



**Hitachi Freedom Storage™
Thunder 9500™ V Series
ShadowImage 9500V User's Guide**

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The following source documents were used to produce this 9500v user guide:

- *Hitachi Freedom Storage™ Thunder 9500™ V Series ShadowImage 9500 User's Guide*, RSD-92DF607-5
- *Hitachi ShadowImage Configuration Guide (DF600)*, Revision K6602873-4

Changes in this Revision

- Added a note to sections 1.1 and 2.2 stating that Windows® 2000 dynamic disks are not supported
- Changed Table 5.1 to reflect recent updates
- Changed Table 5.2 to include a more comprehensive list of ShadowImage 9500V functions
- Added the following sections: 5.2.1, 5.2.2, 5.2.3, 5.2.4, 5.2.5, 5.2.6, 5.2.7, and 5.2.8
- Added section 5.4
- Changed P-VOL and S-VOL information in sections 7.1 and 7.2
- Added section 7.3
- Changed the HP platform operating system version in Table 8.1
- Changed section 5.2.1 and 5.2.3 to reflect recent updates
- Added Appendix C Operation of volumes with Solaris Version VxVM

Referenced Documents

- *Hitachi Freedom Storage™ Thunder 9500™ V Series Resource Manager 9500V User's Guide Graphical User Interface (GUI) (MK-92DF605)*
- *Hitachi Freedom Storage™ Thunder 9500™ V Series Resource Manager 9500V User's Guide Command Line Interface (CLI) (MK-92DF603)*
- *Hitachi Freedom Storage™ Thunder 9500™ V Series Command Control Interface (CCI) User and Reference Guide (MK-92DF609)*

Preface

The *Hitachi Freedom Storage™ Thunder 9500™ V Series ShadowImage 9500 User's Guide* describes and provides instructions for performing ShadowImage 9500V operations on the Thunder 9500V array subsystem using the Hitachi Data Systems ShadowImage 9500V software.

Note: This product is not supported by the 9531V subsystem.

This user's guide assumes the following:

- The user has a background in data processing and understands RAID storage subsystems and their basic functions.
- The user is familiar with the Hitachi Freedom Storage™ Thunder 9500™ V Series array subsystem.
- The user has read and understands the *Hitachi Freedom Storage™ Thunder 9500™ V Series Command Control Interface (CCI) User and Reference Guide (MK-92DF609)*.
- The user is familiar with the Windows 98, Windows NT, and/or the Windows 2000 operating system.

Note: The term "9500V" refers to the entire Hitachi 9500V subsystem family, unless otherwise noted. Please refer to the *Hitachi Freedom Storage™ Thunder 9500™ V Series User and Reference Guide (MK-92DF601)* for further information on the 9500V disk array subsystems, or contact your Hitachi Data Systems account team.

Note: The use of ShadowImage 9500V software, and all other Hitachi Data Systems products is governed by the terms of your license agreement(s) with Hitachi Data Systems.

Terminology

Please note the following:

- The term DF600 refers to the Thunder 9500™ V Series subsystem.

COMMENTS

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Please refer to specific page(s) and paragraph(s) whenever possible.**

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Chapter 1 Overview of Hitachi Data Systems Copy Solutions

1.1 Hitachi Data Systems ShadowImage 9500V

The Hitachi Data Systems ShadowImage 9500V features enable you to maintain subsystem-internal copies of all user data on the Thunder 9500V storage subsystem for purposes such as data backup or duplication. The duplicated volumes are created within the same Thunder 9500V subsystem as the secondary volumes. ShadowImage 9500V is used for UNIX®-based and PC server data, and can provide one duplicate for each primary volume.

ShadowImage 9500V operations are non-disruptive and allow the primary (main) volume of each volume pair to remain online to all hosts for both read and write I/O operations. Once established, ShadowImage 9500V operations continue unattended to provide asynchronous internal data backup. Usability is further enhanced through a resynchronization capability that reduces data duplication requirements and backup time, thereby increasing user productivity.

Note:

- If a ShadowImage 9500V pair suspended-error (PSUE) occurs, the cause is usually due to a failure in the hardware (or when the user forcibly suspends the pair). To recover from a suspended status, the hardware error and designated data must be recovered. To accomplish this task, contact Hitachi Data Systems Customer Support.
- ShadowImage 9500V operations are performed from the UNIX® and/or PC-server host using the Hitachi Data Systems Command Control Interface (CCI) software. For information and instructions on using CCI to perform ShadowImage 9500V operations, refer to the *Hitachi Freedom Storage™ Thunder 9500™ V Series Command Control Interface (CCI) User and Reference Guide (MK-92DF609)*.
- Windows® 2000 dynamic disks are not supported.

Chapter 2 Overview of ShadowImage 9500V Operations

Hitachi Data Systems ShadowImage 9500V is a storage-based hardware solution for duplicating logical volumes which reduce backup time and provide point-in-time backup. The ShadowImage 9500V primary volumes (P-VOLs) contain the original data; the ShadowImage 9500V secondary volume(s) (S-VOLs) contain the duplicate data. Since each P-VOL is paired with its S-VOL independently, each volume can be maintained as an independent copy set that can be split (pairsplit), resynchronized (pairresync), and released (pairsplit -S) separately.

ShadowImage 9500V operations are performed from the UNIX[®] and/or PC-server host using the Hitachi Data Systems Command Control Interface (CCI) software. ShadowImage 9500V commands are issued from Command Control Interface (CCI) through command devices in the Thunder 9500V subsystem. These command devices can be specified or released by the user by using the Resource Manager 9500V.

2.1 ShadowImage 9500V Components

ShadowImage 9500V operations involve the primary and secondary volumes in the Thunder 9500V subsystem, the Resource Manager 9500V, and the Hitachi Data Systems Command Control Interface (CCI). Figure 2.1 shows a typical ShadowImage 9500V configuration. The ShadowImage 9500V system components include:

- ShadowImage 9500V volume pairs (P-VOLs and S-VOLs) (see section 2.1.1)
- Resource Manager 9500V (see section 2.1.2)
- Hitachi Data Systems Command Control Interface (CCI) on the UNIX[®] and/or PC-server host. Refer to the *Hitachi Freedom Storage™ Thunder 9500™ V Series Command Control Interface (CCI) User and Reference Guide (MK-92DF609)*.

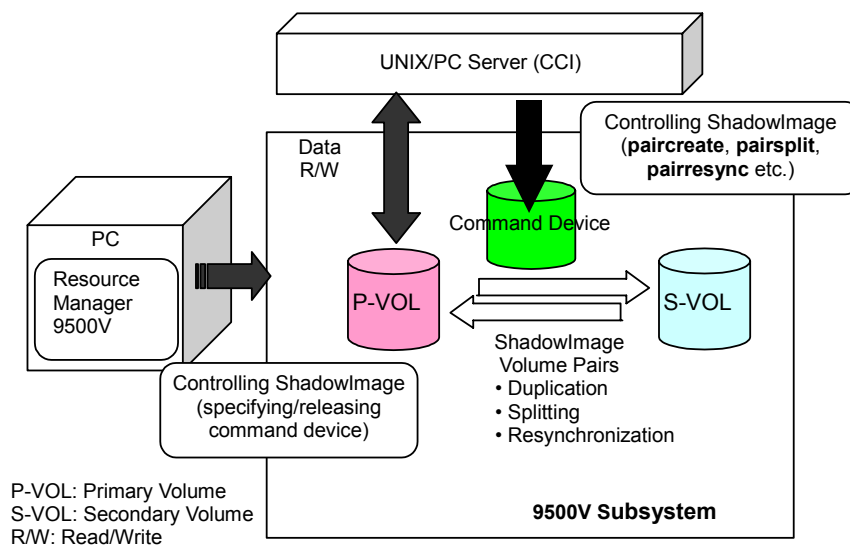


Figure 2.1 ShadowImage 9500V Components

2.1.1 ShadowImage 9500V Volume Pairs (P-VOLs and S-VOLs)

The Thunder 9500V subsystem contains and manages both the original and copied ShadowImage 9500V data. ShadowImage 9500V supports a maximum of 31 pairs.

ShadowImage 9500V performs internal copy operations for logical volume pairs established by the user. Each ShadowImage 9500V pair consists of one primary volume (P-VOL) and one secondary volume (S-VOL), which are located in the same Thunder 9500V subsystem. The ShadowImage 9500V P-VOLs are the primary volumes, which contain the original data. The ShadowImage 9500V S-VOLs are the secondary or mirrored volumes, which contain the duplicated data. During ShadowImage 9500V operations, the P-VOLs remain available to all hosts for read and write I/O operations (except during reverse resync). The S-VOLs become available for host access only after the pair has been suspended or released.

When a ShadowImage 9500V volume pair is created, the data on the P-VOL is copied to the S-VOL to synchronize the volumes. During this initial copy operation and after the pair is synchronized, all write operations to the S-VOL are prohibited. If you need to access an S-VOL, you can “suspend” the pair to make the S-VOL accessible (the P-VOL is accessible except during reverse resync). While a ShadowImage 9500V pair is suspended, the Thunder 9500V subsystem keeps track of all changes to the P-VOL and S-VOL. When you “resync” the pair, the differential data in the P-VOL (due to P-VOL updates) is copied to the S-VOL so that the S-VOL is again identical to the P-VOL. For reverse resync, the differential data in the S-VOL (due to S-VOL updates) is copied to the P-VOL so that the P-VOL is now identical to the S-VOL.

Note: For performance reasons, ShadowImage 9500V P-VOLs and S-VOL pairs should not be from the same RAID group. ShadowImage 9500V pairs for which ShadowImage 9500V operations are performed simultaneously should be on different controllers, but the P-VOL and S-VOL of each pair must be on the same controller. If ShadowImage pairs are concentrated in the same controller, the host I/O performance may be impacted.

While multiple paircreate command can be issued, the 9500V is capable of performing only one paircreate command at a time per controller.

2.1.2 Resource Manager 9500V

The Resource Manager 9500V displays ShadowImage 9500V pair information and enables you to create a command device. The Resource Manager 9500V can set up the ShadowImage 9500V environment by connecting the PC where Resource Manager 9500V is installed to the Thunder 9500V subsystem through the LAN. This operation enables the command device to be specified or released. The Resource Manager 9500V also displays the status of ShadowImage 9500V volumes.

2.2 ShadowImage 9500V Requirements

ShadowImage 9500V operations provide subsystem-internal copies of UNIX®/PC server volumes (LUs) on the Thunder 9500V subsystem. Table 2.1 lists and describes the operational requirements for ShadowImage 9500V.

Note: Windows® 2000 dynamic disks are not supported.

Table 2.1 ShadowImage 9500V Requirements (continued on next page)

Parameter	Requirement																											
User interface	The following software is necessary: <ul style="list-style-type: none"> • Hitachi Command Control Interface (CCI): used for issuing commands to create and split ShadowImage 9500V pairs • Resource Manager 9500V: used for specifying and releasing command devices 																											
Number of controllers	2																											
Max number of command devices	2																											
Unit of pair management	LUs are the target of ShadowImage 9500V pairs, and are managed per logical unit.																											
Max number of pairs	31																											
Pair structure	One copy (S-VOL) per P-VOL																											
Stripe size	You cannot specify stripe size on a 9500V, it is fixed at 64.																											
Supported RAID level	RAID 0, RAID 1, RAID 5, RAID 1+0 (However, using a P-VOL and S-VOL which have a RAID level of RAID 1, RAID 5, or RAID 1+0 is recommended.)																											
Combination of RAID levels	The number of data disks must be the same. <table border="0"> <thead> <tr> <th>P-VOL type</th> <th>S-VOL type</th> <th></th> </tr> </thead> <tbody> <tr> <td>RAID 5 (4D+1P)</td> <td>RAID 5 (4D+1P)</td> <td>=> available</td> </tr> <tr> <td>RAID 5 (4D+1P)</td> <td>RAID 1+0 (4D+4P)</td> <td>=> available</td> </tr> <tr> <td>RAID 1+0 (2D+2P)</td> <td>RAID 1+0 (2D+2P)</td> <td>=> available</td> </tr> <tr> <td>RAID 5 (4D+1P)</td> <td>RAID 0 (4D)</td> <td>=> available</td> </tr> <tr> <td>RAID 5 (4D+1P)</td> <td>RAID 5 (3D+1P)</td> <td>=> not available</td> </tr> <tr> <td>RAID 5 (4D+1P)</td> <td>RAID 1+0 (2D+2P)</td> <td>=> not available</td> </tr> <tr> <td>RAID 5 (4D+1P)</td> <td>RAID 0 (5D)</td> <td>=> not available</td> </tr> <tr> <td>RAID 1+0 (2D+2P)</td> <td>RAID 1+0 (5D+5P)</td> <td>=> not available</td> </tr> </tbody> </table>	P-VOL type	S-VOL type		RAID 5 (4D+1P)	RAID 5 (4D+1P)	=> available	RAID 5 (4D+1P)	RAID 1+0 (4D+4P)	=> available	RAID 1+0 (2D+2P)	RAID 1+0 (2D+2P)	=> available	RAID 5 (4D+1P)	RAID 0 (4D)	=> available	RAID 5 (4D+1P)	RAID 5 (3D+1P)	=> not available	RAID 5 (4D+1P)	RAID 1+0 (2D+2P)	=> not available	RAID 5 (4D+1P)	RAID 0 (5D)	=> not available	RAID 1+0 (2D+2P)	RAID 1+0 (5D+5P)	=> not available
P-VOL type	S-VOL type																											
RAID 5 (4D+1P)	RAID 5 (4D+1P)	=> available																										
RAID 5 (4D+1P)	RAID 1+0 (4D+4P)	=> available																										
RAID 1+0 (2D+2P)	RAID 1+0 (2D+2P)	=> available																										
RAID 5 (4D+1P)	RAID 0 (4D)	=> available																										
RAID 5 (4D+1P)	RAID 5 (3D+1P)	=> not available																										
RAID 5 (4D+1P)	RAID 1+0 (2D+2P)	=> not available																										
RAID 5 (4D+1P)	RAID 0 (5D)	=> not available																										
RAID 1+0 (2D+2P)	RAID 1+0 (5D+5P)	=> not available																										
Size of LU	The P-VOL size must equal the S-VOL LU size in blocks. The Command Device LU size must be greater than or equal to 33 MB.																											
Allocation of P-VOL and S-VOL	The P-VOL and S-VOL can only be allocated in the same controller.																											
Initial copy	When receiving the paircreate command, the entire copy is executed in the direction of P-VOL to S-VOL.																											
Split	When receiving the pairsplit command, splitting P-VOL and S-VOL is executed. Splitting/suspending is completed immediately (within 10ms).																											
Differential management	When the P-VOL and S-VOL is in suspend status (PSUS), write operations received individually will be managed as the differential data of the P-VOL and the S-VOL.																											

Table 2.1 ShadowImage 9500V Requirements (continued)

Parameter	Requirement
Resynchronization	When receiving the pairresync command, the differential copy is executed in the direction of P-VOL to S-VOL, or S-VOL to P-VOL.
S-VOL data creation	The S-VOL data in cache is created during the write operation. 1. Receiving the write command from the host 2. Creates the P-VOL data 3. Reports "GOOD" to host 4. Creates the S-VOL data
Management of LUs while using ShadowImage 9500V	Formatting, extending, and deleting LUs are not available. When formatting, extending, and deleting LUs, split ShadowImage 9500V pair(s) using the pairsplit command.
Concurrent use of Dual ID Succession	Cannot use ID Succession concurrently
Concurrent use of LUN Size Expansion	Available
Concurrent use of FlashAccess	The LU specified for LU cache residence cannot be set as a S-VOL or P-VOL.
Concurrent use of SNMP Agent	Available
Concurrent use of LUN Security	Available
Concurrent use of Password Protection	Available
Concurrent use of LUN Management	Available
Failures	When a failure of the copy operation from P-VOL to S-VOL occurs, ShadowImage 9500V will suspend the pair (PSUE). If a LU failure occurs, ShadowImage 9500V suspends the pair. If a drive failure occurs, the ShadowImage 9500V pair status is not affected because of the RAID architecture.
Restriction for formatting the volumes	Do not execute ShadowImage 9500V operations while formatting the volume. Formatting takes priority and the ShadowImage 9500V operations will be suspended.

2.3 ShadowImage 9500V Operations

ShadowImage 9500V operations can be performed from the UNIX®/PC server host using Hitachi Data Systems Command Control Interface (CCI) software. For further information on using the Hitachi Data Systems Command Control Interface, refer to the *Hitachi Freedom Storage™ Thunder 9500™ V Series Command Control Interface (CCI) User and Reference Guide (MK-92DF609)*.

The following ShadowImage 9500V operations are discussed in this section:

- Paircreate Operation
- Pairsplit Operation
- Pairresync Operations (Normal, Reverse)
- Pairsplit -E Operation
- Pairsplit -S Operation

2.3.1 Paircreate Operation

The ShadowImage 9500V **paircreate** operation establishes the newly specified ShadowImage 9500V pair(s). The volumes, which will become the P-VOL and S-VOL, must both be in the SMPL (simplex) state before becoming a ShadowImage 9500V pair.

2.3.1.1 Initial Copy Operation

The ShadowImage 9500V initial copy operation takes place when you create a new ShadowImage 9500V pair (see Figure 2.2). The ShadowImage 9500V initial copy operation copies all data on the P-VOL to the associated S-VOL. The P-VOL remains available to all hosts for read and write I/Os throughout the initial copy operation. Write operations performed on the P-VOL during the initial copy operation will always be duplicated to the S-VOL. The status of the pair is COPY(PD) (PD = pending) while the initial copy operation is in progress. The pair status changes to PAIR when the initial copy is complete.

When creating pairs, you can select the pace for the initial copy operation(s): slow, medium, and fast. The pace is divided on the scale of 1 to 15. The default value is 3. However, you must set the maximum value of 15.

For details, see section 4.1.

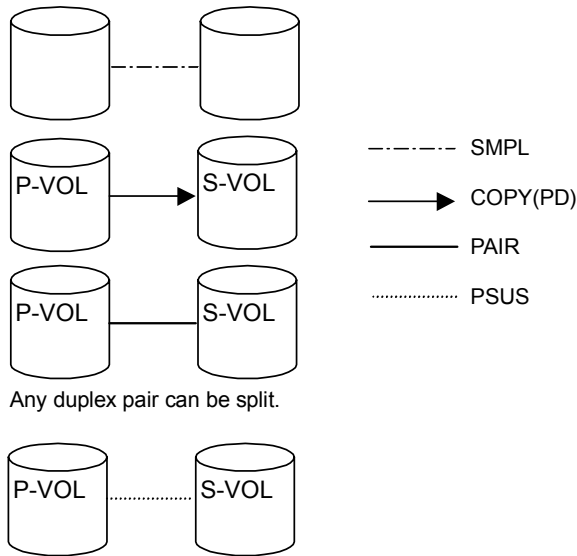


Figure 2.2 Adding a ShadowImage 9500V Pair

For details on `paircreate` operation, see section 4.1.

2.3.2 Pairsplit Operation

The ShadowImage 9500V `pairsplit` operation performs all pending S-VOL updates (those issued prior to the split command and recorded in the P-VOL track map) to make the S-VOL identical to the state of the P-VOL when the suspend command was issued, and then provides full read/write access to the split S-VOL. You can split existing pairs as needed, and you can also use the `paircreate` operation to create and split pairs in one step. This feature provides point-in-time backup of your data, and also facilitates real data testing by making the ShadowImage 9500V copies (S-VOLs) available for host access.

When the split operation is complete, the pair status changes to PSUS, and you have full read/write access to the split S-VOL. While the pair is split, the Thunder 9500V establishes a track map for the split P-VOL and S-VOL and records all updates to **both** volumes. The P-VOL remains fully accessible during the `pairsplit` operation. `Pairsplit` operations cannot be performed on suspended (PSUE) pairs.

For details on `pairsplit` operation, see section 4.2.

2.3.3 Pairresync Operations (Normal, Reverse)

The ShadowImage 9500V **pairresync** operation resynchronizes the suspended pairs (PSUS) or the suspended on error pairs (PSUE). When the **pairresync** operation starts, the pair status changes to COPY(RS) or COPY(RS-R). The pair status changes to PAIR when the **pairresync** operation completes.

ShadowImage 9500V allows you to perform two types of **pairresync** operations:

- **Normal.** The normal **pairresync** operation (see Figure 2.3) resynchronizes the S-VOL with the P-VOL. The copy direction for a normal **pairresync** operation is P-VOL to S-VOL. The pair status during a normal resync operation is COPY(RS). The S-VOL becomes inaccessible to all hosts for write operations, and the P-VOL remains accessible to all hosts for both read and write operations during a normal **pairresync**. The normal **pairresync** operation can be executed for pairs with the status PSUS and PSUE.
- **Reverse.** The reverse **pairresync** (**pairresync -restore**) operation (see Figure 2.4) synchronizes the P-VOL with the S-VOL. The copy direction for a reverse **pairresync** operation is S-VOL to P-VOL. The pair status during a reverse resync operation is COPY(RS-R), and the S-VOL becomes inaccessible to all hosts for write operations during a reverse **pairresync** operation. The P-VOL remains accessible for both read and write operations, and the write operations on P-VOL will always be reflected to S-VOL (see Figure 2.5).

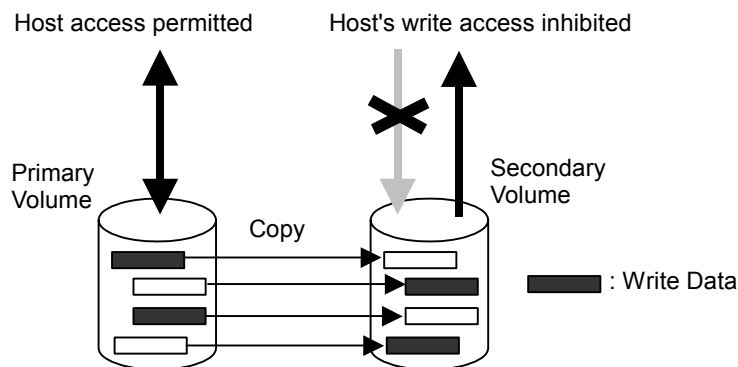


Figure 2.3 Normal Pairresync Operation

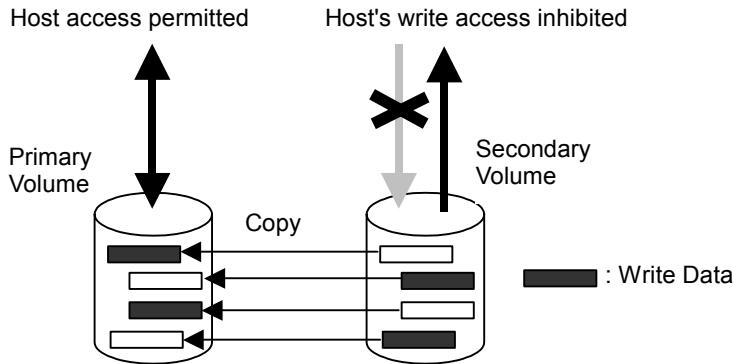


Figure 2.4 Reverse Pairresync Operation (`pairresync -restore`)

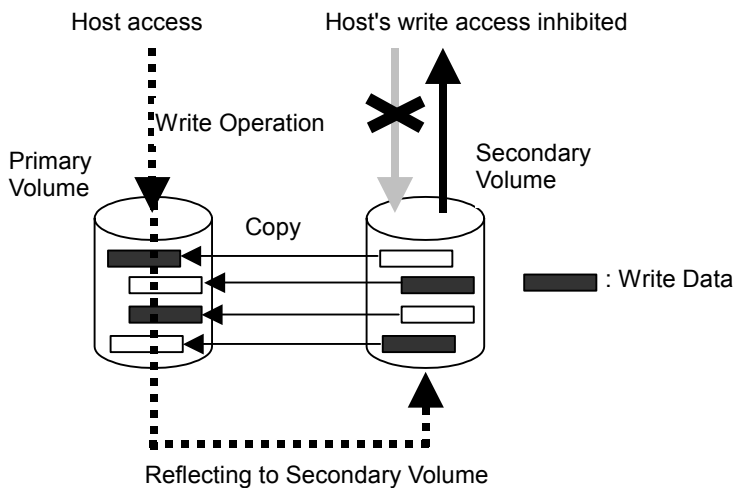


Figure 2.5 Reflecting Write Data to S-VOL during Reverse Pairresync Operation (`pairresync -restore`)

ShadowImage 9500V allows you to perform normal and quick `pairresync` operations on split and suspended pairs.

- **Pairresync for a suspended pair.** When a `pairresync` operation is performed on a suspended pair (status = PSUS), the subsystem merges the S-VOL differential track map into the P-VOL differential track map and then copies all flagged data from the P-VOL to the S-VOL. When a reverse `pairresync` operation is performed on a suspended pair, the subsystem merges the P-VOL differential track map into the S-VOL differential track map and then copies all flagged tracks from the S-VOL to the P-VOL. This ensures that the P-VOL and S-VOL are properly resynchronized in the desired direction, and also greatly reduces the time needed to resynchronize the pair.
- **Pairresync for suspended pair.** When a `pairresync` operation is performed on a suspended pair (status = PSUS), the subsystem copies all data on the P-VOL to the S-VOL, since all P-VOL tracks were flagged as difference data when the pair was suspended. The `pairresync` operation takes as long as the ShadowImage 9500V initial copy operation.

For details on `pairresync` operation, see section 4.3.

2.3.4 Pairsplit –E Operation

The ShadowImage 9500V **pairsplit-E** operation immediately suspends the ShadowImage 9500V copy operations to the S-VOL of the pair. The user can suspend a ShadowImage 9500V pair at any time. When a ShadowImage 9500V pair is suspended on error (status = PSUE), the subsystem stops performing ShadowImage 9500V copy operations to the S-VOL, continues accepting write I/O operations to the P-VOL, and marks the entire P-VOL track map as difference data. When a **pairresync** operation is performed on a suspended pair, the entire P-VOL is copied to the S-VOL (when a **pairresync -restore** operation is performed, the entire S-VOL is copied to the P-VOL). While the **pairresync** operation for a split ShadowImage 9500V pair can be very fast, the **pairresync** operation for a suspended on error pair will take as long as the initial copy operation.

The Thunder 9500V subsystem will automatically suspend a ShadowImage 9500V pair when it cannot keep the pair mirrored for any reason. When the Thunder 9500V suspends a pair, a file is output to the system log or event log to notify the host. The Thunder 9500V will automatically suspend a pair under the following conditions:

- When the ShadowImage 9500V volume pair has been suspended or deleted from the UNIX[®]/PC server host using the Hitachi Data Systems Command Control Interface (CCI),
- When the Thunder 9500V detects an error condition related to an initial copy operation. When a volume pair with COPY(PD) status is suspended on error, the Thunder 9500V aborts the initial copy operation, changes the status of the P-VOL and S-VOL to PSUE and accepts all subsequent write I/Os to the P-VOL.

For details on **pairsplit -E** operation, see section 4.4.

2.3.5 Pairsplit –S Operation

The ShadowImage 9500V **pairsplit-S** operation stops the ShadowImage 9500V copy operations to the S-VOL of the pair and releases the volume in paired status. The user can release a ShadowImage 9500V pair at any time except when the volumes are already in SMPL status. In both ShadowImage 9500V volumes, the status will change to SMPL.

For details on **pairsplit -S** operation, see section 4.5.

2.4 ShadowImage 9500V Pair Status

The ShadowImage 9500V displays the pair status of all ShadowImage 9500V volumes (LUs). Figure 2.6 illustrates the ShadowImage 9500V pair status transitions and the relationship between the pair status and the ShadowImage 9500V operations.

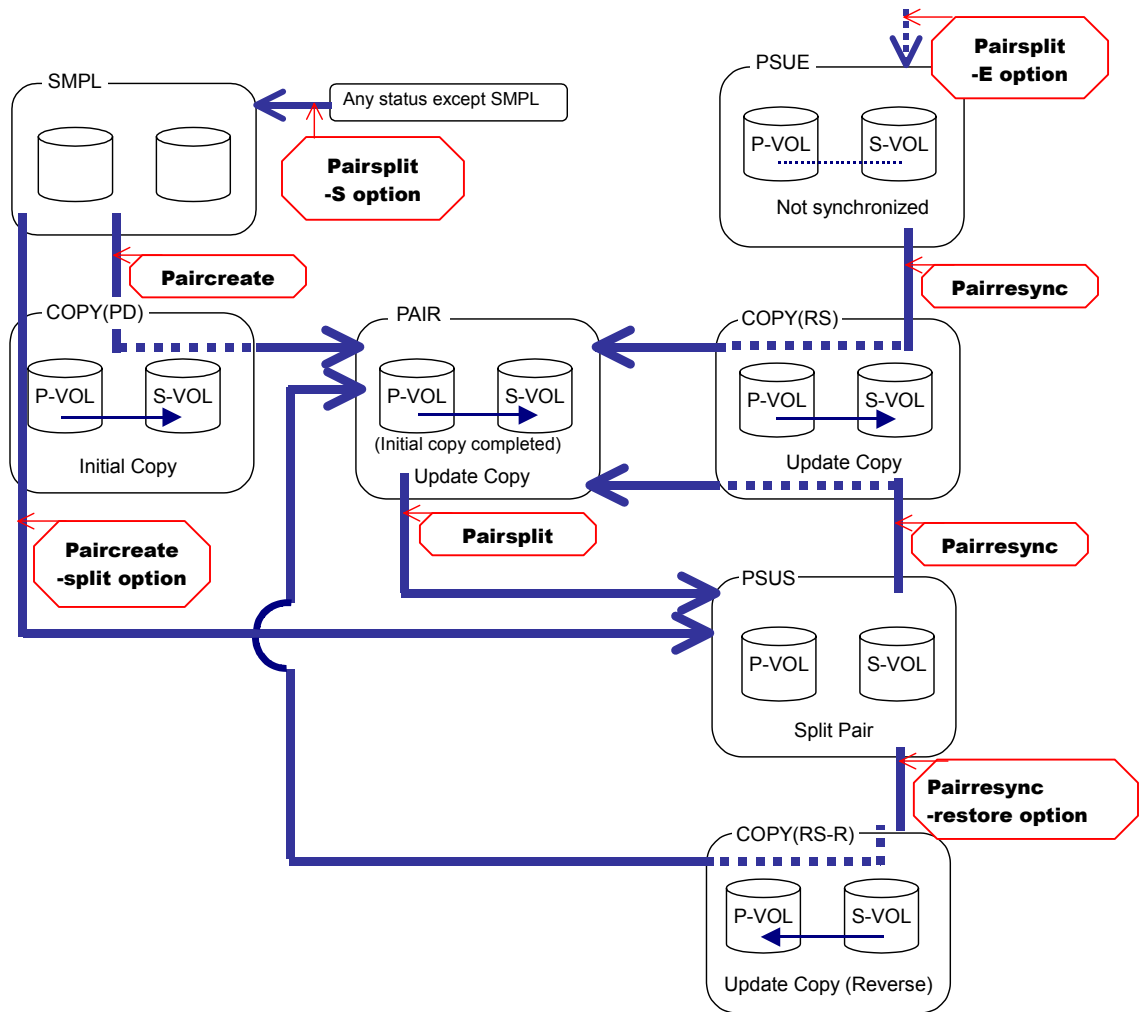


Figure 2.6 ShadowImage 9500V Pair Status Transitions

Table 2.2 lists and describes the ShadowImage 9500V pair status conditions. If a volume is not assigned to a ShadowImage 9500V pair, its status is SMPL. When you create a ShadowImage 9500V pair, the status of the P-VOL and S-VOL changes to COPY(PD). When the initial copy operation is complete, the pair status becomes PAIR. If the Thunder 9500V cannot maintain PAIR status for any reason, or if you suspend on error the pair (**pairsplit -E**), the pair status changes to PSUE. When you suspend a pair (**pairsplit**), the pair status changes to COPY(SP). When the **pairsplit** operation is complete, the pair status changes to PSUS to enable you to access the suspended S-VOL. When you start a **pairresync** operation, the pair status changes to COPY(RS). When you specify reverse mode for a **pairresync** operation (**pairresync -restore**), the pair status changes to COPY(RS-R) (data is copied in the reverse direction from the S-VOL to the P-VOL). When the **pairresync** operation is complete, the pair status changes to PAIR. When you split/release a pair (**pairsplit -S**), the pair status changes to SMPL.

Table 2.2 ShadowImage 9500V Pair Status

Pair Status	Description	S-VOL Access
SMPL	The volume is not assigned to a ShadowImage 9500V pair. The Thunder 9500V accepts read and write I/Os for all SMPL volumes.	N/A (there is no S-VOL yet)
COPY(PD)	The initial copy operation is in progress. The Thunder 9500V continues to accept read and write operations for the P-VOL but does not accept write operations for the S-VOL.	Read only
PAIR	The initial copy operation is complete, and the Thunder 9500V starts asynchronously copying the write operation taken to the P-VOL data onto the S-VOL. The P-VOL and S-VOL of a duplex pair (PAIR status) is identical. The Thunder 9500V rejects all write I/Os for S-VOLs with the status PAIR.	Read only
PSUS	The Thunder 9500V starts accepting write I/Os for PSUS S-VOLs. The Thunder 9500V keeps track of all updates to the suspended P-VOL and S-VOL, so that the pair can be resynchronized quickly.	Read and write The S-VOL can be mounted.
COPY(RS)	The Thunder 9500V does not accept write I/Os for COPY(RS) S-VOLs. When a suspended pair is resynchronized in normal mode, the Thunder 9500V copies only the P-VOL differential data to the S-VOL. When a PSUE (suspended under error) pair is resynchronized, the Thunder 9500V copies the entire P-VOL to the S-VOL.	Read only
COPY(RS-R)	The Thunder 9500V does not accept write I/Os for COPY(RS-R) S-VOLs. When a split pair is resynchronized in reverse mode, the Thunder 9500V copies only the S-VOL differential data to the P-VOL.	Read only
PSUE	The Thunder 9500V continues accepting read and write I/Os for a PSUE (suspended under error) P-VOL (however, if the status transits from COPY(RS-R), all access to P-VOL is disabled). The Thunder 9500V marks the entire P-VOL track map as difference data, so that the entire P-VOL is copied to the S-VOL when the PSUE pair is resumed. Use the pairresync command to resume a PSUE pair.	Read only (If the status transits from COPY(RS-R), all access to P-VOL is disabled.)

For details on pairdisplay operation, see section 4.6.

Chapter 3 Preparing for ShadowImage 9500V Operations

The following preparation is required for ShadowImage 9500V operations:

- Installing and Uninstalling ShadowImage 9500V (see section 3.1)
- Setting the Command Device (see section 3.2)
- Setting the Target ID (see section 3.3)
- Defining the Configuration Definition File (see section 3.4)
- Setting the Environment Variable (see section 3.5)

3.1 Installing and Uninstalling ShadowImage 9500V

Since ShadowImage 9500V is an extra-cost option, ShadowImage 9500V cannot usually be selected (locked) when first using the Thunder 9500V. To make ShadowImage 9500V available, you must install the ShadowImage 9500V and make its function selectable (unlocked).

ShadowImage 9500V can be installed from the Resource Manager 9500V. This section describes the installation/uninstallation procedures performed by using the Resource Manager 9500V via the Graphical User Interface (GUI). For details on the GUI version of Resource Manager 9500V, refer to the *Hitachi Freedom Storage™ Thunder 9500™ V Series Resource Manager 9500V User's Guide Graphical User Interface (GUI)* (MK-92DF605).

For procedures performed by using the Command Line Interface (CLI) of Resource Manager 9500V, see Appendix B.

Note: Before installing/uninstalling ShadowImage 9500V, verify that the array unit is operating in a normal state. If a failure such as a controller blockade has occurred, installation/uninstallation cannot be performed.

3.1.1 Installing ShadowImage 9500V

To install ShadowImage 9500V, the key code provided with the optional feature is required. The following describes the installation procedure.

To install ShadowImage 9500V:

1. Start Resource Manager 9500V, and change the operation mode to **Management Mode** (administrator mode).
2. Register the subsystem (array unit) in which ShadowImage 9500V is to be installed, and connect to the subsystem.

The Array System Viewer panel is displayed, and the connected subsystem is displayed.

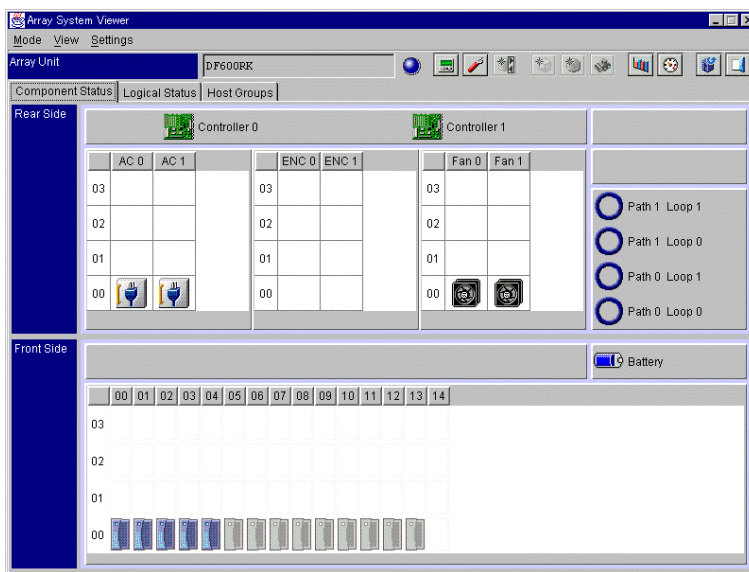



Figure 3.1 Array System Viewer Panel (Component Status Page)

3. From the Settings menu, select Configuration Settings. Alternatively, from the tool bar, select the Configuration Settings  button. The Parameter panel is displayed.

4. On the Parameter panel, select the Options tab. The Options page is displayed in front.

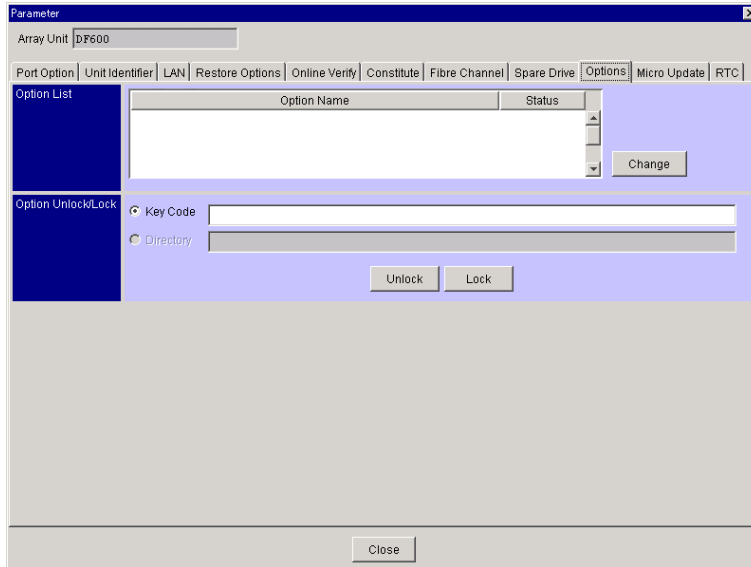


Figure 3.2 Parameter Panel (Locked)

5. Enter the key code. Select the **Unlock** button.
6. A message appears, asking you to confirm that you want to unlock ShadowImage. Select the **OK** button.

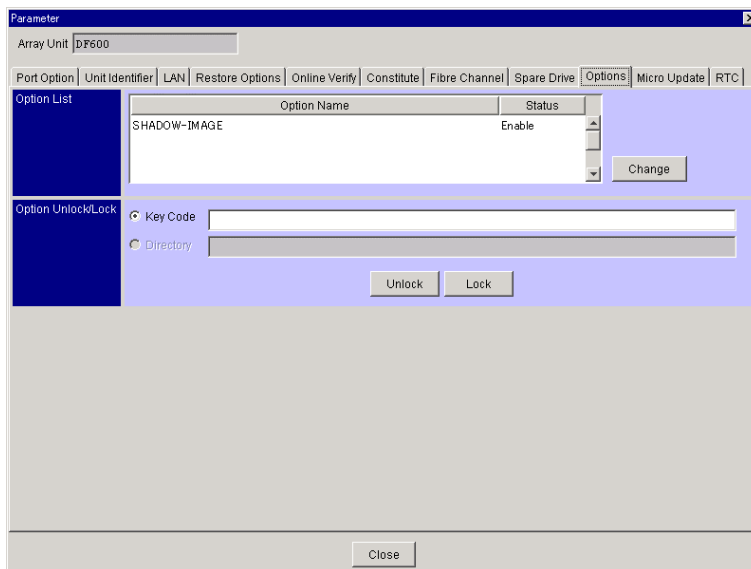


Figure 3.3 Parameter Panel (Unlocked)

The ShadowImage 9500V installation is now complete. To perform other operations, connect to the subsystem again and open the Array System Viewer panel.

3.1.2 Uninstalling ShadowImage 9500V

To uninstall ShadowImage 9500V, the key code provided with the optional feature is required. Once uninstalled, ShadowImage 9500V cannot be used until it is again unlocked using the key code.


Note: The following conditions must be satisfied in order to uninstall ShadowImage 9500V.

- All ShadowImage 9500V pairs must be released (that is, the status of all LUs are SMPL).

To uninstall ShadowImage 9500V:

1. Start Resource Manager 9500V, and change the operation mode to Management Mode (administrator mode).
2. Register the subsystem (array unit) in which the ShadowImage 9500V is to be uninstalled, then connect to the subsystem.

The Array System Viewer panel (see Figure 3.1) opens displaying the connected subsystem.

3. From the Settings menu, select Configuration Settings. Alternatively, from the tool bar, select the Configuration Settings  button.

The Parameter panel is displayed.

4. On the Parameter panel, select the Options tab.

The **Options** page (see Figure 3.3) is displayed in front.

5. Enter the key code. Select the **Lock** button.
6. A message appears, asking you to confirm that you want to lock ShadowImage. Select the **OK** button.

ShadowImage 9500V is now uninstalled. To perform other operations, connect to the subsystem again and open the Array System Viewer panel.

3.1.3 Enabling or Disabling ShadowImage 9500V

Once ShadowImage 9500V is installed, it can be enabled or disabled.


Note: The following conditions must be satisfied in order to disable ShadowImage 9500V.

- All ShadowImage 9500V pairs must be released (that is, the status of all LUs are SMPL).

The following describes the enabling/disabling procedure.

1. Start Resource Manager 9500V, and change the operation mode to **Management Mode** (administrator mode).
2. Register the subsystem (array unit) from which the status of ShadowImage 9500V is to be changed and connect to the subsystem.

The Array System Viewer panel (see Figure 3.1) opens displaying the connected subsystem.

3. From the **Settings** menu, select **Configuration Settings**. Alternatively, from the tool bar, select the **Configuration Settings**  button.

The Parameter panel is displayed.

4. On the Parameter panel, select the **Options** tab. The **Options** page is displayed in front.
5. From **Option Name**, select **SHADOW-IMAGE**, then select the **Change** button.
6. A message appears, asking you to confirm that you want to change the status (enable or disable). Select the **OK** button.

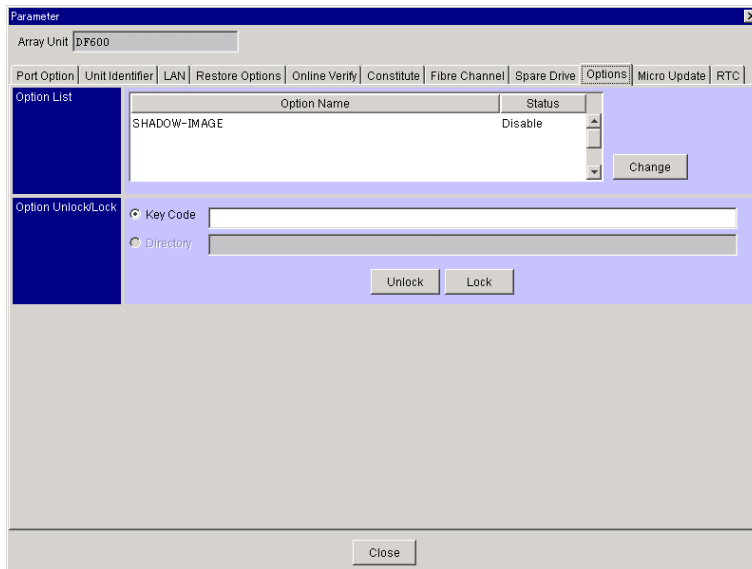


Figure 3.4 Parameter Panel (Disabled)

Enabling or disabling ShadowImage 9500V is now complete. To perform other operations, connect to the subsystem again and open the Array System Viewer panel.


3.2 Setting the Command Device

The command device is a user-selected, dedicated logical volume on the Thunder 9500V subsystem, which functions as the interface to the CCI software. The ShadowImage 9500V commands are issued by CCI (HORCM) to the Thunder 9500V command device.

A command device must be designated in order to issue ShadowImage 9500V commands. The command device must be defined in the HORCM_CMD section of the configuration definition file for the CCI instance on the attached host. Two command devices can be designated for the Thunder 9500V subsystem. You can designate command devices using Resource Manager 9500V.

Note: LUs set for command devices must be recognized by the host.

To designate command device(s):

1. Start Resource Manager 9500V and change the operation mode to **Management Mode** (administrator mode).
2. Connect to the subsystem. The Array System Viewer panel (Figure 3.1) opens displaying the connected subsystem.
3. From the **Settings** menu, select **Configuration Settings**. Alternatively, from the tool bar, select the **Configuration Settings**  button. The Parameter panel is displayed.
4. On the Parameter panel, select the **Command Device** tab. The Command Device page is displayed in front.

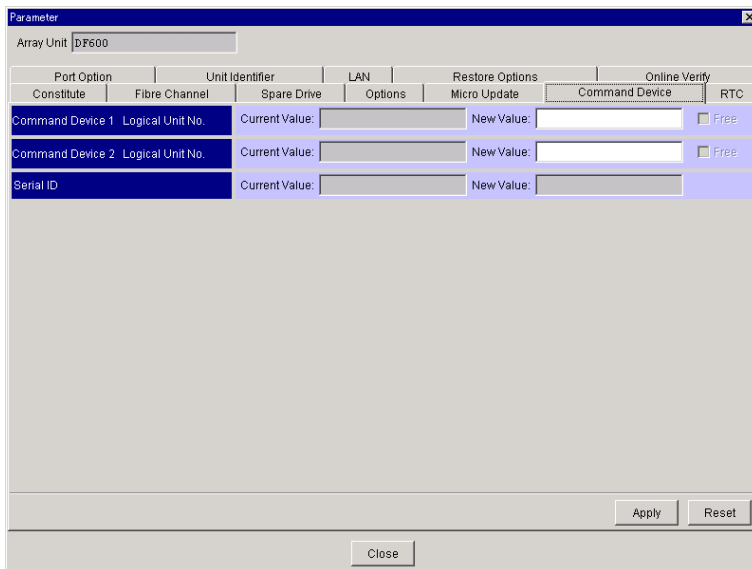


Figure 3.5 Parameter Panel (Command Device Page)

5. In the **Command Device 1 - Logical Unit No. - New Value**, enter the LU number of the command device.
6. If you want to set one more command device, in the **Command Device 2 - Logical Unit No.**, enter the LU number.

Note: To use the alternate command device function, or to avoid data loss and subsystem downtime, designate two command devices. For details on the alternate command device function, refer to the *Hitachi Freedom Storage™ Thunder 9500™ V Series Command Control Interface (CCI) User and Reference Guide (MK-92DF609)*.

7. **To release an already set command device**, select the LU number of the command device you want to release. The **Free** check box activates. Select the check box on.
Note: The last command device defined cannot be released unless all volumes are in SMPL status
8. Select the **Apply** button, and then select the **Close** button.
The Parameter panel closes and you will return to the Array System Viewer panel.

Designating the command device is now complete. Leave the Array System Viewer panel open, and go on to the next section (Setting the LU Mapping).

3.3 LU Mapping

The following is the procedure for mapping LUs. The port address is set up with the fibre channel tab. This section includes the following:

- Selecting Mapping Mode
- Setting Mapping Information

3.3.1 Selecting Mapping Mode

1. On the Array System Viewer panel, select the **Host Groups** tab. The **Host Groups** page is displayed in front.
2. Double-click Controller 0 or Controller 1, select Port A or Port B.
3. On the **Settings** menu, click **Mapping Mode**, and then select **Enable**.

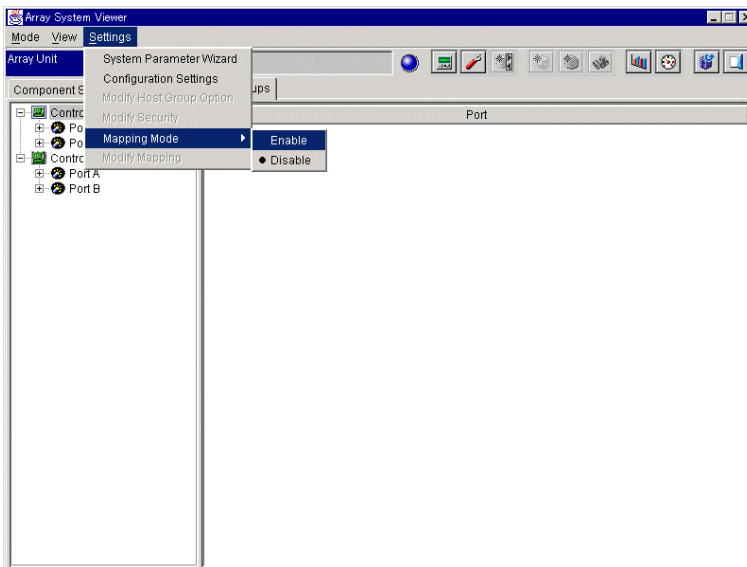


Figure 3.6 Array System Viewer Panel (Host Groups Page)

4. A confirmation message appears. Click the **OK** button.

3.3.2 Setting Mapping Information

1. Click Port A or Port B. Select **000:G000**.
2. Select **Logical Unit**. On the **Settings** menu, select **Modify Mapping**.
The Mapping Property panel is displayed.

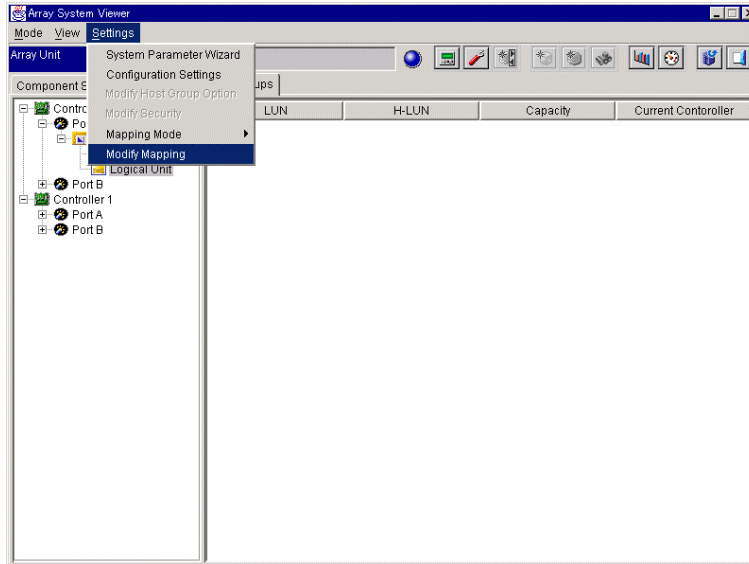



Figure 3.7 Setting Mapping Information

3. On the Mapping Property panel, specify the LU number between the subsystem and the host. Select the following items:
 - For LUN, select the starting LUN number in the LUN box.
 - For Host LUN, select the LUN numbers that the host can recognize.

Note: The specification may differ, depending on the system configuration.

4. Select the  button. The specification that you just made will be added to the **Reserved Configuration**. Click the **OK** button.

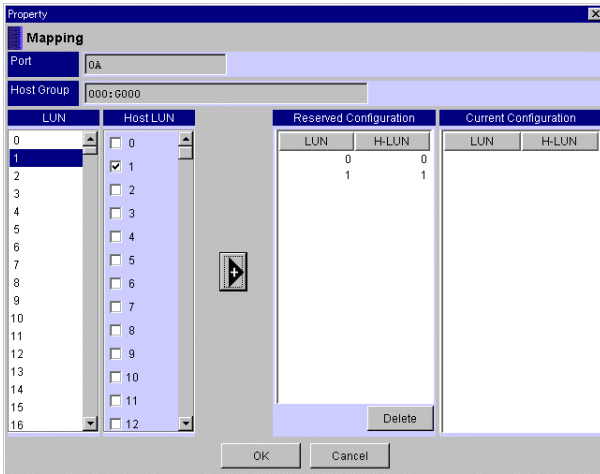
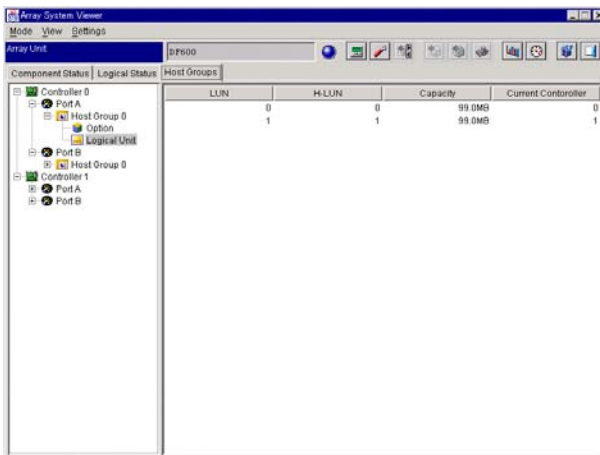


Figure 3.8 Mapping Property Panel

5. A confirmation message appears. Click the **OK** button.
The set mapping information is updated and the following window is displayed.



The LU mapping operation is now complete.

3.4 Defining the Configuration Definition File

The configuration definition file describes the system configuration in order to make CCI operational. The configuration definition file is a text file created and/or edited using any standard text editor, and can be defined from the PC where the CCI software is installed. This sample configuration definition file (HORCM_CONF), is included with the CCI software, and this file should be used as the basis for creating your configuration definition file(s). The system administrator should copy the sample file, set the necessary parameters in the copied file, and place the copied file in the proper directory. For details on configuration definition file, refer to the *Hitachi Freedom Storage™ Thunder 9500™ V Series Command Control Interface (CCI) User and Reference Guide (MK-92DF609)*.

The configuration definition file can be automatically created using the mkconf command tool. However, the parameters, such as poll(10ms) must be set manually (see step 4 below). For details on the mkconf command tool, refer to the *Hitachi Freedom Storage™ Thunder 9500™ V Series Command Control Interface (CCI) User and Reference Guide (MK-92DF609)*.

The following describes an example for manually defining the configuration definition file, when the system is configured with two instances within the same server (Windows NT®/2000).

1. On the host where CCI is installed, verify that the CCI is not running. If the CCI software is still running, shut down the CCI software using the horcmshutdown command. For details on horcmshutdown, refer to the *Hitachi Freedom Storage™ Thunder 9500™ V Series Command Control Interface (CCI) User and Reference Guide (MK-92DF609)*.
2. In the command prompt, make two copies of the sample file (horcm.conf).

Example:

```
c:\HORCM\etc> copy \HORCM\etc\horcm.conf \WINNT\horcm0.conf
c:\HORCM\etc> copy \HORCM\etc\horcm.conf \WINNT\horcm1.conf
```

3. Open horcm0.conf using the text editor.
4. In the **HORCM_MON** section, set the necessary parameters.

Important: A value more than or equal to 6000 must be set for poll(10ms). Please refer to the *Hitachi Freedom Storage™ Thunder 9500™ V Series Command Control Interface (CCI) User and Reference Guide (MK-92DF609)* for details on calculating the poll(10ms) value. Specifying the value incorrectly may cause resource contention in the internal process; the process is temporarily suspended and pauses the internal processing of the subsystem. For more details on configuration parameters, refer to the *Hitachi Freedom Storage™ Thunder 9500™ V Series Command Control Interface (CCI) User and Reference Guide (MK-92DF609)*.

- In the **HORCM_CMD** section, specify the physical drive (command device) on the subsystem.

```

horcm0.conf - Notepad
File Edit Search Help
HORCH_MON
#ip_address      service      poll(10ms)    timeout(10ms)
XXXXXXXXX        5000         12000         3000

HORCH_CMD
#dev_name        dev_name      dev_name
\\.\PHYSICALDRIVE1

HORCH_DEV
#dev_group       dev_name      port#          TargetID       LU#           MU#
UG01             oradb1        CL1-A         1              1             0

HORCH_INST
#dev_group       ip_address    service
UG01             XXXXXXXXX    5001

```

Figure 3.9 Horcm0.conf Example

- Save the configuration definition file and use the horcmstart command to start the CCI software. For details on horcmstart, refer to the *Hitachi Freedom Storage™ Thunder 9500™ V Series Command Control Interface (CCI) User and Reference Guide (MK-92DF609)*.
- Execute the raidscan command and write down the target ID displayed in the execution result. For details on the raidscan command, refer to the *Hitachi Freedom Storage™ Thunder 9500™ V Series Command Control Interface (CCI) User and Reference Guide (MK-92DF609)*.
- Shut down the CCI software and then open the configuration definition file again.
- In the **HORCM_DEV** section, set the necessary parameters. For the target ID, set the ID of the raidscan result you wrote down. Also, the item **MU#** must be added after the **LU#**, and the value must be set as 0 (zero).
- In the **HORCM_INST** section, set the necessary parameters, and then save (overwrite) the file.
- Repeat step 3 to 10 for the horcm1.conf file (Figure 3.10).

```

horcm1.conf - Notepad
File Edit Search Help
HORCH_MON
#ip_address      service      poll(10ms)    timeout(10ms)
XXXXXXXXX        5001         12000         3000

HORCH_CMD
#dev_name        dev_name      dev_name
\\.\PHYSICALDRIVE1

HORCH_DEV
#dev_group       dev_name      port#          TargetID       LU#           MU#
UG01             oradb1        CL1-A         1              2             0

HORCH_INST
#dev_group       ip_address    service
UG01             XXXXXXXXX    5001

```

Figure 3.10 Horcm1.conf Example

12. Enter the following in the command prompt to verify the connection between CCI and the subsystem.

Example:

```
C:\>cd horcm\etc

C:\horcm\etc>echo hd1-3 | .inqraid
Harddisk 1 -> [ST] CL1-A Ser = 174 LDEV= 0 [HITACHI ] [DF600F-CM ]
Harddisk 2 -> [ST] CL1-A Ser = 174 LDEV= 1 [HITACHI ] [DF600F ]
                HORC = NONE HOMRCF[MU#0 = SMPL MU#1 = NONE MU#2 = NONE]
                RAID5[Group 1-0] SSID = 0x0000
Harddisk 3 -> [ST] CL1-A Ser = 174 LDEV= 2 [HITACHI ] [DF600F ]
                HORC = NONE HOMRCF[MU#0 = SMPL MU#1 = NONE MU#2 = NONE]
                RAID5[Group 2-0] SSID = 0x0000

C:\horcm\etc>
```

For details on configuration definition file, refer to the *Hitachi Freedom Storage™ Thunder 9500™ V Series Command Control Interface (CCI) User and Reference Guide (MK-92DF609)*.

3.5 Setting the Environment Variable

To perform ShadowImage 9500V operations, you must set the environment variable for the execution environment. The following describes an example supposing the system configuration with two instances within the same server (Windows NT[®]/2000).

1. Set the environment variable for each instance. Enter the following from the command prompt.

Example:

```
C:\HORCM\etc>set HORCMINST=0
```

2. To use ShadowImage 9500V, you must set the environment variable shown below.

Example:

```
C:\HORCM\etc>set HORCC_MRCF=1
```

3. Execute the horcmstart script, and then execute the pairdisplay command to verify the configuration.

Example:

```
C:\HORCM\etc>horcmstart 0 1
starting HORCM inst 0
HORCM inst 0 starts successfully.
starting HORCM inst 1
HORCM inst 1 starts successfully.

C:\HORCM\etc>pairdisplay -g VG01
group  PairVOL(L/R)  (Port#,TID,LU-M),Seq#,LDEV#.P/S,Status, Seq#,P-LDEV# M
VG01   oradb1(L)     (CL1-A , 1, 1-0) 174  1..SMPL  ----,-----  ----  -
VG01   oradb1(R)     (CL1-A , 1, 2-0) 174  2..SMPL  ----,-----  ----  -
```

Preparing for ShadowImage 9500V operation is now complete.

Chapter 4 Performing ShadowImage 9500V Operations

This chapter provides examples of ShadowImage 9500V commands using the Windows NT®/2000 systems. The icons of the pairs, which indicate pair status in Resource Manager 9500V, are also displayed.

To execute ShadowImage 9500V commands, from the host where CCI is installed, display the command prompt.

4.1 Creating ShadowImage 9500V Pairs (paircreate)

To create ShadowImage 9500V pairs:

1. For example, if the group name in the configuration definition file is VG01, follow these steps:

Execute the `pairdisplay` command to verify that the status of the ShadowImage 9500V volumes is `SMPL`.

```
C:\HORCM\etc>pairdisplay -g VG01
Group PairVol(L/R) (Port#,TID,LU-M),Seq#,LDEV#.P/S,Status, Seq#,P-LDEV# M
VG01 oradb1(L) (CL1-A ,1, 1-0) 174 1..SMPL ----,----- ---- -
VG01 oradb1(R) (CL1-A ,1, 2-0) 174 2..SMPL ----,----- ---- -
```

Figure 4.1 Paircreate Command Example

2. Execute the `paircreate` command. When executing the command, always use the `-c` option with the value 15 to specify the copying pace. And then, execute the `pairevtwait` command to verify that the status of each volume is `PAIR`.

Example:

```
C:\HORCM\etc>paircreate -g VG01 -vl -c 15
C:\HORCM\etc>pairevtwait -g VG01 -s pair -t 300 10
pairevtwait : Wait status done.
```

3. Execute the `pairdisplay` command to verify the pair status and the configuration.

Example:

```
C:\HORCM\etc>pairdisplay -g VG01
Group PairVol(L/R) (Port#,TID,LU-M),Seq#,LDEV#.P/S,Status, Seq#,P-LDEV# M
VG01 oradb1(L) (CL1-A ,1, 1-0) 174 1..P-VOL PAIR, 174 2 -
VG01 oradb1(R) (CL1-A ,1, 2-0) 174 2..S-VOL PAIR,----- 1 -
```

The ShadowImage 9500V pair is created. For details on the `paircreate` command and its options, refer to the *Hitachi Freedom Storage™ Thunder 9500™ V Series Command Control Interface (CCI) User and Reference Guide (MK-92DF609)*.

4.2 Splitting ShadowImage 9500V Pairs (pairsplit)

To split ShadowImage 9500V pairs:

1. For example, if the group name in the configuration definition file is VG01:

Execute the **pairsplit** command to split the ShadowImage 9500V pair in the PAIR status.

```
C:\HORCM\etc>pairsplit -g VG01
```

Figure 4.2 Pairsplit Command Example

2. Execute the **pairdisplay** command to verify the pair status and the configuration.

```
C:\HORCM\etc>pairdisplay -g VG01
Group PairVol(L/R) (Port#,TID,LU-M),Seq#,LDEV#.P/S,Status, Seq#,P-LDEV# M
VG01 oradb1(L) (CL1-A ,1, 1-0) 174 1..P-VOL PSUS, 174 2 -
VG01 oradb1(R) (CL1-A ,1, 2-0) 174 2..S-VOL SSUS,----- 1 -
```

The ShadowImage 9500V pair is split. For details on the **pairsplit** command and its options, refer to the *Hitachi Freedom Storage™ Thunder 9500™ V Series Command Control Interface (CCI) User and Reference Guide (MK-92DF609)*.

4.3 Resynchronizing ShadowImage 9500V Pairs (pairresync)

To resynchronize ShadowImage 9500V pairs:

1. For example, if the group name in the configuration definition file is VG01:

Execute the **pairresync** command to resynchronize the ShadowImage 9500V pair. When executing the command, always use the **-c** option with the value 15 to specify the copying pace. Then execute the **pairevtwait** command to verify that the status of each volume is PAIR.

```
C:\HORCM\etc>pairresync -g VG01 -c 15
C:\HORCM\etc>pairevtwait -g VG01 -s pair -t 300 10
pairevtwait : Wait status done.
```

Figure 4.3 Pairresync Command Example

2. Execute the **pairdisplay** command to verify the pair status and the configuration.

Example:

```
C:\HORCM\etc>pairdisplay -g VG01
Group PairVol(L/R) (Port#,TID,LU-M),Seq#,LDEV#.P/S,Status, Seq#,P-LDEV# M
VG01 oradb1(L) (CL1-A ,1, 1-0) 174 1..P-VOL PAIR, 174 2 -
VG01 oradb1(R) (CL1-A ,1, 2-0) 174 2..S-VOL PAIR,----- 1 -
```

The ShadowImage 9500V pair is resynchronized. For details on the **pairresync** command and its options, refer to the *Hitachi Freedom Storage™ Thunder 9500™ V Series Command Control Interface (CCI) User and Reference Guide (MK-92DF609)*.

4.4 Suspending ShadowImage 9500V Pairs (pairsplit -E)

To suspend under error the ShadowImage 9500V pairs:

1. For example, if the group name in the configuration definition file is VG01:

Execute the **pairdisplay** command to verify that the pair to be suspended is in PAIR status.

Example:

```
C:\HORCM\etc>pairdisplay -g VG01
Group PairVol(L/R) (Port#,TID,LU-M),Seq#,LDEV#.P/S,Status, Seq#,P-LDEV# M
VG01 oradb1(L) (CL1-A ,1, 1-0) 174 1..P-VOL PAIR, 174 2 -
VG01 oradb1(R) (CL1-A ,1, 2-0) 174 2..S-VOL PAIR,----- 1 -
```

2. Execute the **pairsplit (pairsplit -E)** command to suspend under error the ShadowImage 9500V pair.

```
C:\HORCM\etc>pairsplit -g VG01 -E
```

Figure 4.4 Pairsplit -E Command Example

3. Execute the **pairdisplay** command to verify that the pair status changed to PSUE.

Example:

```
C:\HORCM\etc>pairdisplay -g VG01
Group PairVol(L/R) (Port#,TID,LU-M),Seq#,LDEV#.P/S,Status, Seq#,P-LDEV# M
VG01 oradb1(L) (CL1-A ,1, 1-0) 174 1..P-VOL PSUE, 174 2 -
VG01 oradb1(R) (CL1-A ,1, 2-0) 174 2..S-VOL PSUE,----- 1 -
```

The ShadowImage 9500V pair is split. For details on the **pairsplit** command and the **-E** option, refer to the *Hitachi Freedom Storage™ Thunder 9500™ V Series Command Control Interface (CCI) User and Reference Guide (MK-92DF609)*.

4.5 Releasing ShadowImage 9500V Pairs (pairsplit -S)

To release the ShadowImage 9500V pair and change the status to SMPL:

1. For example, if the group name in the configuration definition file is VG01:

Execute the **pairdisplay** command to verify that the status of the ShadowImage 9500V pair is PAIR.

Example:

```
C:\HORCM\etc>pairdisplay -g VG01
Group PairVol(L/R) (Port#,TID,LU-M),Seq#,LDEV#.P/S,Status, Seq#,P-LDEV# M
VG01 oradb1(L) (CL1-A ,1, 1-0) 174 1..P-VOL PAIR, 174 2 -
VG01 oradb1(R) (CL1-A ,1, 2-0) 174 2..S-VOL PAIR,----- 1 -
```

2. Execute the **pairsplit (pairsplit -S)** command to release the ShadowImage 9500V pair.

```
C:\HORCM\etc>pairsplit -g VG01 -S
```

Figure 4.5 Pairsplit -S Command Example

3. Execute the **pairdisplay** command to verify that the pair status changed to SMPL.

Example:

```
C:\HORCM\etc>pairdisplay -g VG01
Group PairVol(L/R) (Port#,TID,LU-M),Seq#,LDEV#.P/S,Status, Seq#,P-LDEV# M
VG01 oradb1(L) (CL1-A ,1, 1-0) 174 1..SMPL ----,----- 2 -
VG01 oradb1(R) (CL1-A ,1, 2-0) 174 2..SMPL ----,----- 1 -
```





The ShadowImage 9500V pair is released. For details on the **pairsplit** command and the **-S** option, refer to the *Hitachi Freedom Storage™ Thunder 9500™ V Series ShadowImage 9500V User's Guide Interface (CCI) User and Reference Guide (MK-92DF609)*.

4.6 Confirming the Status of Pairs

The status of the logical units through CCI can be confirmed in the Resource Manager 9500V.

The status of the logical units is displayed in icon format in the **Logical Status** page of the Array System Viewer panel.

Table 4.1 Icons for Pair Status

Icons	Paired Status	Meaning
 yellow	PAIR	Indicates the paired volume
 light yellow	COPY	Indicates a paired status, but initial copy or resync operation is not complete
 yellow and blue	PSUS	In paired status, but updates to the S-VOL data are suspended due to user-requested pairsplit.
 red	PSUE	In paired status, but updates to the S-VOL data are suspended forcibly or due to an error condition.

Verify the properties of the coupled logical unit by double clicking the icon. The Property panel will be displayed.

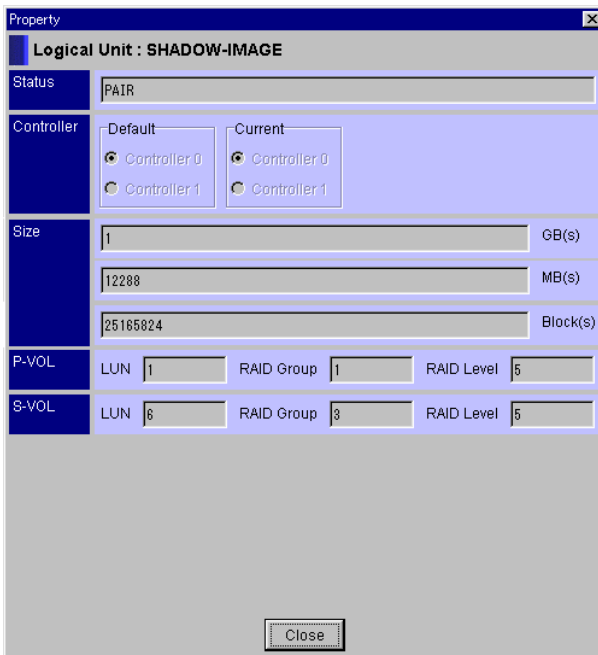


Figure 4.6 Property Panel

4.7 Troubleshooting

When a software error occurs while operating ShadowImage 9500V, user operation (CCI operation by the user) is necessary in addition to system maintenance performed by Hitachi Data Systems personnel.

For example, when formatting is necessary due to an LU error and that LU is used for ShadowImage 9500V, the pair must be released by the user (CCI operation by the user) before formatting the LU. Therefore, contact Hitachi Data Systems personnel because maintenance requires the user to issue CCI commands. Note that Hitachi Data Systems personnel can only remove the error caused by the hardware. Operations such as recovering a ShadowImage 9500V pair status (e.g. resynchronizing) must be done by the user.

If you have a problem with the ShadowImage 9500V operation, refer to the troubleshooting section in the *Hitachi Freedom Storage™ Thunder 9500™ V Series Command Control Interface (CCI) User and Reference Guide (MK-92DF609)*. ShadowImage 9500V error messages and procedures for recovering the PSUE errors are described in detail.

Chapter 5 ShadowImage Basic Specifications and Function Comparison with the 9900 Disk Array Subsystem

5.1 External Specifications

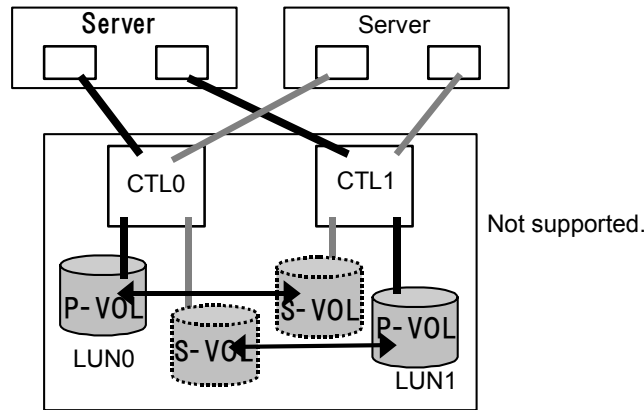
This section describes basic ShadowImage specifications. For details of functional specifications and a functional comparison between the 9900 disk array subsystem, see the *Hitachi Freedom Storage™ Lightning 9900™ V Series ShadowImage 9900 User's Guide 9900 (MK-92RD110)* reference manual.

Table 5.1 External Specifications

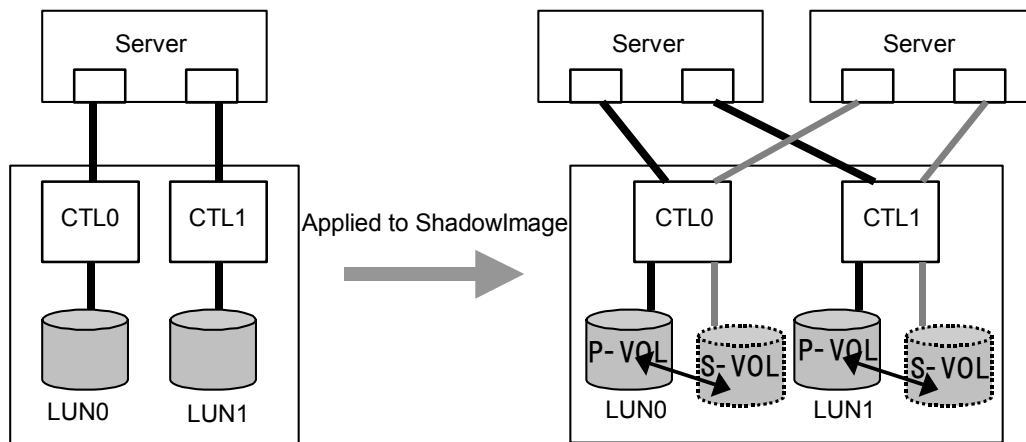
No.	Item	9500V	9900 ShadowImage (reference)
1	Applicable model	9500V/9530 (For dual configuration only.)	—
2	Number of pairs	31 (maximum)	64 or 512 (maximum) (depends on the configuration of the subsystem)
3	Number of command devices	Two LUs (see Note 1)	No restriction
4	Pair structure (number of S-VOLs per P-VOL)	1:1	1:9 (1×3×3)
5	P-VOL and S-VOL arrangement (SMPL)	Within the same CTL (see Note 2)	No restriction
6	RAID level	P-VOL: RAID 1+0, RAID 5 (“with redundancy” only) S-VOL: RAID 0, RAID 1+0, RAID 5 (“with redundancy” recommended)	[1–1], [5–5], [1–5], [5–1] For RAID 5, 3D+1P only.
7	RAID configuration for P-VOL and S-VOL	P-VOL and S-VOL can be paired between different RAIDs. Note that <i>N</i> for ND of P-VOL and S-VOL must be the same.	P-VOL and S-VOL can be paired between different RAIDs. Only N=3 is supported.
8	Coupling capacity	At maximum 288 GB × 224 units	At maximum 4,096 logical volumes
9	Mixing ShadowImage and non-ShadowImage	Available (mixing within CTL, and between CTLs are available) (see Note 4)	—
10	Host interface	Fibre	Fibre only
11	Size of P-VOL and S-VOL	P-VOL = S-VOL	
12	Deleting during Coupling (RAID group, P-VOL, S-VOL) Formatting during Coupling Expansion during Coupling	Not available	Not available

Note 1: For details on command devices, see the *Hitachi Freedom Storage™ Thunder 9500™ V Series Command Control Interface (CCI) User and Reference Guide (MK-92DF609)*. Command devices can be shared between multiple servers. However, this does not mean the data is shared. Command devices must not be used by ordinary applications. Set the command device with caution. For details on setting the command device, see the *Hitachi Freedom Storage™ Thunder 9500™ V Series Command Control Interface (CCI) User and Reference Guide (MK-92DF609)*.

Note 2: The configuration shown below (the P-VOL and S-VOL arranged to across two different CTLs) is not supported.



Concept:



Configuration for ordinary system operation (without ShadowImage):
Usually, LUs are assigned to each dual controller (LU ownership), and the system is used in Active-Active mode.

ShadowImage Configuration:
The S-VOLs are defined to each LU within and under the same controller, and the system is used in Active-Active mode.

Figure 5.1 Concept

Note 3: The *N* for ND of P-VOL and S-VOL must be the same (*N* = Number of data drives in RAID). For example: RAID 5 (2*D*+1) for P-VOL and RAID 5 (5*D*+1) for S-VOL are invalid. RAID 1+0 (4*D*+4*P*) for P-VOL and RAID 5 (4*D*+1) for S-VOL are valid.

Note 4: Mixing LUs (P-VOL and S-VOL) of ShadowImage and LUs of non-ShadowImage are available within the 9500V subsystem. However, note that there may be some effects to the performance. The performance decreases when the resync mode is in priority during resynchronization (even if the LUs are non-ShadowImage).

5.2 Functions

Table 5.2 lists and describes ShadowImage 9500V functions.

Table 5.2 Functions

No.	Function	Contents
1	Pair Creation	Supported For P-VOL: Read/Write For S-VOL: Read only
2	Pair Splitting	Supported For P-VOL: Read/Write For S-VOL: Read/Write
3	Resynchronization (resync) in the Direction of P-VOL to S-VOL	Supported For P-VOL: Read/Write For S-VOL: Read only
4	Resynchronization (reverse resync) in the Direction of S-VOL to P-VOL	Supported For P-VOL: Read from S-VOL/Write For S-VOL: Read only See explanation below for details. (Figure 5.3)
5	Pair Suspension (Note 1)	Supported For P-VOL: Read/Write For S-VOL: Read only
6	Pair Release	Supported
7	Quick Pair Creation & Splitting	Not supported See explanation below for details (Figure 5.4).
8	Quick Resync & Splitting	This function will be supported with the DF600 enhancement. See explanation below for details. (Figure 5.5)
9	Splitting	Supported Immediate split is possible (data is also fixed immediately).
10	Switching Between P-VOL and S-VOL	Not supported

Note1: Read/Write command cannot be executed for P-VOL and for S-VOL when the pair is suspended during resynchronization.

This section includes the following:

- Pair Creation
- Pair Splitting
- Resynchronization (resync) in the Direction of P-VOL to S-VOL
- Resynchronization (resync) in the Direction of S-VOL to P-VOL
- Pair Suspension
- Pair Release
- Quick Pair Creation and Splitting
- Quick Resync and Splitting

5.2.1 Pair Creation

The ShadowImage paircreate operation establishes the newly specified ShadowImage pair(s). The volumes that will become the P-VOL and S-VOL must be in the SMPL (simplex) state before being joined as a ShadowImage pair.

The ShadowImage initial copy operation takes place when you create a new ShadowImage pair. The ShadowImage initial copy operation copies all data on the P-VOL to the associated S-VOL. The P-VOL remains available to all hosts for read and write I/Os throughout the initial copy operation. Write operations performed on the P-VOL during the initial copy operation will always be duplicated to the S-VOL. The status of the pair is COPY(PD) (PD = pending) while the initial copy operation is in progress. The pair status changes to PAIR when the initial copy is complete.

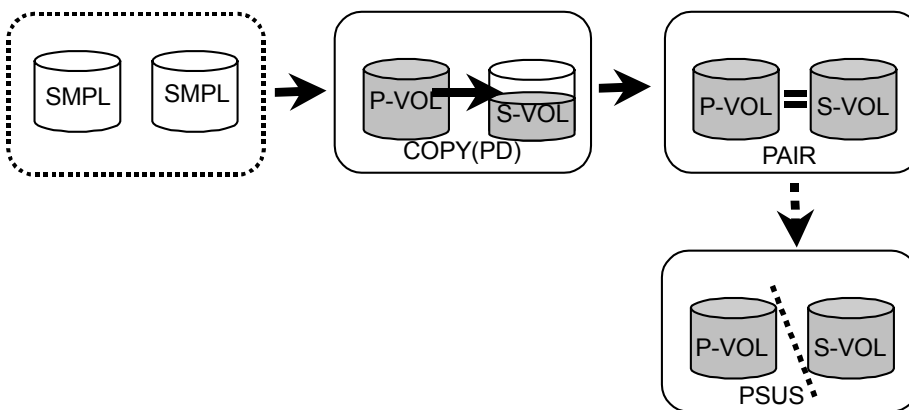


Figure 5.2 Pair Creation

5.2.2 Pair Splitting

The ShadowImage pairsplit operation performs all pending S-VOL updates (those issued prior to the split command and recorded in the P-VOL track map) to make the S-VOL identical to the state of the P-VOL when the split command was issued, and then provides full read/write access to the split S-VOL. You can split existing pairs as needed, and you can also use the pairsplit operation to create and split pairs in one step. This feature provides point-in-time backup of your data, and also facilitates real data testing by making the ShadowImage copies (S-VOLs) available for host access.

5.2.3 Resynchronization (resync) in the Direction of P-VOL to S-VOL

The ShadowImage pairresync operation resynchronizes the split pairs (PSUS) or the suspended pairs (PSUE). When the pairresync operation starts, the pair status changes to COPY(RS) or COPY(RS-R). The pair status changes to PAIR when the pairresync operation completes.

The normal pairresync operation resynchronizes the S-VOL with the P-VOL. The copy direction for a normal pairresync operation is P-VOL to S-VOL. The pair status during a normal resync operation is COPY(RS). The S-VOL becomes inaccessible to all hosts for write operation, and the P-VOL remains accessible to all hosts for both read and write operations during a normal pairresync. The normal pairresync operation can be executed for pairs with the status PSUS and PSUE.

5.2.4 Resynchronization (resync) in the Direction of S-VOL to P-VOL

This function enables Read and Write access to P-VOL while resynchronizing in the direction of S-VOL to P-VOL (the Read access to P-VOL is performed from S-VOL). Therefore, reconstructing P-VOL data (due to a failure) from S-VOL can be performed and recovered quickly (shorten the time for stopping the host applications to P-VOL) without activating the P-VOL/S-VOL switch function.

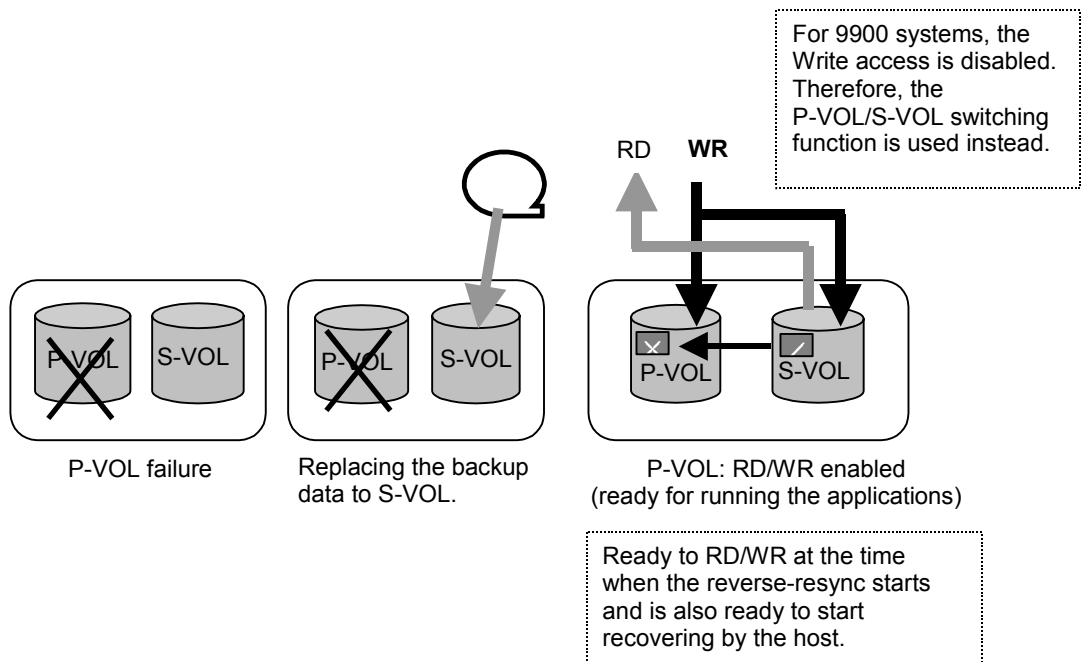


Figure 5.3 Resynchronization (reverse resync) in the Direction of S-VOL to P-VOL

5.2.5 Pair Suspension

The ShadowImage pairsplit-E operation suspends the ShadowImage copy operations to the S-VOL of the pair. A ShadowImage pair can be suspended by the user at any time. When a ShadowImage pair is suspended (status = PSUE), the subsystem stops performing ShadowImage copy operations to the S-VOL, continues accepting write I/O operations to the P-VOL, and marks the entire P-VOL track map as difference data. When a pairresync operation is performed on a suspended pair, the entire P-VOL is copied to the S-VOL (when a pairresync -restore operation is performed, the entire S-VOL is copied to the P-VOL). While the pairresync operation for a split ShadowImage pair can be very fast, the pairresync operation for a suspended pair will take as long as the initial copy operation.

The 9500V subsystem will automatically suspend a ShadowImage pair when it cannot keep the pair mirrored for any reason. When the 9500V suspends a pair, a file is output to the system log or event log to notify the host. The 9500V will automatically suspend a pair under the following conditions.

- When the ShadowImage volume pair has been suspended or deleted from the UNIX[®]/PC server host using the Hitachi Command Control Interface (CCI).
- When the 9500V detects an error condition related to an initial copy operation. When a volume pair with COPY(PD) status is suspended, the 9500V aborts the initial copy operation, changes the status of the P-VOL and S-VOL to PSUE and accepts all subsequent write I/Os to the P-VOL.

5.2.6 Pair Release

The ShadowImage pairsplit-S operation stops the ShadowImage copy operations to the S-VOL of the pair and releases the volume in paired status. A ShadowImage pair can be released by the user at any time except during the pairsplit operation (i.e., any status except SMPL). Volumes status changes to SMPL for both.

5.2.7 Quick Pair Creation and Splitting (not supported with 9500V)

This function enables pairs to be split immediately after the start of initial copy. This function processes initial copy internally to under cover the completion of splitting pairs to the host, and permits the host access to the P-VOL and S-VOL to execute jobs.

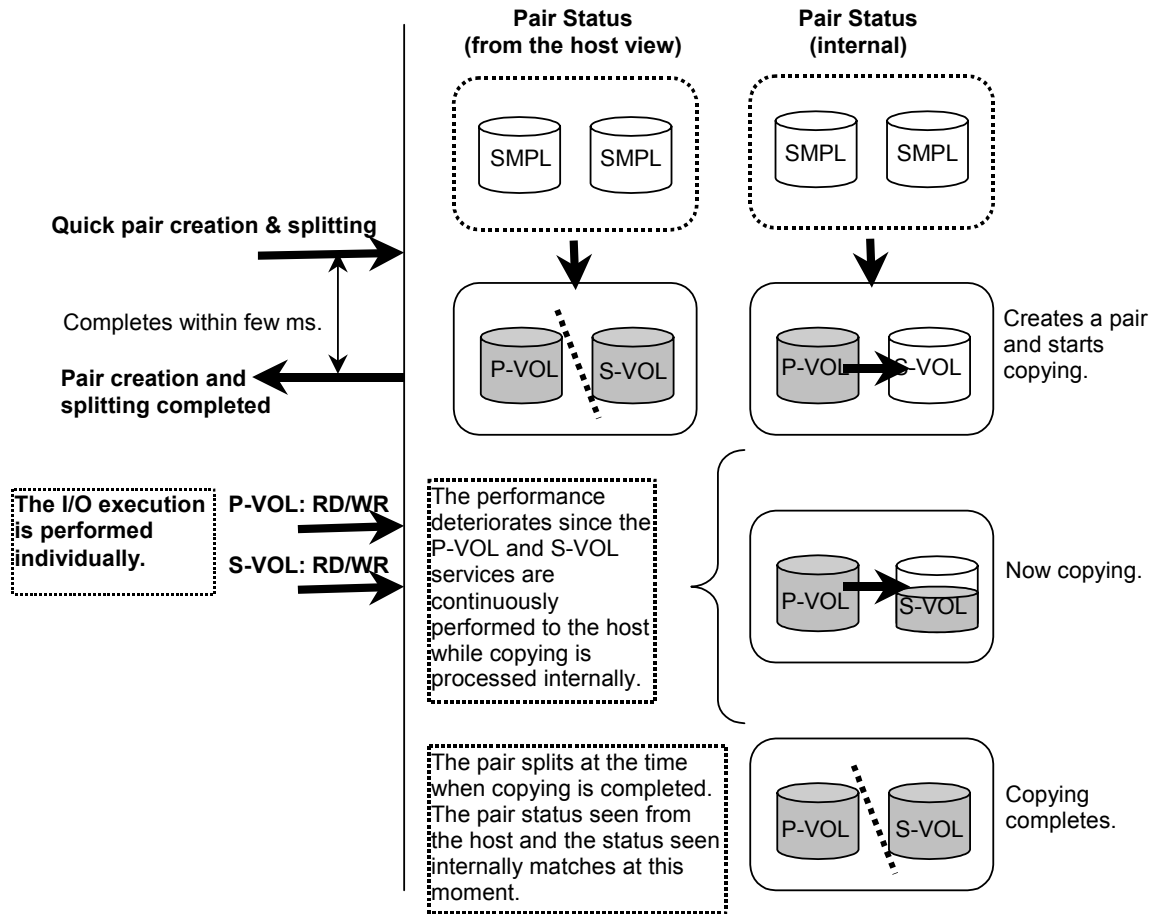


Figure 5.4 Quick Pair Creation and Splitting

5.2.8 Quick Resync and Splitting (supported with the 9500V enhancement)

This function enables the splitting of pairs immediately after the start of a resync operation (resynchronization). This function processes resynchronization internally to under cover the completion of resynchronization to the host, and permits the host access to the P-VOL and S-VOL to execute jobs.

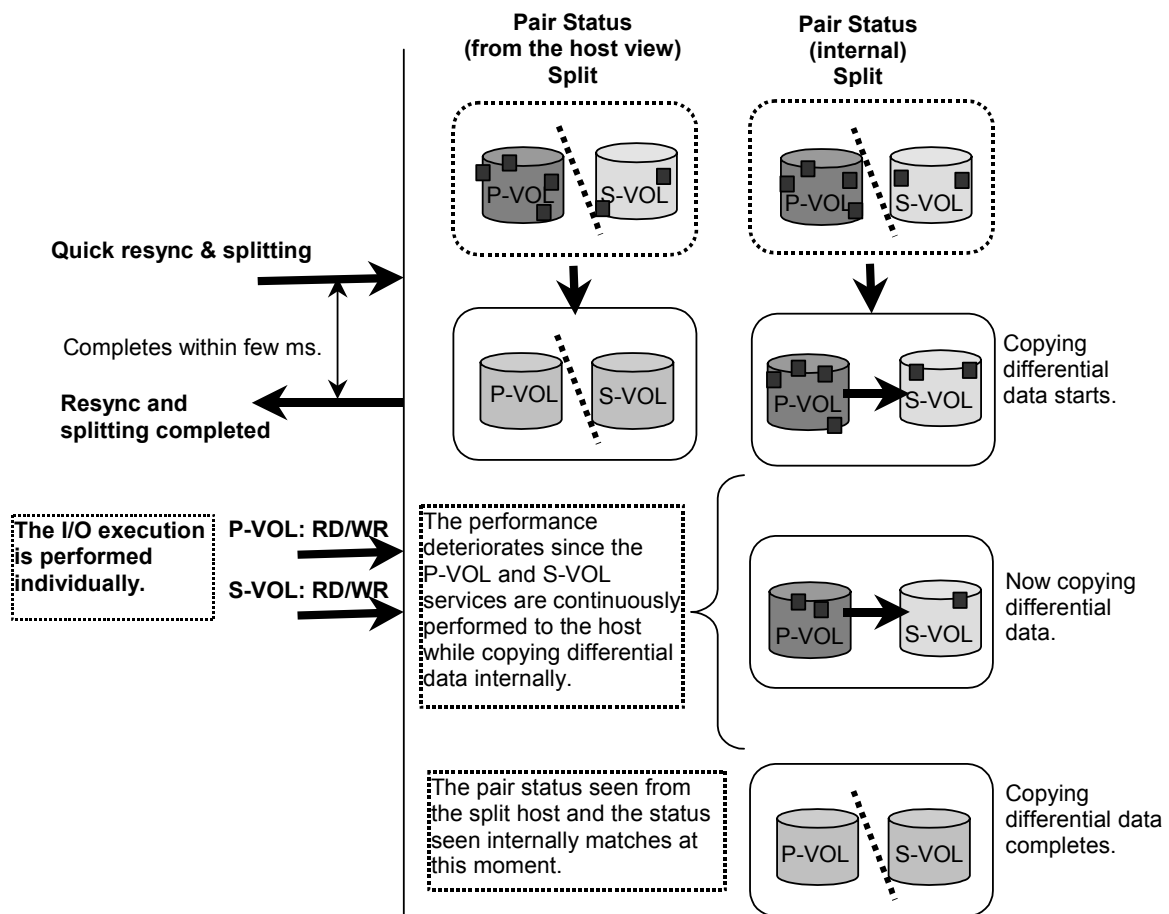
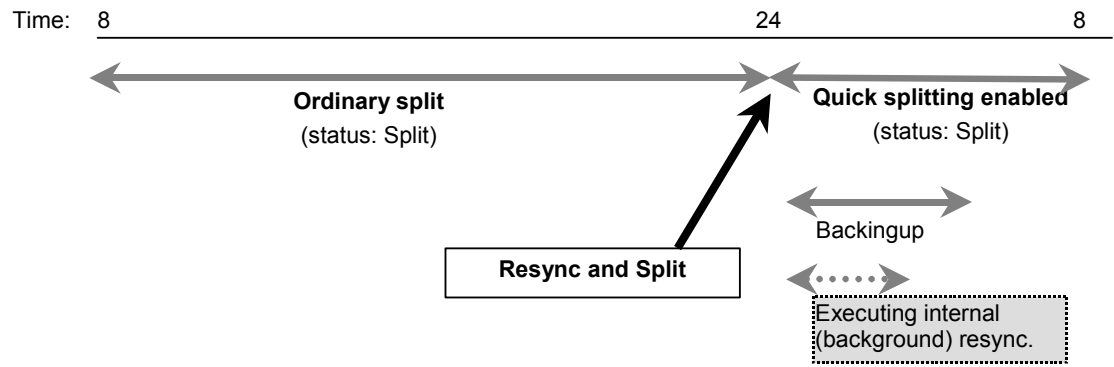


Figure 5.5 Quick Resync & Splitting

9900 Example (supported with the 9500V enhancement)



9500V Example

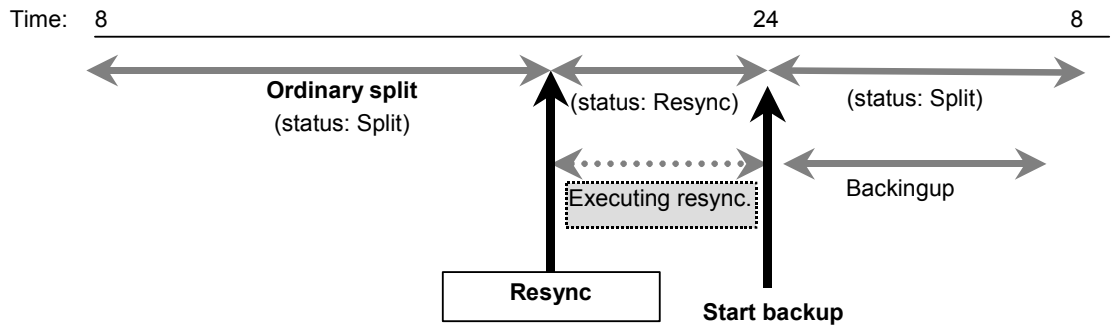


Figure 5.6 Quick Resync and Splitting Examples

5.3 Resync Operation and the Differential Data Copy Process

When a pair is split in ShadowImage, the P-VOL and S-VOL can be updated individually. It is different than coupling; updates on P-VOL will not be reflected to S-VOL while it is in suspension. Therefore, the user must synchronize the data again to match the P-VOL and S-VOL data after the suspend operation.

5.3.1 Managing Differential Data

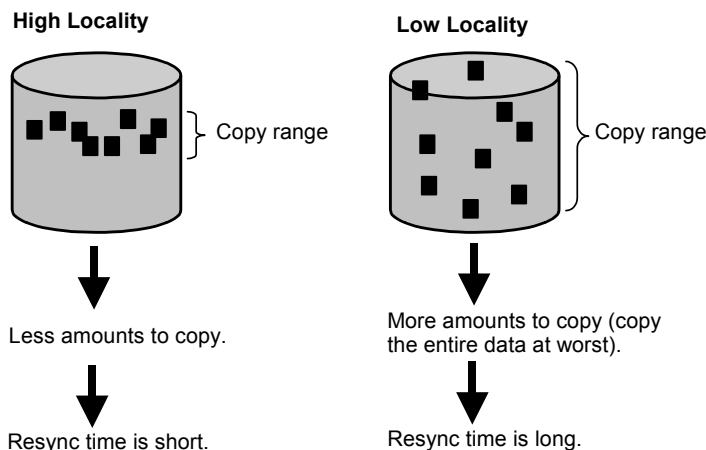
When the pair is suspended, the status of each volume (P-VOL and S-VOL) changes to be managed individually. To reunite the pairs, the user must resynchronize the volumes in order to match the data. However, regardless of the amount of updates, copying the entire volume takes time. Therefore, ShadowImage manages (records) the updated data for each volume (P-VOL and S-VOL) and copies only the differential data (called "differential data management") to help shorten the time for resynchronization.

5.3.2 Differential Data

The ShadowImage records both the P-VOL and S-VOL host Write positions on a bitmap and refers to these bitmaps when resynchronizing the volumes. ShadowImage copies only the differential data, so that the contents of the P-VOL and S-VOL match.

The range for a single bit within the bitmap is equivalent to 1 MB, therefore:

- A 1 KB update requires a 1 MB copy when resynchronizing the volume.
- The amount of data to copy becomes less when the access pattern from the host is localized.



■ : Updated data

Note: The ShadowImage performance evaluation described in Chapter 7 is measured in the status of low locality (entire copy).

Figure 5.7 Differential Data

5.4 ShadowImage 9500V Pair Status

ShadowImage 9500V displays the pair status of all ShadowImage 9500V volumes (LUs). Figure 5.8 illustrates the ShadowImage 9500V pair status transitions and the relationship between the pair status and the ShadowImage 9500V operations.

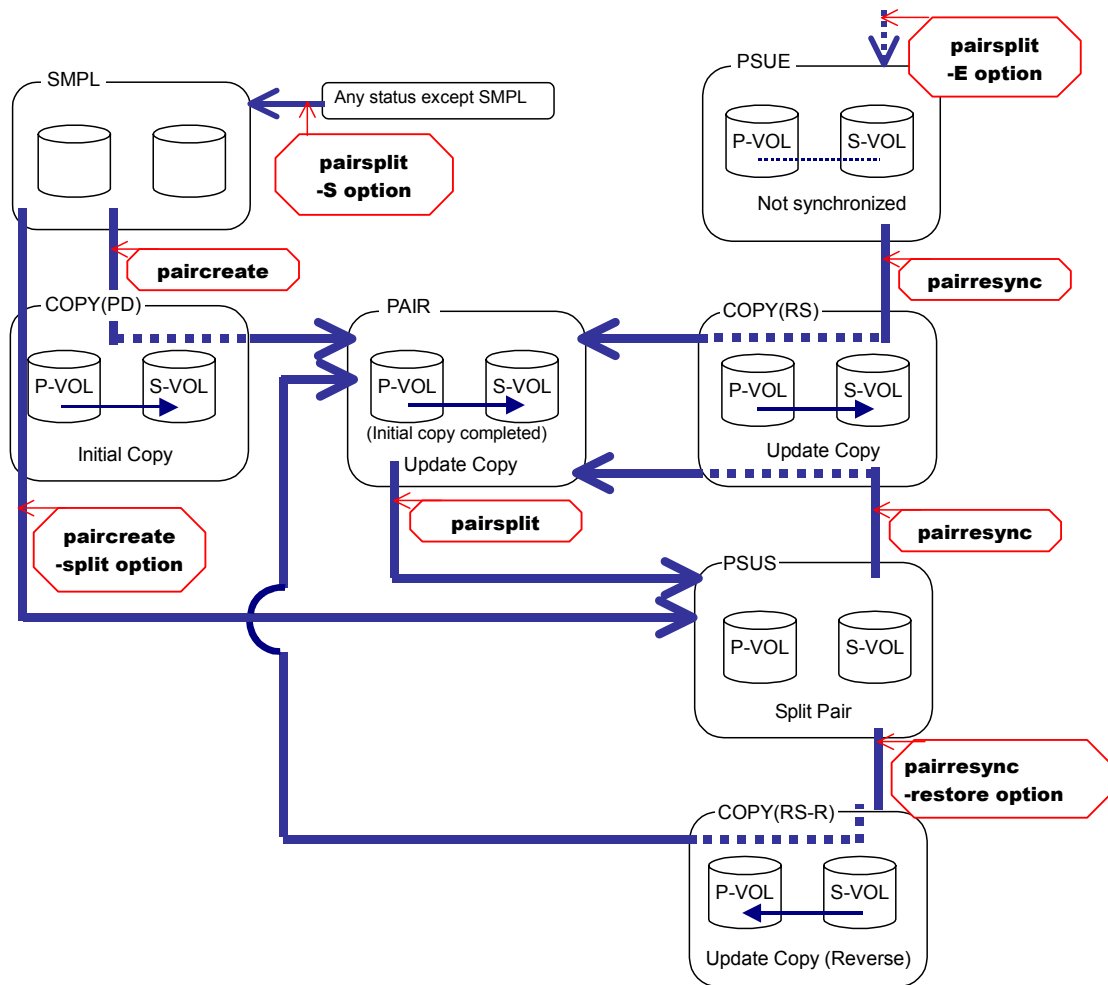


Figure 5.8 ShadowImage Pair Status Transitions

Table 5.3 lists and describes the ShadowImage 9500V pair status conditions. If a volume is not assigned to a ShadowImage 9500V pair, its status is SMPL. When you create a ShadowImage 9500V pair, the status of the P-VOL and S-VOL changes to COPY(PD). When the initial copy operation is complete, the pair status becomes PAIR. If the 9500V cannot maintain PAIR status for any reason, or if you suspend the pair (pairsplit -E), the pair status changes to PSUE. When you split a pair (pairsplit), the pair status changes to COPY(SP). When the pairsplit operation is complete, the pair status changes to PSUS to enable you to access the split S-VOL. When you start a pairresync operation, the pair status changes to COPY(RS). When you specify reverse mode for a pairresync operation (pairresync -restore), the pair status changes to COPY(RS-R) (data is copied in the reverse direction from the S-VOL to the P-VOL). When the pairresync operation is complete, the pair status changes to PAIR. When you release a pair (pairsplit -S), the pair status changes to SMPL.

Table 5.3 ShadowImage Pair Status

Pair Status	Description
SMPL	The volume is not assigned to a ShadowImage 9500V pair. The 9500V accepts read and write I/Os for all SMPL volumes.
COPY(PD)	The initial copy operation is in progress. The 9500V continues to accept read and write operations for the P-VOL but does not accept write operations for the S-VOL.
PAIR	The initial copy operation is complete, and the 9500V starts copying the write operation taken to the P-VOL data onto the S-VOL. The P-VOL and S-VOL of a duplex pair (PAIR status) is identical. The 9500V rejects all write I/Os for S-VOLs with the status PAIR.
PSUS	The 9500V starts accepting write I/Os for PSUS S-VOLs. The 9500V keeps track of all updates to the split P-VOL and S-VOL, so that the pair can be resynchronized quickly.
COPY(RS)	The 9500V does not accept write I/Os for COPY(RS) S-VOLs. When a split pair is resynchronized in normal mode, the 9500V copies only the P-VOL differential data to the S-VOL. When a PSUE (suspended) pair is resynchronized, the 9500V copies the entire P-VOL to the S-VOL.
COPY(RS-R)	The 9500V does not accept write I/Os for COPY(RS-R) S-VOLs. When a split pair is resynchronized in reverse mode, the 9500V copies only the S-VOL differential data to the P-VOL.
PSUE	The 9500V continues accepting read and write I/Os for a PSUE (suspended) P-VOL (however, if the status transits from COPY(RS-R), all access to P-VOL is disabled). The 9500V marks the entire P-VOL track map as difference data, so that the entire P-VOL is copied to the S-VOL when the PSUE pair is resumed. Use the pairresync command to resume a PSUE pair.

Chapter 6 ShadowImage System Configuration

This section includes the following:

- Path Connection
- Locating P-VOLs and S-VOLs
- P-VOLs and S-VOLs in RAID Configuration
- Others (example: mode setting)
- Supported Configurations

6.1 Path Connection

6.1.1 9570V

Configuration A is not recommended (the S-VOL is run by the other system's CTL). For the host side, use two ports per CTL (a single port per CTL causes an FC bottleneck on the host side and disables the process to perform).

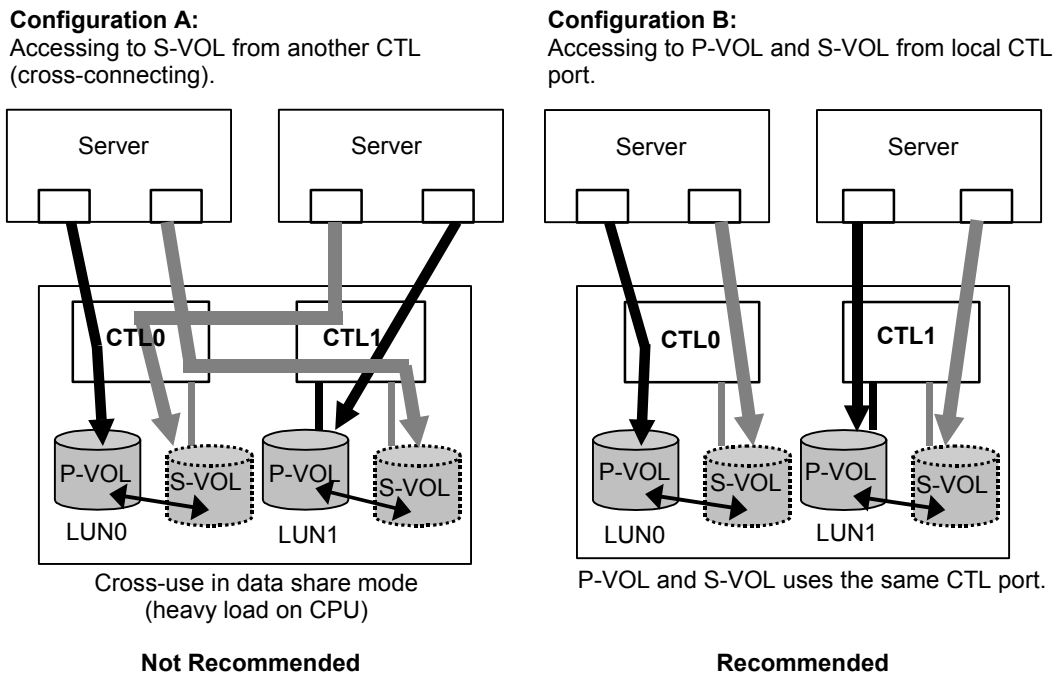


Figure 6.1 Path Connection (9570V)

6.1.2 9530V

The 9530V system cannot establish connections as was done with a 9570V; only a single port can be attached to a CTL. Therefore, different from the 9570V above, cross-connecting ports from other CTLs to the secondary side is recommended (when accessing the P-VOL and S-VOL through the same port, the performance to the P-VOL may deteriorate).

6.2 Locating P-VOLs and S-VOLs

This section includes the following:

- Location Recommendations for P-VOLs and S-VOLs
- Locating Multiple LUs Within the Same Drive Column
- ShadowImage Status Differences when Setting Multiple Pairs

6.2.1 Location Recommendations for P-VOLs and S-VOLs

DO NOT locate P-VOLs and S-VOLs within the same ECC group of the same RAID group:

- A single drive failure causes status degeneration in the P-VOL and S-VOL.
- Initial copy, coupling, and resync processes incurs a drive bottleneck which deteriorates performance.

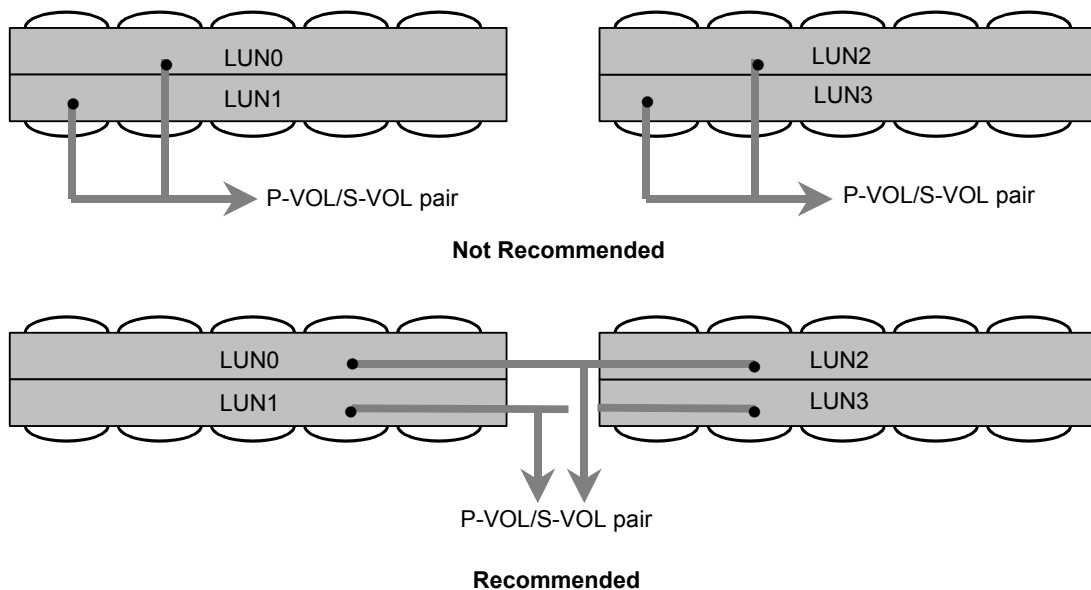


Figure 6.2 Locations for P-VOLs and S-VOLs (Not Recommended and Recommended)

6.2.2 Locating Multiple LUs within the Same Drive Column

If multiple LUs are set within the same parity group and if each pair state differs, it is difficult to estimate the performance and to design the system operational settings. An example is as follows: the LUN0 and LUN2 are both P-VOLs and exist within the same group in the same drive (S-VOLs are located in a different parity group) and when the LUN0 is in a coupling process and the LUN2 is in resync process.

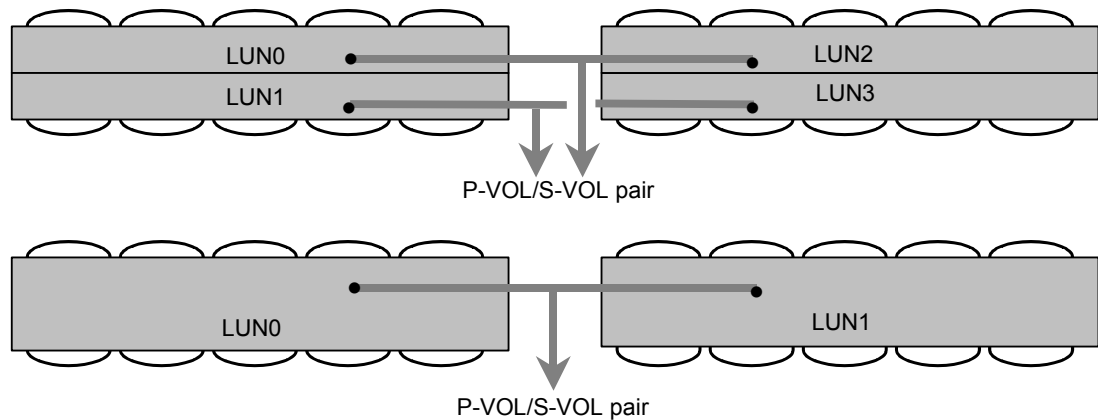


Figure 6.3 Locating Multiple LUs within the Same Drive Column

6.2.3 Pair Status Differences when Setting Multiple Pairs

Even with a single LU per parity group, it is recommended that you keep the status of pairs the same (such as SMPL, coupling, and split) when setting multiple ShadowImage pairs. If each ShadowImage pair status differs, it is difficult to estimate the performance when designing the system operational settings. For details on ShadowImage status, see the *Hitachi Freedom Storage™ Thunder 9500™ V Series Command Control Interface (CCI) User and Reference Guide (MK-92DF609)*.

6.3 P-VOLs and S-VOLs in a RAID Configuration

Note the following about P-VOLs and S-VOLs in RAID configuration:

- For P-VOL: RAID level with redundancy is necessary.
- For S-VOL: RAID level with redundancy is recommended.
- The number of drives ($ND+1$, $ND+NP$, and N of ND) for P-VOL and S-VOL in the RAID configuration must be the same.
- P-VOL redundancy => S-VOL redundancy
(N = number of data drives in RAID)

Table 6.1 P-VOLs and S-VOLs in a RAID Configuration

No.	P-VOL	S-VOL	Amount of User Data	Total Amount of ShadowImage	Share of User Data
1	RAID 1+0 ($N = 1$ to 8)	RAID 1+0 ($N = 1$ to 8)	1	4	1/4
2	RAID 1+0 ($N = 1$ to 8)	RAID 5 ($N = 1$ to 8)	1	$2+1.25 = 3.25$	1/3.25
3	RAID 1+0 ($N = 2$ to 8)	RAID 0 ($N = 2$ to 8)	1	$2+1 = 3$	1/3
4	RAID 5 (see Note 1) (When $N = 4$)	RAID 5 (When $N = 4$)	1	$1.25+1.25 = 2.5$	1/2.5
	RAID 5 (see Note 2) (When $N = 4$)	RAID 0 (When $N = 4$)	1	$1.25+1 = 2.25$	1/2.25

Note 1: Total amount of ShadowImage = $(1+1/N) \times 2$

Note 2: Total amount of ShadowImage = $(1+1/N)+1$

The recommended RAID configuration is RAID 5 (4D+1)/RAID 5 (4D+1):

- 4D+1 has an outstanding performance in RAID.
- Large number of 4D+1 has been adopted based on the past sales record.
- The cost can be cut down due to the large share of user data.

6.4 Others (example: mode setting)

Set the copy pace for initial copy and restoring. The criteria is as follows:

1. Prioritize the resync operation (recommended).
Enter a value 15 for <size> to set the copy pace.
2. Select **Normal** only when placing importance on the performance to the P-VOL during a resync operation.

This can be specified when there is no update processes during the resync operation. The copy time for the resync operation is not guaranteed. (The copy time for resync operation delay depends on the I/O performance.)

3. For estimating the resync time, see 5.3. **DO NOT SELECT** "Slow".

Table 6.2 Relationship Between the Copy Pace Parameters and Resync Process

No.	Parameters	Resync Pace	Resync Process	Host's I/O Performance
1	1 to 5	Slow (<u>do not select</u>)	Single copy unit (stripe size) is processed per copy every 10 ms. The process is performed in longer intervals if the I/O performance from the host is heavy. The time of resync completion cannot be guaranteed because the pace differs depending on the I/O performance from the host. Minimum: 1 MB/S Maximum: 16 MB/S	Random type: Executing 90 % of host limitation is possible. Sustained type: Read: Executing 90 % of host limitation is possible. Write: Executing 40 % of host limitation is possible.
2	6 to 10	Normal	The resync process is performed continuously, but the time of resync completion cannot be guaranteed. The pace differs depending on the I/O performance from the host.	Same as above.
3	11 to 15	Prior	The resync process is performed continuously and takes prior. Therefore, the I/O performance from the host is restricted. The time of resync completion is guaranteed.	Random Read: Random Write: Sequential Read: Sequential Write:

Chapter 7 System Operation Example

This section includes the following:

- 9500V System in Full-Time Operation (Backup and Resync at Night)
- 9500V in Full-Time Split Operation
- 9530V Recommended Configuration

7.1 9500 System in Full-Time Operation (Backup and Resync at Night)

- Backup using DLT8000 (assuming the backup speed of DLT8000 is 7MB/sec)
 - Backup must be performed from two ports at the same time.
 - The total of P-VOL and S-VOL must be less than or equal to 0.5 TB. (Since this varies depending on the backup speed, the capacity restriction shall be alleviated through connection of the highest speed tape device available.)
(For example, If P-VOL is 252 GB, backup takes 5 hours and 10 minutes for 14 MB/sec.)
 - During resynchronization, backup is performed when the host load is at minimum (less than 1,000 IOPS).
 - The backup operation is executable under a high load (up to 2,000 IOPS).

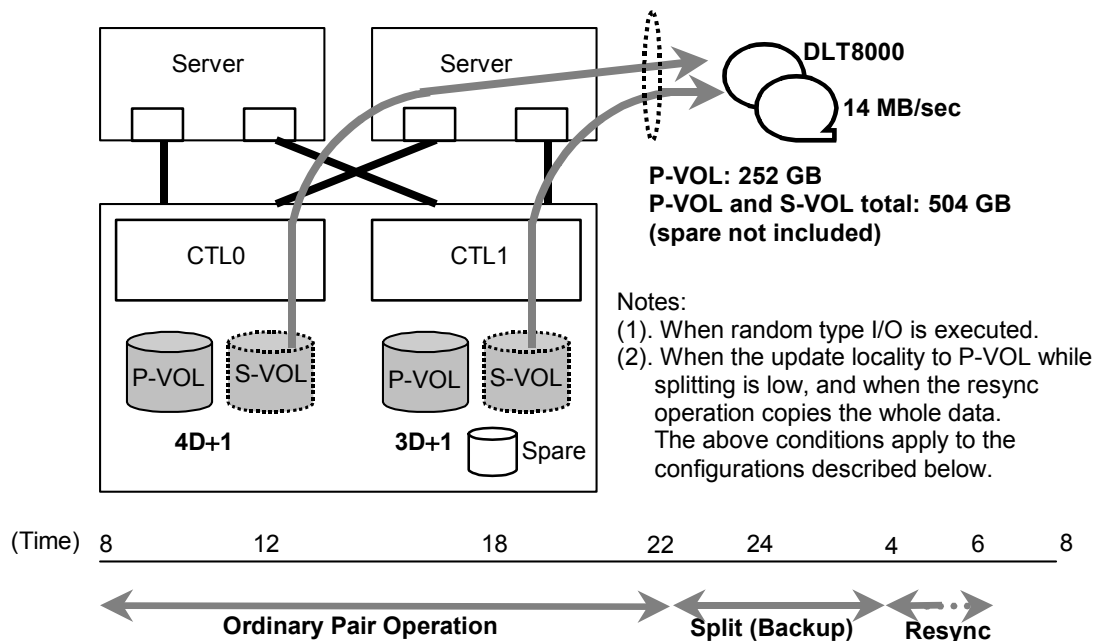


Figure 7.1 Backup Using DLT8000

- Backup using TF350
 - Backup must be performed from two ports at the same time.
 - The total of P-VOL and S-VOL must be less than or equal to 2 TB.
(e.g., If P-VOL is 1 TB, backup takes 2 hours and 40 minutes for 108 MB/sec.)
 - During resynchronization, backup is performed when the host load is at minimum (less than 1,000 IOPS).
 - Resynchronization is executable at a high speed of 80 MB/sec when the load of updating process (Random) is low. When the load of updating process is high, the processing speed should be approximately 50 MB/sec.
 - It takes 3 hours 40 minutes to resynchronize the entire 1 TB.

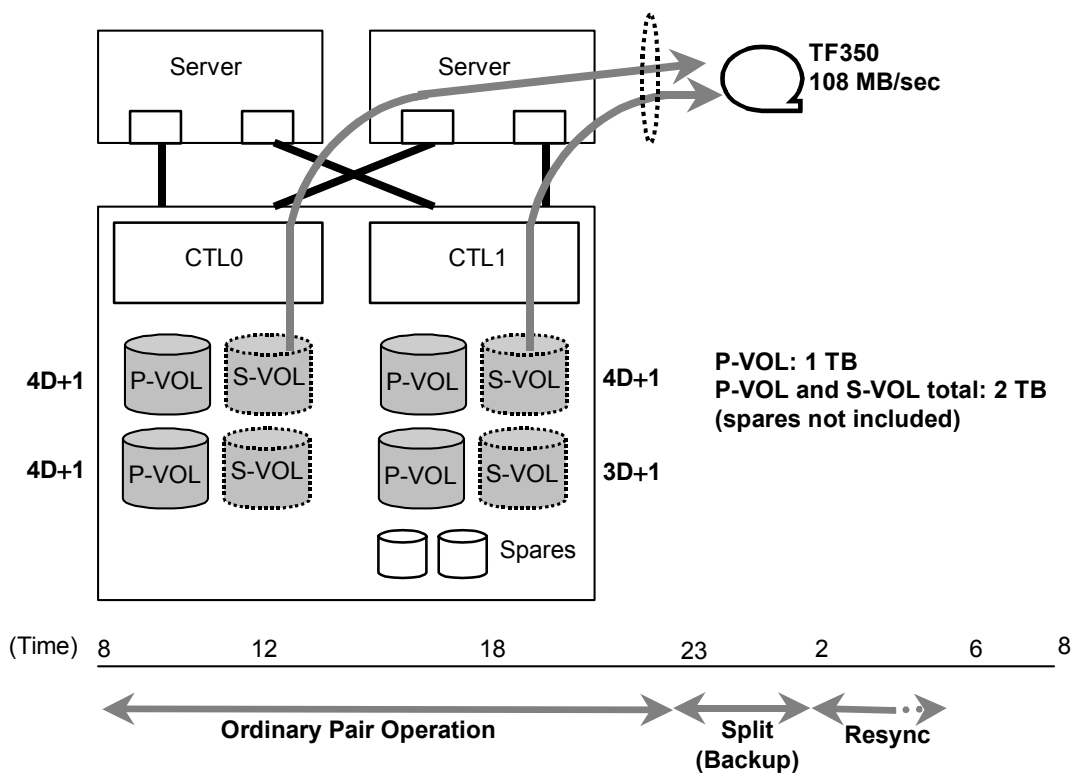


Figure 7.2 Backup Using TF350

Note: The figure above illustrates an example of when six hours are allocated for the backup and resynchronization time process. If more than six hours can be used for this process, a larger capacity of backup data is obtainable.

- S-VOL (during split) connected to TF350 for backup (resync and backup at night)
 - The total of P-VOL and S-VOL must be less than or equal to 2 TB.
(For example, If P-VOL is 1 TB, backup takes 2 hours and 50 minutes for 108 MB/sec.)
 - During resynchronization, backup is performed when the host load is at minimum (less than 1,000 IOPS).

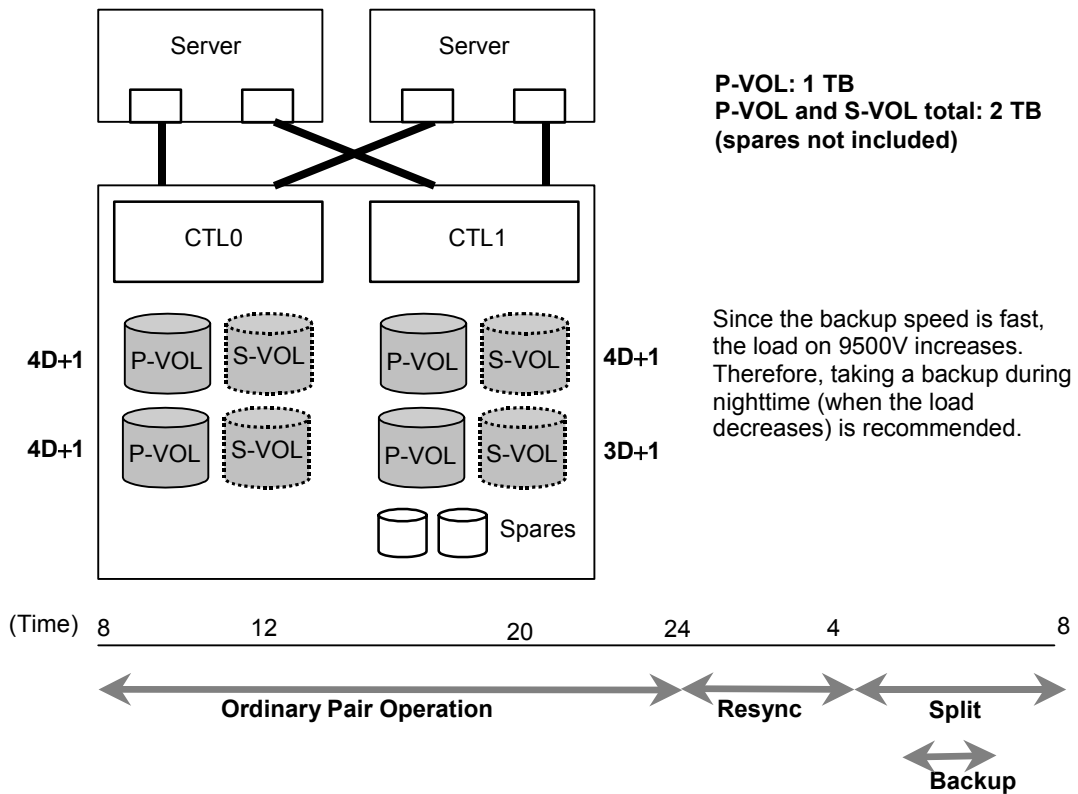
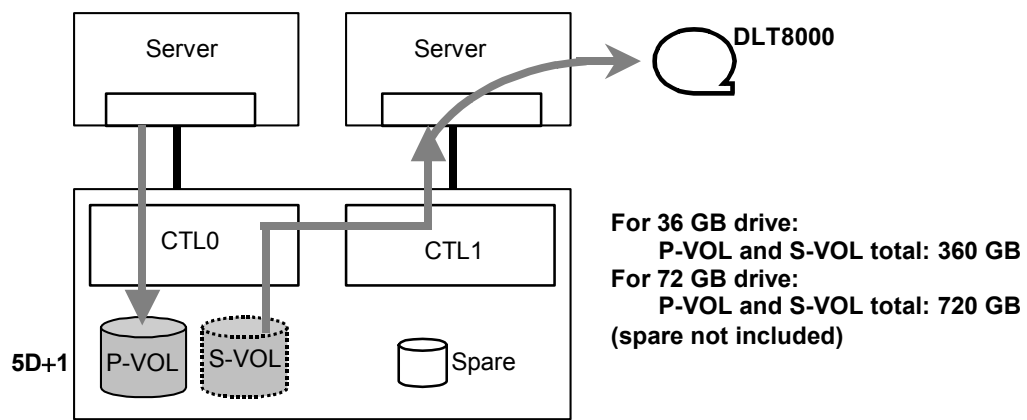


Figure 7.4 S-VOL (during split) Connected to TF350 for Backup

7.3 9530V Recommended Configuration

- Backup using DLT8000 (assuming the backup speed of DLT8000 is 7 MB/sec)
 - P-VOL is accessed from other system's CTL while splitting. Daytime backup is recommended.
 (For example, if the drive is 36 GB and the P-VOL is 180 GB, backup takes 7 hours and 20 minutes for 7 MB/sec.)
 (For example, if the drive is 72 GB and the P-VOL is 360 GB, backup takes 14 hours and 40 minutes for 7 MB/sec.)
 - During resynchronization, backup is performed when the host load is at minimum.



Example when using the 72 GB Drive:

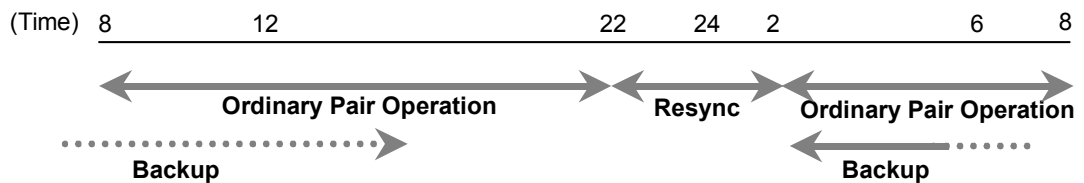


Figure 7.5 Backup using DLT8000

Chapter 8 Supported Platforms and Restrictions

This section includes the following:

- Supported Platforms
- Restrictions

8.1 Supported Platforms

The following table describes the supported platforms.

Table 8.1 External Specifications

No.	Platforms	Operating System Version
1	SUN	Solaris 8
2	PC Server (Microsoft)	Windows NT 4.0
		Windows 2000
3	HP	HP-UX 11.x
4	IBM	AIX 4.3.3
		AIX 5.1.0
5	HP (Compaq)	Tru64 UNIX 5.1
6	—	Red Hat Linux 7.2
7	SGI	IRIX 6.5.15f

8.2 Restrictions

This section describes the restrictions for configuration.

8.2.1 For VxVM+ShadowImage Configuration

To make the same host recognize both a P-VOL and an S-VOL, refer to the instruction given in Appendix C Operation of Volumes with Solaris Version VxVM. However, since a wrong operation can cause a data loss, make a script after you have understood VxVM and ShadowImage 9500V fully and use it. In addition, VxVM in which employment by the same host is possible is version 3.5 MP1 Point Patch 3.1 or later.

8.2.2 MSCS+ShadowImage 9500V Configuration

- When setting the S-VOL to be recognized by the host, use the CCI **mount** command instead of using the Disk Administrator. For details on the mount command, see the *Hitachi Freedom Storage™ Thunder 9500™ V Series Command Control Interface (CCI) User and Reference Guide (MK-92DF609)*.
- Do not place the MSCS Quorum Disk in RAID Manager (CCI).
- Shutdown MSCS before executing the CCI “sync” command.

8.2.3 AIX+ShadowImage 9500V Configuration

- Volumes recognized by the host

To ensure that the same host recognizes both a P-VOL and an S-VOL, the HDLM (JP1/HiCommand Dynamic Link Manager) of version 04-00-/B or later is required.

Chapter 9 Comparison of the Hitachi Model with Others

Table 9.1 Comparison of the Hitachi Model with Others

No.	Item	Hitachi 9500V	EMC CX600	COMPAQ EVA	Remarks
1	Physical clone-creation function by an array unit	Available	Not available	Available (Only for system operation for splitting full-time. No re-coupling. Therefore, initial copy is essential.)	—
2	Snapshot function by an array unit	(Available) Immediate snapshot at any given time is not possible. Resync operation is required before the snapshot (immediate resync will be supported the 9500V enhancement)	Available (Snap View)	Available	Cannot update data when the size for SAVE AREA overflows. Designing the operation system is extremely difficult.
3	Function for copying the internal volume in a unit (1:N)	Not available (but sometimes available) (Up to 1:1) However, implements a function that creates a copy of an S-VOL by internally coping the data from S-VOL while splitting.	Not available	Available	—
4	Performance (SMPL status)	110,000 IOPS	90,000 IOPS	150,000 IOPS	Announced value
		680 MB/S	1,200 MB/S	675 MB/S	Announced value
	Performance during copy (coupling)	Since a single Write command causes to write onto physically different drives twice, the performance is half the usual (of SMPL). There is no contention for the drive.	Since a single Write command causes to read from the same drive and then writes onto the drive twice, it is assumed that a contention for the drive will take place. The performance may deteriorate heavily.	(Copying (coupling) status does not exist since the system operates only for splitting after creating the clone.)	—
	Performance during backup	P-VOL is hardly affected (because the sustain power as a unit is high)	The performance is assumed to deteriorate since a not-yet-updated data is read from P-VOL and the access concentrates on the P-VOL.	It is assumed that there is no affect for transaction type. Sustained type is assumed to deteriorate in performance (because the sustain power as a unit is low).	—
	Speed when creating a clone				Announced value

Chapter 10 Notes on System Configuration

10.1 Previously Designed Procedure for Recovering Data During Malfunction

In ShadowImage 9500V, the P-VOL and S-VOL synchronous may become corrupt due to a hardware malfunction. Even if the user has a hardware maintenance contract (including free warranty period) with Hitachi, recovering ShadowImage status (such as resynchronization) is beyond the maintenance personnel's task. Maintenance personnel's include removing the cause of malfunction and recovering the hardware only. Therefore, the procedure for recovering the ShadowImage status must be specified by the user when designing the system.

10.2 Applying ShadowImage 9500V to an Existing System

When newly applying ShadowImage 9500V to an already existing system, follow the description described in Chapter 6 and determine the optimal configuration.

Appendix A Acronyms and Abbreviations

CLI	command line interface
GUI	graphical user interface
I/O	input/output
LAN	local area network
LDEV	logical device
LU	logical unit
LUN	logical unit number
PC	personal computer
PSUE	pair suspended-error
PSUS	pair suspended-split
P-VOL	primary volume
RAID	redundant array of independent disks
SMPL	simplex
S-VOL	secondary volume
TID	target ID

Appendix B Operations Using CLI

This section describes the following operation procedure for ShadowImage 9500V using the CLI of the Resource Manager 9500V. The following sections are included:

- Installing ShadowImage 9500V
- Uninstalling ShadowImage 9500V
- Enabling or Disabling ShadowImage 9500V
- Setting the Command Device
- Setting the Target ID
- Confirming the Status of the Pairs

For details on Resource Manager 9500V, refer to the *Hitachi Freedom Storage™ Thunder 9500™ V Series Resource Manager 9500V User's Guide Command Line Interface (CLI)* (MK-92DF603).

B.1 Installing ShadowImage 9500V

Since ShadowImage 9500V is an extra-cost option, ShadowImage 9500V cannot usually be selected (locked) before it can be used. To make ShadowImage 9500V available, you must install the ShadowImage 9500V and set its function selectable (unlock).

Note: Before installing/uninstalling ShadowImage 9500V, verify that the array unit to be operated is functioning normally. If a failure such as a controller blockage has occurred, installation/uninstallation cannot be performed.

To install ShadowImage 9500V, a key code provided with the optional feature is required. The following describes the installation procedure.

To install ShadowImage 9500V:

1. From the command prompt, register the subsystem (array unit) in which the ShadowImage 9500V is to be installed, then connect to the subsystem.
2. Execute the **auopt** command to unlock ShadowImage 9500V. The example is shown below.

Example:

```
% auopt -unit subsystem-name -lock off -keycode manual-attached-keycode
Password: manager-password
Option was opened.
%
```

3. Execute the **auopt** command to confirm whether ShadowImage 9500V has been unlocked. The example is shown below.

Example:

```
% auopt -unit subsystem-name -refer
Password: manager-password
Option name      Status
SHADOW-IMAGE    Enable
%
```

ShadowImage 9500V is installed and the status is “Enable”. Installation of ShadowImage 9500V is now complete.

B.2 Uninstalling ShadowImage 9500V

To uninstall ShadowImage 9500V, a key code provided with the optional feature is required. Once uninstalled, ShadowImage 9500V cannot be used (locked) until it is again unlocked using the key code.

Note: The following conditions must be satisfied in order to uninstall ShadowImage 9500V.

- All ShadowImage 9500V pairs must be released (that is, the status of all LUs are SMPL).

The following describes the uninstallation procedure.

To uninstall ShadowImage 9500V:

1. From the command prompt, register the subsystem (array unit) in which the ShadowImage 9500V is to be uninstalled, then connect to the subsystem.
2. Execute the **auopt** command to lock ShadowImage 9500V. The example is shown below.

Example:

```
% auopt -unit subsystem-name -lock on -keycode manual-attached-keycode
Password: manager-password
Option was closed.
%
```

3. Execute the **auopt** command to confirm whether ShadowImage 9500V has been locked. The example is shown below.

Example:

```
% auopt -unit subsystem-name -refer
Password: manager-password
DMEC002015: No information displayed.
%
```

Uninstalling ShadowImage 9500V is now complete.

B.3 Enabling or Disabling ShadowImage 9500V

Once installed, ShadowImage 9500V can be enabled or disabled.

Note: The following conditions must be satisfied in order to disable ShadowImage 9500V.

- All ShadowImage 9500V pairs must be released (that is, the status of all LUs are SMPL).

The following describes the enabling/disabling procedure.

1. From the command prompt, register the subsystem (array unit) in which the status of the feature is to be changed, then connect to the subsystem.
2. Execute the **auopt** command to change the status (enable or disable). The following is an example of changing the status from enable to disable. If you want to change the status from disable to enable, enter **enable** after the **-st** option.

Example:

```
% auopt -unit subsystem-name -option SHADOW-IMAGE -st disable
Password: manager-password
Option modification completed successfully.
%
```

3. Execute the **auopt** command to confirm whether the status has been changed. The example is shown below.

Example:

```
% auopt -unit subsystem-name -refer
Password: manager-password
Option name      Status
SHADOW-IMAGE    Disable
%
```

Enabling or disabling ShadowImage 9500V is now complete.

B.4 Setting the Command Device

The command device is a user-selected, dedicated logical volume on the Thunder 9500V subsystem that functions as the interface to the CCI software. The ShadowImage 9500V commands are issued by the CCI (HORCM) to the Thunder 9500V command device.

In order to accept read and write commands that are executed by the Thunder 9500V subsystem and return read requests to the UNIX®/PC host, the command device must be designated. The command device must be defined in the HORCM_CMD section of the configuration definition file for the CCI instance on the attached host. Two command devices can be designated for the Thunder 9500V subsystem. You can designate command devices using the Resource Manager 9500V.

Note: LUs set for command devices must be recognized by the host.

To designate command device(s):

1. From the command prompt, register the subsystem (array unit) to which you want to create the command device. Connect to the subsystem.
2. Execute the **aucmddev** command to create a command device. The following is an example of specifying LU 2 for command device 1.

Example:

```
% aucmddev -unit subsystem-name -set -id 0123 -dev 1 2
Password: manager-password
%
```

3. Execute the **aucmddev** command to verify that the command device has been created. The following shows the example.

Note: To set the alternate command device function or to avoid data loss and subsystem downtime, designate two command devices. For details on alternate command device function, refer to the *Hitachi Freedom Storage™ Thunder 9500™ V Series Command Control Interface (CCI) User and Reference Guide (MK-92DF609)*.

Example:

```
% aucmddev -unit subsystem-name -refer
Password: manager-password
Command Device  LUN
1                2
%
```

4. **To release an already set command device**, specify as follows.

The following is an example of releasing command device 1.

Example:

```
% aucmddev -unit subsystem-name -rm -dev 1
Password: manager-password
%
```

5. **To change an already set command device**, release the already set command device first, then change the LU number. The following is an example of specifying LU 3 for command device 1.

Example:

```
% aucmddev -unit subsystem-name -set -id 0123 -dev 1 3
Password: manager-password
%
```

B.5 Setting the Target ID

The following is the procedure for specifying the target ID. The target ID is specified using the Resource Manager 9500V.

1. From the command prompt, register the subsystem (array unit) to which you want to set the system parameter, then connect to the subsystem.
2. Execute the **auhgmap** command to set the target ID. The following is the example of setting LU 0 in the subsystem to be recognized as 6 by the host. The port is connected via host group 0 of port 0A on controller 0.

Example:

```
% auhgmap -unit subsystem-name -MappingMode on
Password: manager-password
Are you sure you want to set the mapping mode? (y/n [n]): y
when setting starts, the subsystem stops accepting the access to the controller from
the host.
Before setting, stop the access to the controller from the host.
Do you want to continue processing? (y/n [n]): y
The mapping mode has been set successfully.
%

% auhgmap -unit subsystem-name -add 0 A 0 6 0
Password: manager-password
The mapping information has been set successfully.
%
```

3. Execute the **auhgmap** command to verify that the target ID has been set.

Example:

```
% auhgmap -unit subsystem-name -refer
Password: manager-password
Mapping mode = ON
Port  Group  H-LUN  LUN
  0A      0      6      0
%
```

B.6 Confirming the Status of Pairs

You can display the ShadowImage 9500V paired logical units using CLI. The following steps describe the procedure.

1. From the command prompt, register the subsystem (array unit) to which you want to display the status of paired logical volumes. Connect to the subsystem.
2. Execute the `aumrcfluc` command to display the pair status.

Example:

```
% aumrcfluc -unit subsystem-name
Password: manager-password
  RAID      RAID      Capacity
LU  Group   Level   [block]   D-CTL  C-CTL  Status
2/ 3  0/1     5 / 5   100000000  0      0      PAIR
7/ 8  2/3     1 / 1   100000000  1      1      PAIR
%
```

The pair status is displayed.

Appendix C Operation of Volumes with Solaris Version VxVM

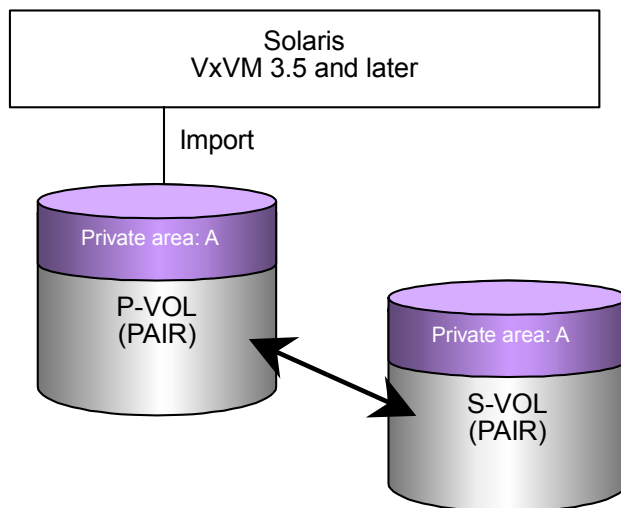
C.1 Overview

Since ShadowImage 9500V creates a perfect copy of a physical disk, two disks, a P-VOL and an S-VOL, have the same private areas of VxVM. Because VxVM cannot determine an appropriate member of a disk group, both the P-VOL and S-VOL cannot be recognized by the same host.

Appendix B explains a method of enabling the same host to recognize both the P-VOL and S-VOL using VxVM by rewriting the private area of the S-VOL.

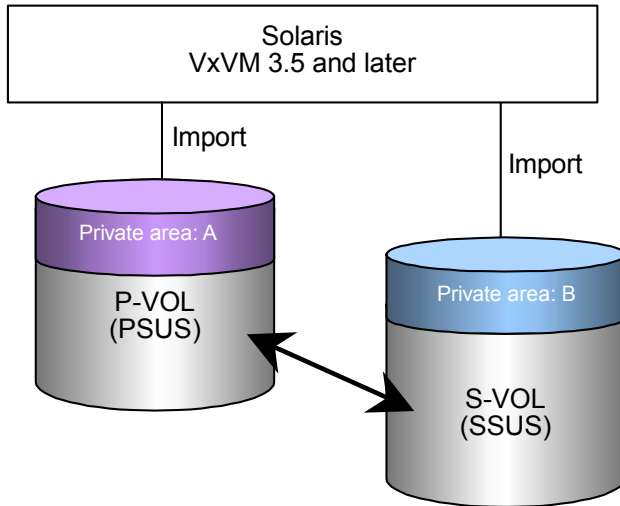
- Pair status:

VxVM can import only the P-VOL because its private areas is the same as that of the S-VOL.



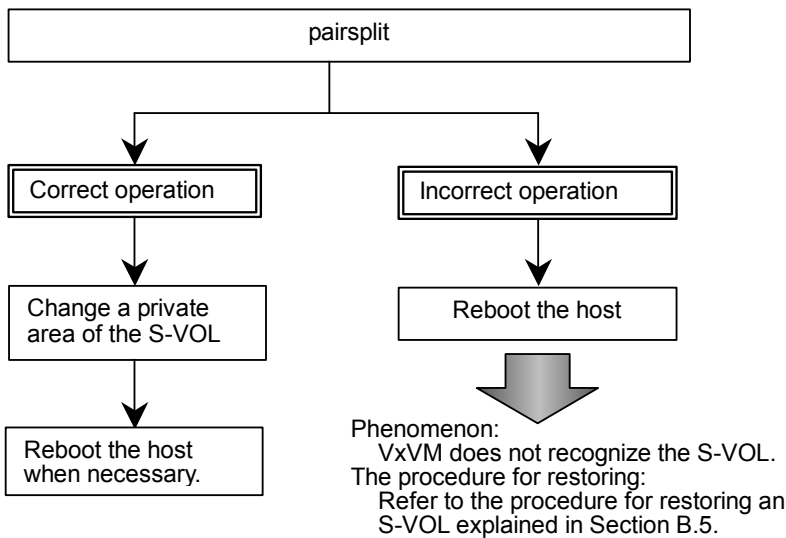
- Split status:

When the private information of the S-VOL is changed, the S-VOL can be imported also.

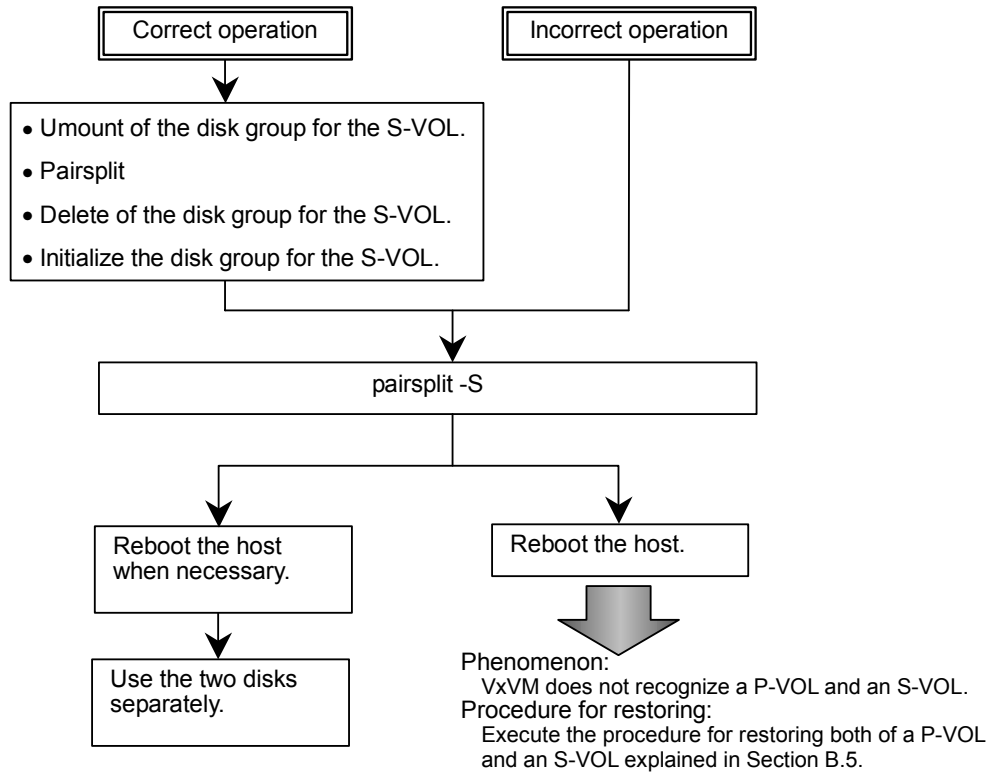


A logic to determine an appropriate member of a disk group when a conflict between disks occurs was added to VxVM of version 3.5 and later. When VxVM finds two or more physical disks that have the same private areas, it selects a disk, that is, ① a P-VOL of TrueCopy or ② a P-VOL of ShadowImage in this order for a disk group. However, there may be a case where the conflict between disks cannot be solved. If the host is rebooted when the private information of the S-VOL has not been rewritten or the pair is left split, VxVM becomes unable to recognize the P-VOL and/or S-VOL.

- Pairs split



- Pairs release:



C.2 Requirements

It cannot be foreseen when and in what situation a reboot of a host occurs. Therefore, when the same host uses both the P-VOL and S-VOL, it is always attended with a risk that it becomes unable to recognize the disk(s).

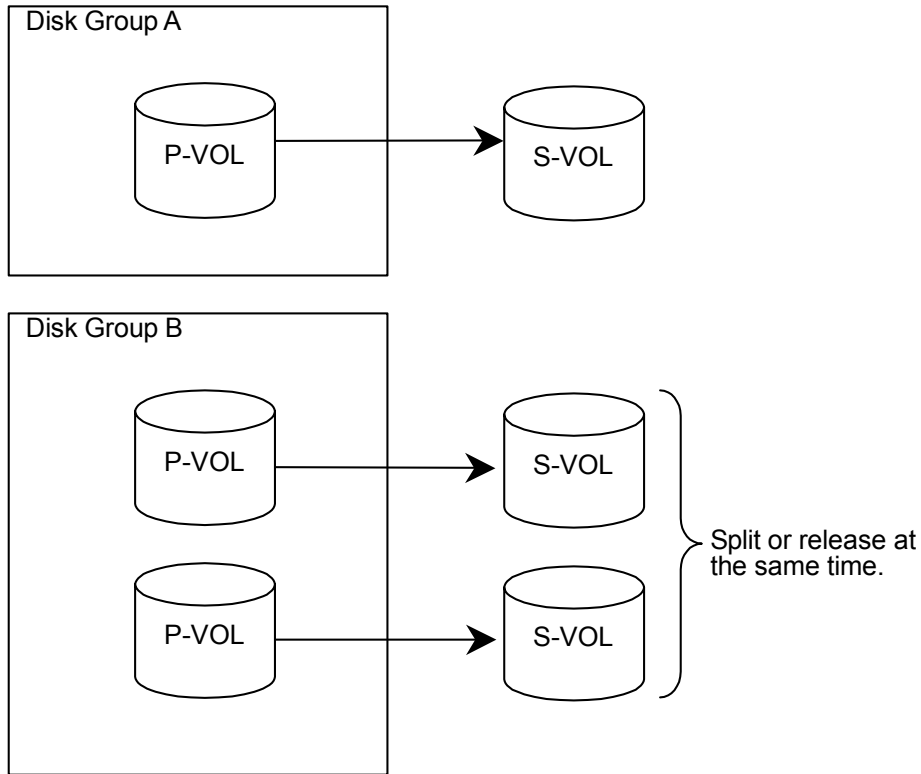
To reduce the risk above, be sure to fulfill the following requirements.

- rootdg of VxVM

Do not use a disk of ShadowImage 9500V as that for rootdg. VxVM always attempts to select a disk under rootdg, however, the logic to solve the disk conflict, which is used by VxVM of version 3.5 or later, is not applicable to rootdg. When VxVM fails to import the disk to rootdg, there is no way of recovery from the failure.

- Operation of pairs

It is recommended that you include only one ShadowImage 9500V pair in a disk group of VxVM. When you include pairs in the disk group, split (with the pairsplit) or release (with the pairsplit-S) all pairs in the same disk group at the same time.



- Setting of the LU number

Give a volume to be used as a P-VOL a lower controller/LU number than that of an S-VOL. Otherwise, VxVM imports not a P-VOL but an S-VOL when VxVM detects an illegal status.

- Automation of operation

Make a script and execute a complete advance test. If the operation is performed manually, data can be destroyed because of an entry of a wrong pair status or a command parameter.

C.3 Preparatory Work

When you create a disk group for a P-VOL and an S-VOL, back up the configuration information first. It is necessary when restoring a disk or performing a reverse resynchronization (with the pairresync -restore).

1. Create a disk group for the P-VOL.
2. Back up the configuration information in a disk group for the P-VOL.
3. Create a disk group for the S-VOL.
4. Back up the configuration information in a disk group for the S-VOL.
5. Create ShadowImage pairs.

Disk group and device names shown below are to be used in the following explanations in Appendix B.

Item	P-VOL Information	S-VOL Information
Disk group name	testdg	N/A
Disk-1 of testdg	HDS9500V0_1	HDS9500V0_3
Disk-2 of testdg	HDS9500V0_2	HDS9500V0_4

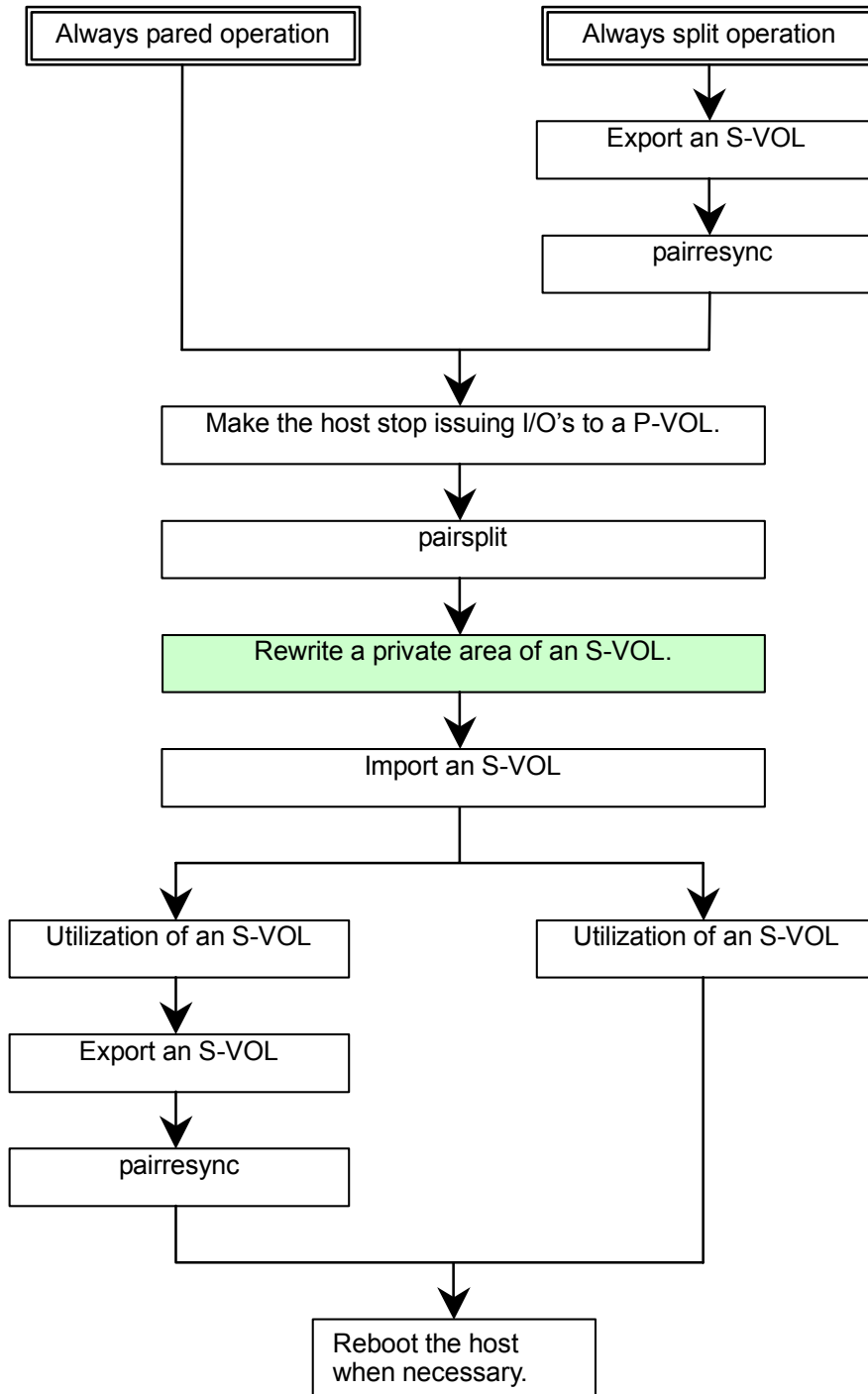
Note: The numerals following the device name “9500V” differ depending on the subsystem number and/or LU number. The device name is indicated as “9200” for the DF500 series.

- A procedure for backing up the configuration information in a disk group
The following command acquires the configuration information from the device /dev/vx/rdmp/HDS9500V0_1 and outputs it to a file specified.

```
# /etc/vx/diag.d/vxprivutil dumpconfig /dev/vx/rdmp/HDS9500V0_1s3 | vxprint -D - - hmvps  
>Name of a file to which the information is output.
```

C.4 Procedure of Operation

Whether volumes are always paired or always split, the basic operation is the same.



- Procedure for rewriting a private area of an S-VOL:

1. Save configuration information on an S-VOL.

```
# /etc/vx/diag.d/vxprivutil dumpconfig /dev/vx/rdmp/HDS9500V0_3s3 | vxprint -D - - hmvps
> /tmp/testdg_svol.conf
```

2. Examine the relation between the disk media and the device.

```
# /etc/vx/diag.d/vxprivutil dumpconfig /dev/vx/rdmp/HDS9500V0_3s3 | vxprint -D - - dm
```

Example:

```
dm      Testdg01
comment = ''
putil0 = ''
putil1 = ''
putil2 = ''
disked = 1015617938.1404.Gertrude
last_da_name = HDS9500V0_3
rid = 0.1027
removed = off
spare = off
failing = off
update_tid = 0.1041
last_da_dev = 32/1096
dm      Testdg02
comment = ''
putil0 = ''
putil1 = ''
putil2 = ''
disked = 1015617944.1404.Gertrude
last_da_name = HDS9500V0_4
rid = 0.1026
removed = off
spare = off
failing = off
update_tid = 0.1041
last_da_dev = 32/632
```

These disk media names and the device name are used in the following steps.

3. Check sizes of the public and private areas.

```
# /etc/vx/diag.d/vxprivutil scan /dev/vx/rdmp/HDS9500V0_3s3
# /etc/vx/diag.d/vxprivutil scan /dev/vx/rdmp/HDS9500V0_4s3
```

Example:

```
disked:      1011488013.2737.heathcliff
group:       name = orardo id = 1011488065.2746.heathcliff
hostid:      heathcliff
version:     2.2
iosize:      512
public:      slice = 4 offset = 0 len = 28447200
private:     slice = 3 offset = 1 len = 2879
update:      time: 1011996624 seqno: 0.15
headers:     0 248
configs:     count = 1 len = 2104
logs:        count = 1 len = 318
```

This information on size is to be used in the following steps.

4. Make the S-VOL online and initialize it using information that was obtained in Step 3.
Specify the parameter as offset/len of public/private that was obtained in Step 3.

```
# vxdisk online HDS9500V0_3
# vxdisk online HDS9500V0_4
# vxdisk -f init HDS9500V0_3 puboffset = 0 publen = 28447200 priveoffset = 1
    privlen = 2879
# vxdisk -f init HDS9500V0_4 puboffset = 0 publen = 28447200 priveoffset = 1
    privlen = 2879
```

5. Create a disk group for the S-VOL using information that was obtained in Step 2.

```
# vxdg init testdg_svol Testdg01 = HDS9500V0_3 Testdg02 = HDS9500V0_4
```

6. Rewrite private information of the S-VOL using configuration information that was output in Step 1.

```
# vxmake -g testdg_svol -d /tmp/testdg_svol.conf
```

7. Restore all volumes in the disk group and restart the host.

```
# vxrecover -g testdg_svol -s -E
```

Rewriting of the private area is completed now. Check the result using the `vxdiskadm` or `vxdisk list` command.

C.5 Procedure for Restoring

The following is the procedure for restoring a P-VOL and S-VOL:

1. When the disk groups of both a P-VOL and an S-VOL become unable to be recognized, restore the P-VOL first, recreate the ShadowImage pair, and split the pair again in the correct procedure. (This can occur because a host reboot was performed after the pair has been split.)
2. When the S-VOL is not recognized, restore it.

- Procedure for restoring both a P-VOL and an S-VOL:

1. Resynchronize the ShadowImage pair.

```
# paircreate -g testdg .....
```

2. Reboot the host. VxVM recognizes a disk group of the P-VOL after a reboot is done.

```
# boot - -r
```

3. Split the ShadowImage pair.

```
# pairsplit -g testdg
```

4. Initialize a disk group of the S-VOL.

```
# vxdisk -f init HDS9500V0_3  
# vxdisk -f init HDS9500V0_4
```

5. Release ShadowImage pair.

```
# pairsplit -g testdg -S
```

- Procedure for restoring an S-VOL:

The procedure for restoring an S-VOL is the same as the “Procedure for rewriting a private area of an S-VOL” explained in Section C.4. When the pair is not split, split it first.

