----  00  NO PATH.....
220          *          ----  00  NO PATH.....
220          *          ----  00  NO PATH.....
220          * SUBSYSTEM          WWNN          LIC LEVEL
220          * -----
220          * PRIMARY...  00000000000000000000          80.9.6.255
220          *****
14.27.59 JOB04573 ANTP0001I CQUERY COMMAND COMPLETED FOR DEVICE 6400. COMPLETION CODE: 00
  
```

Figure 8-10 CQUERY Command

When a command is issued to the target volume (T-VOL) in a consistency group, the field for displaying the serial number of SECONDARY will be outputted in the format shown below.

00 | S | @ | 000 | 30158

Belongs to a consistency group

Split using At-Time Split operation

SECONDARY serial number

Troubleshooting

This chapter provides troubleshooting information for ShadowImage and instructions for calling technical support.

- [Troubleshooting](#)
- [SIM Reporting](#)
- [Calling the Hitachi Data Systems Support Center](#)

Troubleshooting

If you have a problem with the Storage Navigator, see the *Storage Navigator User's Guide* for troubleshooting information.

Table 9-1 provides general troubleshooting instructions for ShadowImage for z/OS operations.

Table 9-1 General ShadowImage for z/OS Troubleshooting

Error	Corrective Action
The Storage Navigator computer hangs, or SIZ operations do not function properly.	<p>Make sure all ShadowImage for z/OS requirements and restrictions are met.</p> <p>Make sure the USP V/VM storage system is powered on and fully functional (NVS, cache, DFW). See the <i>Storage Navigator Messages</i> for operational and troubleshooting information for the USP V/VM storage system.</p> <p>Check all input values and parameters to make sure that you entered the correct information on the ShadowImage for z/OS windows (e.g., S-VOL and T-VOL IDs).</p>
The volume pairs are not displaying correctly.	Make sure the correct CU image is selected.
A SIZ error message is displayed on the Storage Navigator computer.	Storage Navigator displays an error message if an error occurs during SIZ operations. The Error dialog box of SIZ displays the error code and the message (see Figure 9-1).
There is a problem with the Storage Navigator computer.	<p>Save the Java log file on the Storage Navigator computer, and report to the Hitachi Technical Support Center.</p> <p>For Windows 2000, the Java log file is in the following place: c:\Documents and Settings\login user ID\plugin131.trace</p> <p>Exit the Web browser, close all other applications, and then restart the PC. If the problem persists, verify that the PC's operating system and LAN hardware and software are properly configured.</p>
There is a pinned track on a SIZ volume.	If a pinned track occurs on a SIZ S-VOL or T-VOL, the USP V/VM storage system will suspend the pair. Please contact your Hitachi representative for assistance in recovering pinned tracks.
Only the Exit and Refresh menus are effective when accessing the SVP from the Storage Navigator computer.	The SVP might not be ready or perform some write processes from the other system. Wait for a while, and then select File, Refresh from the window.

The ShadowImage for z/OS displays error messages on the Storage Navigator computer when error conditions occur during SIZ operations. The ShadowImage for z/OS Error dialog box (see Figure 9-1) displays the SIZ error code and message.

To display the Error dialog box, select the failed volume in the **Preview List** on the Pair Operation window, right-click the mouse to display the menu, and then click the **Error Detail** command. See the *Storage Navigator Messages* for the list of error codes and corrective actions.

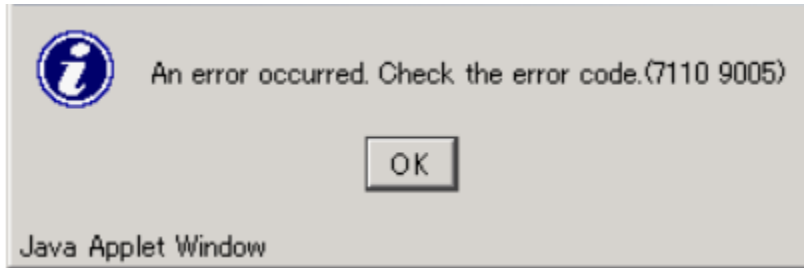


Figure 9-1 Error Dialog Box

SIM Reporting

The storage system reports a service information message (SIM) to the host when it is necessary to notify the user of a possible service requirement for the storage system. The SIMs are classified according to severity for reporting and logging purposes:

1. Service
2. Moderate
3. Serious
4. Acute

The larger the number becomes, more the message becomes important. The SVP reports all SIMs related to SIZ operations, and all SIMs are stored on the SVP for use by Hitachi personnel. The SIMs reported to the zSeries® and S/390® host are logged in the SYS1.LOGREC dataset of the host operating system. Each time a SIM is generated, the amber **Message** LED on the control panel (under the **Ready** and **Alarm** LEDs) turns on as an additional alert for the user. The Storage Navigator computer also displays the SIMs to provide an additional source of notification for the user.

For further information on SIM reporting, please contact your Hitachi Data Systems representative or the Hitachi Data Systems Support Center.

Figure 9-2 shows a typical 32-byte SIM from the storage system.

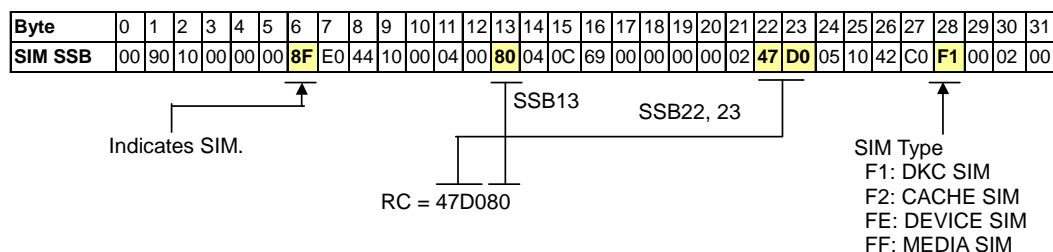


Figure 9-2 Typical SIM Showing Reference Code and SIM Type

SIMs are displayed on the host console by reference code (RC) and severity. The six-digit RC (composed of bytes 22, 23, and 13) identifies the possible error and determines the severity. The SIM type (byte 28) indicates the component which experienced the error.

Table 9-2 describes the DKC SIM (byte 28 = F1) related to SIZ operations.

Table 9-2 SIM for ShadowImage for z/OS

Reference Code		Importance Level	Descriptions
SSB22	SSB23		
47	Dx	Moderate	Copying process ends abnormally and the pair status changes to Suspend. <ul style="list-style-type: none"> ▪ "x" indicates the last digit of the T-VOL's CU number (0x0 to 0xF). ▪ "SSB13" indicates the T-VOL's LDEV number.
47	E7	Moderate	The pair status changes to PSUE because the power supply was turned on while the shared memory volatilized.

Calling the Hitachi Data Systems Support Center

If you need to call the Hitachi Data Systems Support Center, make sure to provide as much information about the problem as possible, including:

- The circumstances surrounding the error or failure.
- The ShadowImage (or other) error code(s) displayed on the Storage Navigator computer.
- The exact content of any error message(s) displayed on the host system(s).
- The Storage Navigator configuration information (use the FD Dump Tool).
- The service information messages (SIMs), including reference codes and severity levels, displayed by Storage Navigator and/or logged on the host.

The Hitachi Data Systems customer support staff is available 24 hours/day, seven days a week. If you need technical support, please log on to the Hitachi Data Systems Portal for contact information: <https://portal.hds.com>



Acronyms and Abbreviations

CU	control unit (logical control unit)
CTG	consistency group
DKC	disk controller
GB	gigabytes (see Convention for Storage Capacity Values)
KB	kilobytes (see Convention for Storage Capacity Values)
LDEV	logical device
LDKC	logical DKC
MB	megabytes (see Convention for Storage Capacity Values)
MCU	main control unit
PB	petabytes (see Convention for Storage Capacity Values)
P-VOL	primary volume
RCU	remote control unit
R-VOL	remote volume
SIz	Hitachi ShadowImage for z/OS
SI	Hitachi ShadowImage (for UNIX- and PC-server-based data)
SIM	service information message
SOM	system option mode
S-VOL	source volume or secondary volume
TB	terabyte (see Convention for Storage Capacity Values)
TCz	Hitachi TrueCopy for z/OS
T-VOL	target volume
URz	Universal Replicator for z/OS
USP V	Hitachi Universal Storage Platform V
USP VM	Hitachi Universal Storage Platform VM



Index

A

- add operation, 2-5
- adding new pairs
 - using PPRC, 8-5
- At-Time Split, 6-25

C

- Cache Residency Manager for IBM z/OS, 3-2
- CDELPAIR (PPRC command), 8-16
- CESTPAIR (PPRC command), 8-5
- CESTPAIR MODE(RESYNC) (PPRC command), 8-12
- consistency group, 6-10, 6-25, 6-27
- Copy Threshold option, 2-24
- CQUERY (PPRC command), 8-18
- CSUSPEND (PPRC command), 8-9
- CTG window, 5-11
- custom-sized volumes, 4-2

D

- delete operation, 2-15
- Delete Volume Pair dialog box, 6-35
- deleting pair, 6-35
- deleting pairs
 - using PPRC, 8-16
- DELPAIR (PPRC command), 8-16
- Detail dialog box, 6-37
- DEVSERV commands, 8-4, 8-18
- displaying pair status
 - using PPRC, 8-18
- duplex (status), 2-19

E

- Error dialog box, 9-2
- ESTPAIR (PPRC command), 8-5
- ESTPAIR MODE(RESYNC), 8-12
- external volumes, 4-2

H

- History Window, 5-8
- Host I/O Performance option, 2-24
- Host I/O Performance Option, 2-24

I

- ICKDSF commands. See PPRC commands
- initial copy operation, 2-5
- installation, software, 4-20

J

- journal volumes, 4-3

N

- normal resync operation, 2-10

O

- operations
 - add, 2-5, 6-13
 - delete, 2-15
 - normal resync, 2-10
 - quick restore, 2-13
 - quick resync, 2-11
 - quick split, 2-7
 - reserve, 2-4
 - resync, 2-10
 - reverse copy, 2-13
 - split, 2-7
 - starting, 4-20
 - steady split, 2-7
 - suspend, 2-10
- Option setting, 6-9
- Option Window, 5-10

P

- Pair Operation Window, 5-2
- pair status, 2-17
- parity group, 4-15
- pending (status), 2-19
- pinned track, 9-2
- PPRC commands
 - DELPAIR, 8-16
 - ESTPAIR, 8-5
 - ESTPAIR MODE(RESYNC), 8-12
 - parameters, 8-5, 8-7, 8-9, 8-12, 8-16, 8-21
 - QUERY, 8-18

- SIZ and TCz operability, 8-3
- SUSPEND, 8-9
- Preview List, 5-6
- PSF commands, 8-4

Q

- QUERY (PPRC command), 8-18
- quick restore operation, 2-13
- quick resync operation, 2-11
- quick split operation, 2-7

R

- RAID level swap (quick restore), 4-16
- requirements, 4-2, 4-11
- reserve attribute, 2-4
 - resetting, 6-7
 - setting, 6-5
- Reset Reserve Attribute dialog box, 6-7
- resync (status), 2-20
- resync operations, 2-10
- Resynchronize Volume Pair dialog box, 6-31
- resynchronizing pairs, 6-31
 - using PPRC, 8-12
- resync-R (status), 2-20
- reverse copy operation, 2-13

S

- service information message, 9-3
- Set Reserve Attribute dialog box, 6-5
- ShadowImage for z/OS
 - adding pairs, 6-13
 - combining with other features, 3-1
 - components, 2-2
 - deleting pairs, 6-35
 - initial copy operation, 2-5
 - operations, 2-4
 - resynchronizing pairs, 6-31
 - sharing volumes with TCz, 3-3
 - sharing volumes with URz, 3-9
 - splitting pairs, 6-18
 - starting operations, 4-20
 - suspending pairs, 6-29
 - system requirements, 4-2
 - update copy operation, 2-6
- shared SIZ/TCz volumes, 3-5
- shared SIZ/URz volumes, 3-9
- SIM, 9-3
- simplex (status), 2-19
- split (status), 2-19
- split operation, 2-7
- Split Volume Pair dialog box, 6-18
- splitting pairs, 6-18
 - using PPRC, 8-9
- SP-pending (status), 2-19
- status, 2-17
- steady split operation, 2-8

- Storage Navigator computer, 2-3
- Storage Navigator main window, 4-20, 6-3
- SUSPEND (PPRC command), 8-9
- suspend operation, 2-10
- Suspend Volume Pair dialog box, 6-29
- suspended (status), 2-20
- suspending pairs, 6-29
- Swap&Freeze, 2-22
- system option modes, 4-4
- system requirements, 4-2

T

- TrueCopy for z/OS
 - sharing volumes with SIZ, 3-3
- TSO commands. See PPRC commands

U

- Universal Replicator for z/OS
 - sharing volumes with SIZ, 3-9
- Universal Volume Manager, 3-3
- update copy operation, 2-6

V

- Virtual LVI, 3-2
- Volume List, 5-4
- Volume Security, 3-2
- V-split (status), 2-19

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