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Hitachi Freedom Storage™ Lightning 9900™ V Series

ShadowImage User's Guide

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Document Revision Level

Revision	Date	Description
MK-92RD110-P1	April 2002	Preliminary Release
MK-92RD110-P2	April 2002	Supersedes and replaces MK-92RD110-P1

Source Documents for this Revision

The following document was used to produce this 9900V user guide:

- *Hitachi Freedom Storage™ Lightning 9900™ ShadowImage User's Guide* (MK-90RD031)
- *RSD reviews of this document*

Changes in this Revision

- Updated microcode level to 21-01-2X/XX.
- Updated panels as needed to reflect new microcode level.

Microcode Level

This document revision applies to 9900 V Series SVP microcode versions 21-01-*2X/XX*.

Preface

The *Lightning 9900™ V Series ShadowImage User's Guide* describes and provides instructions for performing ShadowImage operations on the 9900V subsystem using the ShadowImage feature option. This user's guide assumes that:

- the user has a background in data processing and understands RAID storage subsystems and their basic functions,

- the user is familiar with the Lightning 9900™ V Series (9900V) subsystem and the Lightning 9900™ V Series Remote Console,

- the user has read and understands the *Lightning 9900™ V Remote Console - Storage Navigator User's Guide*, and

- the user is familiar with the Windows® NT or Windows 2000 operating system (e.g., opening, closing, minimizing, and restoring windows; using the keyboard and mouse to navigate on screen and select objects).

Note: The term "9900V" refers to the entire Hitachi 9900V subsystem family, unless otherwise noted. Please refer to the *Lightning 9900™ V Series User and Reference Guide* (MK-92RD100) for further information on the 9900V disk array subsystems, or contact your Hitachi Data Systems account team. For further information on the Lightning 9900™ V Remote Console, please refer to the *Lightning 9900™ V Series Remote Console - Storage Navigator User's Guide* (MK-92RD101), or contact your Hitachi Data Systems account team.

Note: For information on performing ShadowImage operations from the UNIX®-based or PC-server host (instead of the Lightning 9900™ V Series Remote Console - Storage Navigator – Storage Navigator PC), please refer to the *Hitachi Lightning 9900™ V Series Command Control Interface (CCI) User and Reference Guide* (MK-90RD011)

The use of ShadowImage, the ShadowImage Remote Console-Storage Navigator Java applet program, and all *other* Hitachi Data Systems products is governed by the terms of your license agreement(s) with Hitachi Data Systems.

COMMENTS

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Make sure to include the document title, number, and revision.
Please refer to specific page(s) and paragraph(s) whenever possible.

(All comments become the property of Hitachi Data Systems Corporation.)

Thank you!

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1.1   ShadowImage

The ShadowImage feature enables you to maintain subsystem-internal copies of all user data on the Hitachi Lightning 9900™ V Series (9900V) storage subsystem for purposes such as data backup or duplication. The RAID-protected duplicate volumes are created within the same Lightning 9900™ V subsystem as the primary volume at hardware speeds. ShadowImage is used for UNIX®-based and PC server data. ShadowImage can provide up to nine duplicates of one primary volume. ShadowImage is a key component of Hitachi Data Systems' solutions and service offerings.

This document describes and provides instructions for performing ShadowImage operations using the Lightning 9900™ V Remote Console. The licensed ShadowImage software on the Lightning 9900™ V Remote Console displays the ShadowImage information and allows you to perform ShadowImage operations. The Lightning 9900™ V Remote Console can be attached to several Lightning 9900™ V subsystems via the Lightning 9900™ V-TCP/IP local-area network (LAN). The Remote Console communicates and exchanges data directly with the service processor (SVP) of each attached 9900V subsystem. For further information on the 9900™ V (Remote Console-Storage Navigator and software, refer to the *Hitachi Lightning 9900™ V Series Remote Console-Storage Navigator User's Guide* (MK-92RD101).

ShadowImage operations are nondisruptive 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 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. ShadowImage also supports reverse resynchronization for maximum flexibility.

The licensed 9900V Hitachi Remote Console – Storage Navigator software allows you to configure the ShadowImage option on the 9900V subsystem. The 9900V Remote Console software communicates directly with the 9900V subsystem via a LAN. For further information on the 9900V Remote Console software, please refer to the *Hitachi Lightning 9900™ V Series Hitachi Remote Console – Storage Navigator User's Guide* (MK-92RD101).

ShadowImage operations can be performed in conjunction with Hitachi TrueCopy operations (see section 1.3) to provide additional remote copies of ShadowImage volumes. ShadowImage also supports the Open Volume Management Virtual LVI/LUN and FlashAccess features of the 9900™ V subsystem, ensuring that all user data can be duplicated by ShadowImage operations. See section 3.4 for further information on combining ShadowImage with these and other data management features.

ShadowImage operations can also be performed from the UNIX® and/or PC-server host using the Hitachi Command Control Interface (CCI) software. For information and instructions on using CCI to perform ShadowImage (or TrueCopy) operations, please refer to the *Hitachi Lightning 9900™ V Series Command Control Interface (CCI) User and Reference Guide* (MK-90RD011).

This document does not cover ShadowImage – S/390® (SI390) operations. For information and instructions on performing ShadowImage – S/390® operations, please refer to the *Hitachi Lightning 9900™ V Series ShadowImage – S/390® User's Guide* (MK-92RD109).

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

1.2 Hitachi TrueCopy

Hitachi TrueCopy enables open-system users to perform synchronous and/or asynchronous remote copy operations between 9900V subsystems. The user can create, split, and resynchronize LU pairs. Once established, TrueCopy operations continue unattended and provide continuous, real-time data backup. Remote copy operations are nondisruptive and allow the primary TrueCopy volumes to remain online to all hosts for both read and write I/O operations.

Hitachi TrueCopy supports Fibre Channel interface connections between the main and remote 9900V subsystems. For Fibre Channel connection, TrueCopy operations can be performed across distances of up to 30 km (18.6 miles) using single-mode longwave optical fibre cables in a switch configuration. Long-distance solutions are provided, based on user requirements and workload characteristics, using approved channel extenders and communication lines.

Note: For further information on Hitachi TrueCopy, please see the *9900V Hitachi TrueCopy User's Guide*, or contact your Hitachi account team.

1.3 Hitachi Multiplatform Backup/Restore (HMBR)

The Hitachi Multiplatform Backup/Restore (HMBR) feature of the Hitachi Lightning 9900™ V subsystem can also be used in conjunction with the ShadowImage feature to provide S/390®-based backup of ShadowImage volumes. HMBR operations should be configured to back up the ShadowImage primary volumes (P-VOLs), since the ShadowImage S-VOLs are not available to hosts (except when the pair has been split). If you need to perform HMBR operations on ShadowImage S-VOLs, you must split the pairs first to allow host access.

Chapter 2   Overview of ShadowImage Operations

ShadowImage is a storage-based hardware solution for duplicating logical volumes which reduces backup time and provides point-in-time backup. The ShadowImage primary volumes (P-VOLs) contain the original data; the ShadowImage secondary volume(s) (S-VOLs) contain the duplicate data. The user can choose to make up to nine copies of each P-VOL using the ShadowImage cascade function. And since each S-VOL is paired with its P-VOL independently, each S-VOL can be maintained as an independent copy set that can be split, resynchronized, and deleted separately from the other S-VOLs assigned to the same P-VOL.

2.1   ShadowImage Components

ShadowImage operations on the Remote Console-Storage Navigator involve the primary and secondary volumes in the Hitachi Lightning 9900™ V Series (9900V) subsystem and the Remote Console-Storage Navigator Java applet program downloaded from the connected SVP. Figure 2.1 shows a typical ShadowImage configuration. The ShadowImage system components are:

■ ShadowImage pairs (P-VOLs and S-VOLs) (see section 2.1.1), and

■ Java applet program downloaded from the 9900V SVP (Web Server) to the Remote Console-Storage Navigator PC (Web Client) (see section 2.1.2).
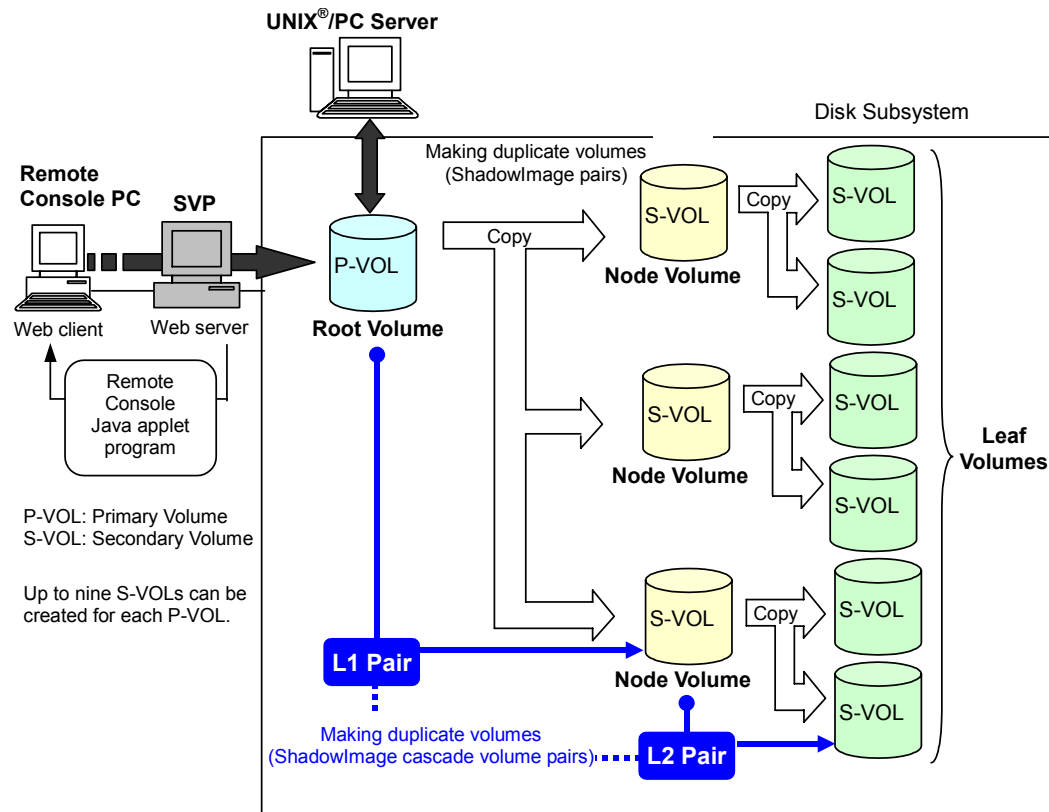
Figure 2.1   ShadowImage Components

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

The Hitachi Lightning 9900™ V subsystem contains and manages both the original and copied ShadowImage data. The 9900V subsystem supports a maximum of 8,190 ShadowImage volumes: 4,095 pairs and the CCI command device. When ShadowImage pairs include size-expanded LUs, the maximum number of pairs decreases.

ShadowImage performs internal copy operations for logical volume pairs established by the user. Each ShadowImage pair consists of one primary volume (P-VOL) and up to three secondary volumes (S-VOLs) which are located in the same 9900V subsystem. The ShadowImage P-VOLs are the primary volumes which contain the original data. The ShadowImage S-VOLs are the secondary or mirrored volumes which contain the backup data. Each S-VOL must be paired with only one P-VOL. During ShadowImage operations, the P-VOLs remain available to all hosts for read and write I/O operations (except during reverse resync and quick restore). The S-VOLs become available for host access only after the pair has been split.

When a ShadowImage 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 "split" the pair to make the S-VOL accessible (the P-VOL is accessible except during reverse resync). While a ShadowImage pair is split, the 9900V 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 and S-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 P-VOL and S-VOL updates) is copied to the P-VOL so that the P-VOL is now identical to the S-VOL.

Note: ShadowImage S-VOLs are updated asynchronously. For a volume pair with PAIR status, the P-VOL and S-VOL may not be identical. For further information on ShadowImage update copy operations, please see section 2.3.3.

Note: ShadowImage P-VOLs or S-VOLs should not be concentrated in the same RAID group. To disperse workloads of the RAID groups, each RAID group should have both P-VOLs and S-VOLs evenly distributed. ShadowImage pairs for which ShadowImage operations are performed simultaneously should be in different RAID groups. If ShadowImage pairs are concentrated in only a few RAID groups, the host I/O performance may be degraded.

If the 9900V subsystem is overloaded, you must increase cache, disk adapters, and/or RAID groups. It is recommended that ShadowImage S-VOLs be assigned in newly installed RAID groups. If you continue ShadowImage operations with an overloaded 9900V subsystem, host I/O performance may be degraded.

Cascade Pairs

The ShadowImage cascade function allows you to add a second layer of pairs onto the first layer of original ShadowImage pairs. These two layers of pairs (L1 and L2) allow you to create and maintain up to nine copies of one original ShadowImage primary volume (P-VOL). See section 2.5 for further information on the cascade function.

2.1.2   Remote Console-Storage Navigator Software

The ShadowImage software for the 9900V Remote Console-Storage Navigator displays ShadowImage information and enables you to perform ShadowImage operations. The ShadowImage Remote Console – Storage Navigator software runs on the remote console and communicates with the SVP of the connected subsystem via the 9900V-internal LAN. The Remote Console can be attached to multiple 9900V subsystems. The Remote Console-Storage Navigator acquires status from and issues commands to both the ShadowImage P-VOLs and the ShadowImage S-VOLs.

Note: If the 9900V Remote Console-Storage Navigator software is not installed, please contact your Hitachi Data Systems account team for information on ShadowImage configuration services.

2.2   ShadowImage Requirements

ShadowImage operations provide subsystem-internal copies of UNIX®/PC server volumes (LUs) on the Hitachi Lightning 9900™ V subsystem. Table 2.1 lists and describes the operational requirements for ShadowImage.

Table 2.1   ShadowImage Requirements

Parameter	Requirement
Pair objects	Logical devices (LDEVs): OPEN-x (e.g., OPEN-3, OPEN-9, OPEN-E), including custom-size devices and size-expanded LUs. Devices must be installed and configured. The P-VOL and S-VOL must be the same type (e.g., OPEN-3 to OPEN-3 allowed, OPEN-3 to OPEN-9 not allowed). A custom-size/expanded P-VOL must be paired with S-VOLs of the same type and same capacity. ShadowImage does not support multiplatform devices (e.g., 3390-3A, -3B, -3C). Please ask your Hitachi Data Systems account team for the latest information on supported device types.
Number of copies	Maximum three copies (S-VOLs) per primary volume (P-VOL). Maximum one P-VOL per S-VOL (P-VOLs cannot share an S-VOL). *Note:* An additional six copies can be created by using the ShadowImage cascade function.
Max number of pairs	4,095 pairs per 9900V subsystem (4,095 P-VOLs and 4,095 S-VOLs). When pairs include size-extended LUs, the maximum number of pairs decreases.
Max number of S-VOLs	4,095
MU numbers of cascade pairs	For L1 pairs = 0, 1, and 2 (a total of 3 pairs) For L2 pairs =1 and 2 (a total of 2 pairs)
Combinations of RAID levels (primary-secondary)	All combinations supported: RAID1-RAID1, RAID5-RAID5, RAID1-RAID5, RAID5-RAID1.
Dynamic sparing and automatic correction copy	If a failure occurs that requires the 9900V to utilize dynamic sparing or automatic correction copy, the status of the paired volumes associated with the failed physical device will not be affected.
Physical device (PDEV) maintenance	If a PDEV requires maintenance, the status of the logical volumes associated with that PDEV will not be affected. However, if PDEV maintenance requires access to a ShadowImage S-VOL, the pair must be deleted, and the **Reserve** attribute must be reset (unreserved).
Logical device (LDEV) maintenance	LDEV maintenance cannot be performed on LDEVs which are assigned to ShadowImage pairs. If LDEV maintenance requires access to a ShadowImage LDEV, the pair must be deleted, and the **Reserve** attribute must be reset (unreserved).
Cache maintenance	If 9900V cache maintenance is performed during a period of high I/O usage, one or more ShadowImage pairs may be suspended. Reduce the I/O load before cache maintenance.
Point-in-time backup	For pairs in PAIR status, host I/Os are copied to the S-VOLs asynchronously. If you want to synchronize a pair and then access the S-VOL as soon as possible, vary the P-VOL offline and then split the pair before using the S-VOL. If the P-VOL cannot be taken offline, a P.I.T. backup will still occur if a pairsplit is issued. When all the data on the P-VOL (up to the pairsplit time) has been copied to the S-VOL, the pair will be split and the S-VOL will become available for use (R/W). The operation may take longer to complete if high write activity is occurring from the host to the P-VOL. A P.I.T. can also be performed by issuing a pairsplit to P-VOLs in the SMPL (simplex) state.
Failures	When a failure of any kind prevents a ShadowImage copy operation from completing, the 9900V will suspend the pair. If an LDEV failure occurs, the 9900V suspends the pair. If a PDEV failure occurs, ShadowImage pair status is not affected because of the RAID architecture.
Maintenance/upgrade	Under certain conditions, ShadowImage volume pairs may need to be re-established.

2.3   ShadowImage Operations

ShadowImage operations can be performed from the **Remote Console** using the **RC-SN** Java applet program for ShadowImage, or from the UNIX®/PC server host using Hitachi Command Control Interface (CCI) software. For further information on using the Hitachi Command Control Interface, please refer to the *Hitachi Lightning* 9900™ V *Command Control Interface User and Reference Guide*. For information on Hitachi Data Systems configuration services (configuring and performing ShadowImage operations using 9900V SVP), please contact your Hitachi Data Systems account team.

2.3.1   Set Reserve Attribute Operation

The ShadowImage set reserve attribute operation reserves a volume so that it can be used as a ShadowImage S-VOL (node and leaf volumes). Reserved volumes can only be used as ShadowImage S-VOLs. The 9900V subsystem rejects all write operations to reserved volumes (unless in split (PSUS) status). You can reserve up to 4,095 volumes in one 9900V subsystem. The Set Reserve Attribute panel (see section 4.3) allows you to reserve volumes for use as ShadowImage S-VOLs.

Note: ShadowImage leaf volumes (L2 cascade pair) also function as S-VOLs and must be reserved prior to being assigned to an L2 cascade pair.

2.3.2   Reset Reserve Attribute Operation

The ShadowImage reset reserve attribute operation unreserves a volume so that it can be mounted and accessed by all hosts. After you reset the reserve attribute, the 9900V will accept all subsequent I/O operations to the volume. The Reset Reserve Attribute panel (see section 4.4) allows you to unreserve volumes.

2.3.3 Paircreate Operation

The ShadowImage paircreate operation establishes the new specified ShadowImage pair(s). The volume which will be the P-VOL must be in the SMPL (simplex) state, and the volume which will be the S-VOL must be SMPL before being added to a ShadowImage pair. *Note:* You can reserve the S-VOL before creating a pair. You can also create a pair with an unreserved S-VOL. The Paircreate panel (see section 4.5) allows you to create new ShadowImage volume pairs.

Initial Copy Operation

The ShadowImage initial copy operation takes place when you create a new volume pair (see Figure 2.2). 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 be duplicated at the S-VOL by update copy operations after the initial copy is complete. The status of the pair is COPY(PD) (PD = pending) while the initial copy operation is in progress. The status changes to PAIR when the initial copy is complete.

When creating pairs, you can select the pace for the initial copy operation(s): slower, medium, and faster. The slower pace minimizes the impact of ShadowImage operations on subsystem I/O performance, while the faster pace completes the initial copy operation(s) as quickly as possible.
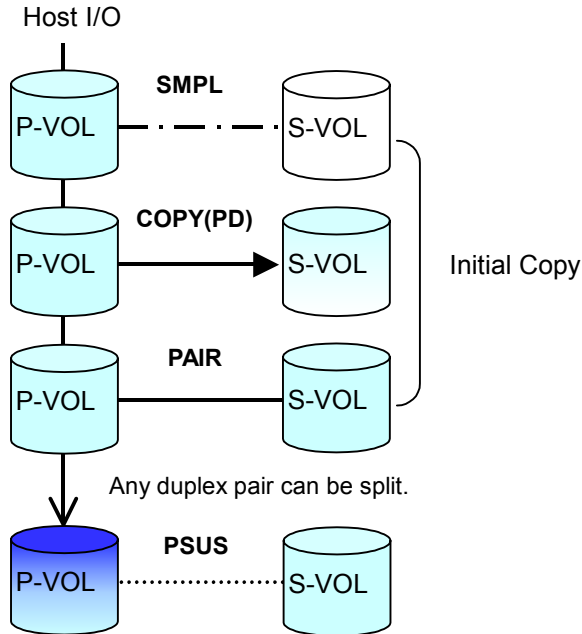
Figure 2.2   Adding a ShadowImage Pair

Update Copy Operation

The ShadowImage update copy operation updates the S-VOL of a ShadowImage pair after the initial copy operation is complete. Update copy operations take place only for duplex pairs (status = PAIR). As write I/Os are performed on a duplex P-VOL, the 9900V stores a map of the P-VOL differential data, and then performs update copy operations periodically based on the amount of differential data present on the P-VOL as well as the elapsed time between update copy operations. Figure 2.3 illustrates an update copy operation in a ShadowImage pair with only one S-VOL. Update copy operations are not performed for pairs with the following status: COPY(PD) (*pending duplex*), COPY(SP) (*steady split pending*), PSUS(SP) (*quick split pending*), PSUS (*split*), COPY(RS) (*resync*), COPY(RS-R) (*resync-reverse*), and PSUE (*suspended*).

Note: Update copy operations do not occur every time a host issues a write I/O operation to the P-VOL of a ShadowImage pair. ShadowImage update copy operations are performed asynchronously according to the differential bitmap, which is stored in shared memory. If shared memory is lost (e.g., offline micro exchange, volatile PS on), the differential bitmap is also lost. In this case the 9900V treats the entire ShadowImage P-VOL (S-VOL for COPY(RS) pairs) as difference data and recopies all data to the S-VOL (P-VOL for COPY(RS) pairs) to ensure proper pair resynchronization. For pairs with COPY(SP) or PSUS(SP) status, the 9900V changes the status to PSUE due to the loss of the differential bitmap, also ensuring proper resynchronization of these pairs. If shared memory has been lost, please allow extra time for ShadowImage operations.
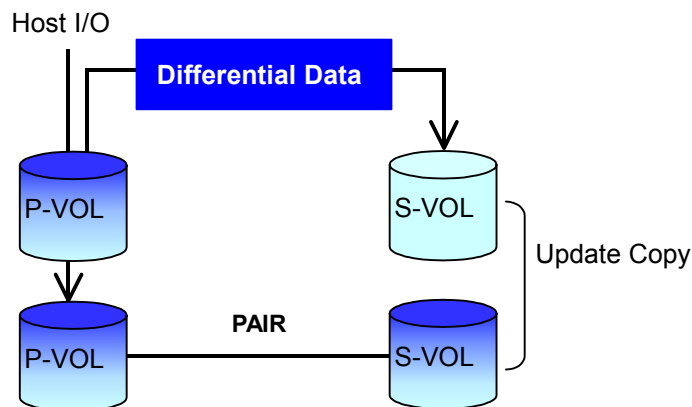
Figure 2.3   Update Copy Operation

Cascade Function

The ShadowImage cascade function allows you to create a second layer of ShadowImage volume pairs (L2) underneath the first layer of ShadowImage pairs (L1). Cascade pairs are created using the **Cascade** button instead of the **Set** button on the Paircreate panel (see section 4.5). This cascade layering scheme allows you to create up to nine copies of one ShadowImage P-VOL. See section 2.5 for further information on cascade pairs and the cascade function.

2.3.4   Pairsplit Operation

The ShadowImage split capability 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. 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.

The Pairsplit panel (see section 4.6) allows you to split existing ShadowImage pairs, and also allows you to add and split new ShadowImage pairs in one step. When the split operation is complete, the pair status changes to PSUS, and you have full read/write access to the split S-VOL (even though it is still reserved). While the pair is split, the 9900V 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.

- When splitting pairs, you can select the pace for the pending update copy operation(s): **slower**, **medium**, and **faster**. The slower pace minimizes the impact of ShadowImage operations on subsystem I/O performance, while the faster pace splits the pair(s) as quickly as possible.

- When splitting pairs, you can also select the split type: **Quick Split** or **Steady Split**.

    - When the quick split operation starts, the pair status changes to PSUS(SP), and the S-VOL is available immediately for read and write I/Os (even though it is still reserved). The 9900V performs all pending update copy operations to the S-VOL in the background. When the quick split is complete, the pair status changes to PSUS.

    - When the steady split operation starts, the pair status changes to COPY(SP), and the 9900V performs all pending update copy operations to the S-VOL. When the Steady Split operation is complete, the pair status changes to PSUS, and you have full read/write access to the split S-VOL (even though it is still reserved).

2.3.5 Pairresync Operations (Normal, Quick, Reverse, and Quick Restore)

ShadowImage allows you to perform four types of pairresync operations:

- **Normal.** The normal pairresync operation (see Figure 2.4) 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), and the P-VOL remains accessible to all hosts for both read and write operations during a normal pairresync.

- **Quick.** The quick pairresync operation speeds up the normal pairresync operation by copying the P-VOL differential data map only without copying the P-VOL data to the S-VOL. The P-VOL and the S-VOL are resynchronized when update copy operations are performed for duplex pairs (status = PAIR). The pair status during a quick pairresync operation is COPY(RS) until the differential map is copied, and the P-VOL remains accessible to all hosts for both read and write operations. The S-VOL becomes inaccessible to all hosts during a quick pairresync operation.

- **Reverse.** The reverse pairresync operation (see Figure 2.5) synchronizes the P-VOL with the S-VOL. The copy direction for a reverse pairresync operation is S-VOL to P-VOL.

  Table 2.2 lists the operational requirements for the reverse pairresync operation. The pair status during a reverse resync operation is COPY(RS-R), and the P-VOL and S-VOL become inaccessible to all hosts for write operations during a reverse pairresync operation. As soon as the reverse pairresync is complete, the P-VOL becomes accessible. The reverse pairresync operation can only be performed on split pairs, not on suspended pairs. The reverse pairresync operation cannot be performed on L2 cascade pairs.

  Note: The P-VOL remains read-enabled during the reverse pairresync operation only to enable the volume to be recognized by the host. The data on the P-VOL is not guaranteed until the reverse pairresync operation is complete and the status changes to PAIR.

- **Quick Restore**. The quick restore operation (see Figure 2.5) speeds up reverse resync by changing the volume map in the 9900V subsystem to swap the contents of the P-VOL and S-VOL without copying the S-VOL data to the P-VOL. The P-VOL and S-VOL are resynchronized when update copy operations are performed for pairs in the PAIR status. The pair status during a quick restore operation is COPY(RS-R) until the volume map change is complete. The P-VOL and S-VOL become inaccessible to all hosts for write operations during a quick restore operation. Quick restore cannot be performed on L2 cascade pairs. Table 2.2 lists the operational requirements for the quick restore operation.

  Note: The P-VOL remains read-enabled during the quick restore operation only to enable the volume to be recognized by the host. The data on the P-VOL is not guaranteed until the quick restore operation is complete and the status changes to PAIR.

  Caution: During a quick restore operation, the **RAID levels**, **HDD types**, and **FlashAccess settings** of the P-VOL and S-VOL are exchanged. For example, if the P-VOL has a RAID-1 level and the S-VOL has a RAID-5 level, the quick restore operation changes the RAID level of the P-VOL to RAID-5 and of the S-VOL to RAID-1. To avoid any performance impact due to the quick restore operation:

1. Make sure that the P-VOL and S-VOL have the same RAID level and HDD type before performing the quick restore operation. If you want to restore the original RAID levels after quick restore, stop host I/Os to the pair, split the pair, perform the quick restore operation for that pair again, and then restart the host I/Os to the pair.

2. Because the FlashAccess settings are exchanged during a quick restore operation, you must perform one of the two following operations. If you do not, the change of location of the cache residence areas may cause I/O performance to the FlashAccess data to be down.

   a) Set the same FlashAccess settings (locations) for the P-VOL and S-VOL before performing the quick restore operation.

   b) Release the FlashAccess settings of the P-VOL and S-VOL before the quick restore operation, and then reset the FlashAccess settings of the P-VOL and S-VOL after the pair changes to PAIR status as a result of the quick restore operation.

If you do not want the P-VOL and S-VOL to be resynchronized after the quick restore operation, you must set the Swap&Freeze option before performing the quick restore operation (see sections 2.4.1 and 4.11.).
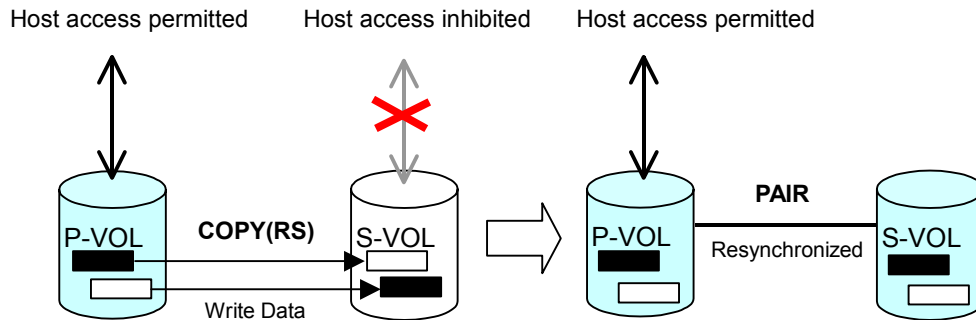
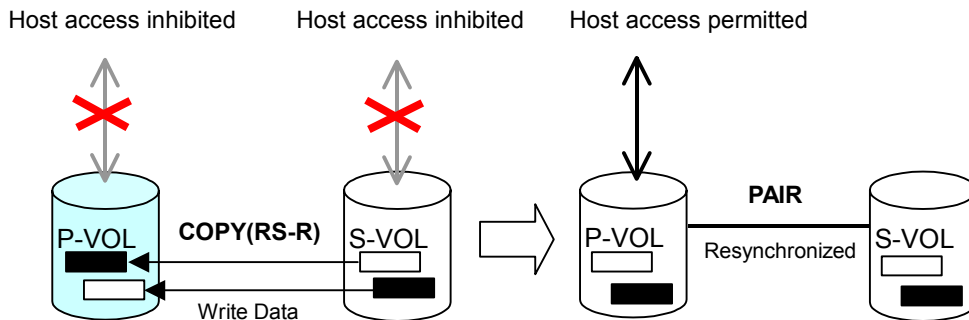

Figure 2.4   Normal and Quick Pairresync Operations

Figure 2.5   Reverse and Quick Restore Pairresync Operations

Table 2.2   Reverse and Quick Restore Pairresync Requirements

Parameter	Requirement(s)
Reverse and quick restore pairresync commands.	The specified pair must be in the PSUS state. If not, the reverse or quick restore pairresync command will be rejected.
	All other pairs which share the same P-VOL as the specified pair must also be in the PSUS or PSUE state. If not, the reverse or quick restore pairresync command will be rejected.
Reverse or quick restore pairresync command issued to a shared ShadowImage/TrueCopy volume.	If the ShadowImage and TrueCopy pairs share the same volume, and the TrueCopy pair is not suspended, the reverse and quick restore pairresync operations cannot be performed. (The command will be rejected.)
	During the reverse or quick restore pairresync operation, a TrueCopy pair cannot be created. The TrueCopy paircreate command will be rejected when the ShadowImage pair status is COPY(RS-R).
Effect on other pairs which share the P-VOL.	If the reverse or quick restore pairresync operation is performed on one ShadowImage pair in a 1-to-n ShadowImage configuration (n>1), the P-VOL and the other S-VOLs are no longer synchronized. While this reverse or quick restore pairresync is in progress, you cannot perform paircreate, pairsplit, or pairresync for any other pair which shares the same P-VOL (pairsplit-S and pairsplit-E are allowed).
Reverse or quick restore resync ends abnormally; OR, Pairsplit-E (PSUE) is requested during reverse or quick restore resync.	1. The pair status changes to PSUE.
	2. The P-VOL of the PSUE pair is read- and write-enabled for all hosts; however, the data on the P-VOL is not guaranteed. The S-VOL of the PSUE pair remains write-disabled (read-only); however, the data on the S-VOL is not guaranteed.
	3. The status of other ShadowImage pairs which share the same P-VOL does not change.

The Pairresync panel (see section 4.7) allows you to resynchronize split and suspended ShadowImage pairs. When the pairresync operation starts, the pair status changes to COPY(RS) or COPY(RS-R). When the pairresync is complete, the pair status changes to PAIR. The 9900V resumes ShadowImage update copy operations after the pair status changes to PAIR. The P-VOL remains fully accessible during a normal pairresync operation, but becomes inaccessible to all hosts during a reverse or quick restore pairresync operation. This ensures that the data on the P-VOL is identical to the data on the S-VOL when the reverse or quick restore pairresync operation completes.

When resynchronizing pairs, you can select the pace for the pairresync operation(s): slower, medium, or faster. The slower pace minimizes the impact of ShadowImage operations on subsystem I/O performance, while the faster pace resynchronizes the pair(s) as quickly as possible.

ShadowImage allows you to perform normal/quick pairresync operations on split and suspended pairs, but reverse/quick restore pairresync operations can only be performed on split pairs:

- **Pairresync for split pair.** When a normal/quick pairresync operation is performed on a split pair (status = PSUS), the 9900V merges the S-VOL track map into the P-VOL track map and then copies all flagged tracks from the P-VOL to the S-VOL. When a reverse or quick restore pairresync operation is performed on a split pair, the 9900V merges the P-VOL track map into the S-VOL 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 normal/quick pairresync operation is performed on a suspended pair (status = PSUE), the 9900V 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. Reverse and quick restore pairresync operations cannot be performed on suspended pairs. The normal pairresync operation for suspended pairs is equivalent to and takes as long as the ShadowImage initial copy operation.

2.3.6   Pairsplit-E Operation (Suspend)

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 9900V 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. While the pairresync operation for a split ShadowImage pair can be very fast, the pairresync operation for a suspended pair takes as long as the initial copy operation. The reverse and quick restore pairresync operations cannot be performed on suspended pairs.

The 9900V subsystem will automatically suspend a ShadowImage pair when it cannot keep the pair mirrored for any reason. When the 9900V suspends a pair, sense information is generated to notify the host. The 9900V 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 9900V detects an error condition related to an update copy operation.

- When the P-VOL and/or S-VOL track map in shared memory is lost (e.g., due to offline microprogram exchange). This applies to COPY(SP) and PSUS(SP) pairs only. For PAIR, PSUS, COPY(RS), or COPY(RS-R) pairs, the pair is not suspended but the entire P-VOL (S-VOL for reverse or quick restore pairresync) is marked as difference data.

The Pairsplit-E panel (see section 4.8) allows you to suspend ShadowImage pairs. When a pair is suspended, the status changes to PSUE. When the pairresync operation starts, the pair status changes to COPY(RS). The P-VOL remains fully accessible while suspended and during the pairresync operation.

2.3.7   Pairsplit-S Operation (Delete)

The ShadowImage pairsplit-S operation (delete pair) stops the ShadowImage copy operations to the S-VOL of the pair and changes the pair status of both volumes to SMPL. A ShadowImage pair can be deleted by the user at any time except during the quick pairsplit operation [i.e., any status except SMPL and PSUS(SP)]. After you delete a ShadowImage pair, the S-VOL is still not available for write operations until the reserve attribute is reset.

The Pairsplit-S panel (see section 4.9) allows you to delete ShadowImage pairs. When a ShadowImage pair is deleted, pending update copy operations for the pair are discarded, and the status of the P-VOL and S-VOL is changed to SMPL.

Caution: The S-VOL of a duplex pair (PAIR status) may not be identical to its P-VOL, due to the asynchronous ShadowImage update copy operations. See section 4.9 for instructions on synchronizing the volumes before deleting the pair.

2.4   ShadowImage Options

ShadowImage allows you to set thirty-two types of options for ShadowImage operations. With these options, you can enhance such ShadowImage operations such as paircreate and pairresync.

Table 2.3   Types of ShadowImage Options

No.	Option Type	Requirement
1	Swap&Freeze (Refer to section 2.4.1.)	The ShadowImage quick restore operation can be performed on the 9900V subsystem. If the 9900V setting disables the quick restore operation, you must change the setting (i.e., enable the quick restore operation in your 9900V subsytem), before using the Swap&Freeze option.
2 - 32	Reserved (for future use)	—

Note: Available option types depend on the 9900V subsystem settings.

2.4.1   Swap&Freeze Option

The Swap&Freeze option allows the S-VOLs of a ShadowImage pair to remain unchanged after the quick restore operation. If the quick restore operation is performed on a ShadowImage pair with the Swap&Freeze option, update copy operations are suppressed, and are thus not performed for pairs in the PAIR status after the quick restore operation. If the quick restore operation is performed without the Swap&Freeze option, the P-VOL and S-VOL are resynchronized when update copy operations are performed for pairs in the PAIR status. Note: Make sure that the Swap&Freeze option remains in effect until the pair status changes to PAIR after the quick restore operation.

Figure 2.6 shows the state of the S-VOL after the quick restore operation with or without the Swap&Freeze option.

The S-VOL remains unchanged after the quick restore operation, because the Swap&Freeze option suppresses update copy operations.

The P-VOL and S-VOL are resynchronized when ordinary update copy operations are performed after the quick restore operation.
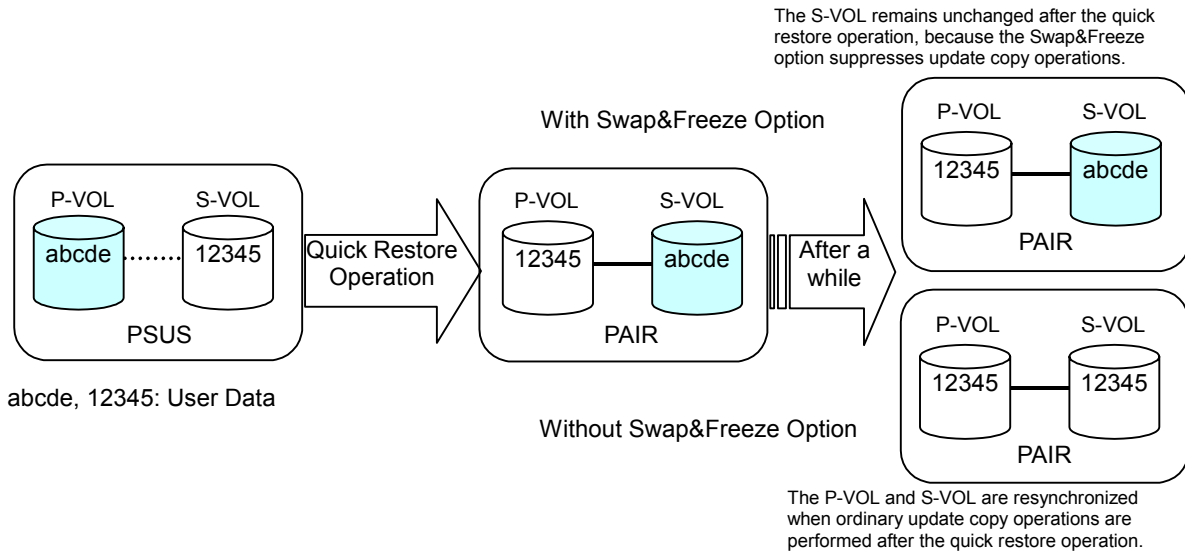
Figure 2.6   Quick Restore Operation With or Without Swap&Freeze Option

2.5   Cascade Function

The ShadowImage cascade function allows you to create a second layer of volume pairs underneath the first layer of ShadowImage pair(s). Figure 2.7 illustrates cascaded ShadowImage volume pairs. The first cascade layer (L1) is the original ShadowImage pair, which consists of one P-VOL (root volume) and up to three S-VOLs (node volumes). In the second cascade layer (L2), the S-VOLs of the original ShadowImage pair function as the P-VOLs of the L2 pairs, and each L2 P-VOL can have up to two S-VOLs (leaf volumes). This layering scheme allows you to create up to nine copies of one ShadowImage primary volume (P-VOL).
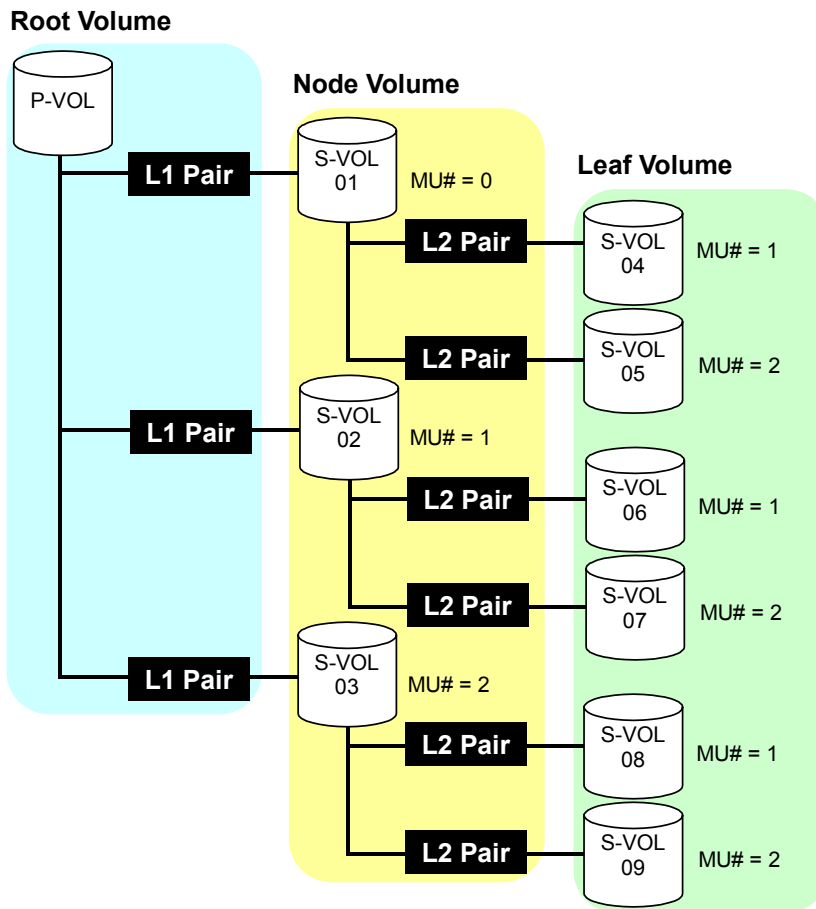
Figure 2.7   Cascade Pairs

When L1 and L2 cascade pairs are created, the P-VOLs and S-VOLs of the cascade pairs are classified using the following terms (as shown in Figure 2.7):

■   The **root volume** is the P-VOL of the L1 pair, which is the original ShadowImage pair. You can add up to three S-VOLs (node volumes) to a root volume.

■   The **node volume** is the S-VOL (reserved) of an L1 pair and the P-VOL of an L2 pair. You can add up to two S-VOLs (leaf volumes) to a node volume.

■   The **leaf volume** is the S-VOL (reserved) of an L2 cascade pair.

Table 2.4 shows the relationship between the L1 pair status and the availability of ShadowImage pair operations on the associated L2 pairs. To split an L2 pair, you must first split the L1 pair (L1 status = PSUS). The reverse and quick restore pairresync operations cannot be used for L2 pairs. Table 2.5 shows the relationship between the L2 pair status and the availability of pair operations on the associated L1 pairs. (CMD RJT = command rejected.) If you delete an L1 pair that contains an L2 pair, the L2 pair becomes the L1 pair.

Note: Combination of L1 and L2 pairs with the TrueCopy volumes is allowed; however, node volumes and leaf volumes are both considered *secondary volumes* (S-VOLs) by TrueCopy.

Table 2.4   Relationship between L1 Pair Status and L2 Pair Operations

L1 Pair Status	L2 Pair Operations					
	Paircreate	Pairsplit	Pairresync	Reverse/Quick Restore	Pairsplit-E	Pairsplit-S
COPY(PD)	OK	NO (CMD RJT)	OK	NO (CMD RJT)	OK	OK
PAIR	OK	NO (CMD RJT)	OK	NO (CMD RJT)	OK	OK
COPY(SP)	OK	NO (CMD RJT)	OK	NO (CMD RJT)	OK	OK
PSUS(SP)	NO (CMD RJT)	NO (CMD RJT)	OK	NO (CMD RJT)	OK	OK
PSUS	OK	OK	OK	NO (CMD RJT)	OK	OK
COPY(RS)	OK	NO (CMD RJT)	OK	NO (CMD RJT)	OK	OK
COPY(RS-R)	OK	NO (CMD RJT)	OK	NO (CMD RJT)	OK	OK
PSUE	OK	NO (CMD RJT)	OK	NO (CMD RJT)	OK	OK

Table 2.5   Relationship between L2 Pair Status and L1 Pair Operations

L2 Pair Status	L1 Pair Operations					
	Paircreate	Pairsplit	Pairresync	Reverse/Quick Restore	Pairsplit-E	Pairsplit-S
COPY(PD)	OK*	OK	OK	OK	OK	OK
PAIR	OK*	OK	OK	OK	OK	OK
COPY(SP)	NO (CMD RJT)	NO (CMD RJT)	NO (CMD RJT)	NO (CMD RJT)	OK	OK
PSUS(SP)	NO (CMD RJT)	NO (CMD RJT)	NO (CMD RJT)	NO (CMD RJT)	OK	OK
PSUS	OK*	OK	OK	OK	OK	OK
COPY(RS)	OK*	OK	OK	OK	OK	OK
COPY(RS-R)	NO (CMD RJT)	NO (CMD RJT)	NO (CMD RJT)	NO (CMD RJT)	OK	OK
PSUE	OK*	OK	OK	OK	OK	OK

* MU# of L2 pair must be 1 or 2.

The read/write operation to each volume (root, node or leaf volume) from the host is enabled or disabled depending on the status of L1/L2 pairs. Table 2.6 indicates the relationship between read/write operation from the host to the node volume and the status of L1/L2 pairs. Table 2.7 indicates the relationship between read/write operation from the host to the leaf volume and the L2 pair status.

Table 2.6   Read/Write to Node Volume According to Status of L1/L2 Pairs

L1 Pair Status	L2 Pair Status					
	COPY(PD)	PAIR	COPY(SP)	PSUS(SP)/PSUS	COPY(RS)	PSUE
COPY(PD)	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only
PAIR	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only
COPY(SP)	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only
PSUS(SP)/PSUS	Read/Write	Read/Write	Read/Write	Read/Write	Read/Write	Read/Write
COPY(RS)	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only
COPY(RS-R)	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only
PSUE	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only

Table 2.7   Read/Write to Leaf Volume According to L2 Pair Status

COPY	L2 Pair Status				
	PAIR	COPY(SP)	PSUS(SP)/PSUS	COPY(RS)	PSUE
Read Only	Read Only	Read Only	Read/Write	Read Only	Read Only

2.6   Pair Status

The ShadowImage remote console displays the pair status of all ShadowImage volumes (LUs) on the specified port of the connected 9900V subsystem. Figure 2.8 illustrates the ShadowImage pair status transitions and the relationship between the pair status and the ShadowImage operations.
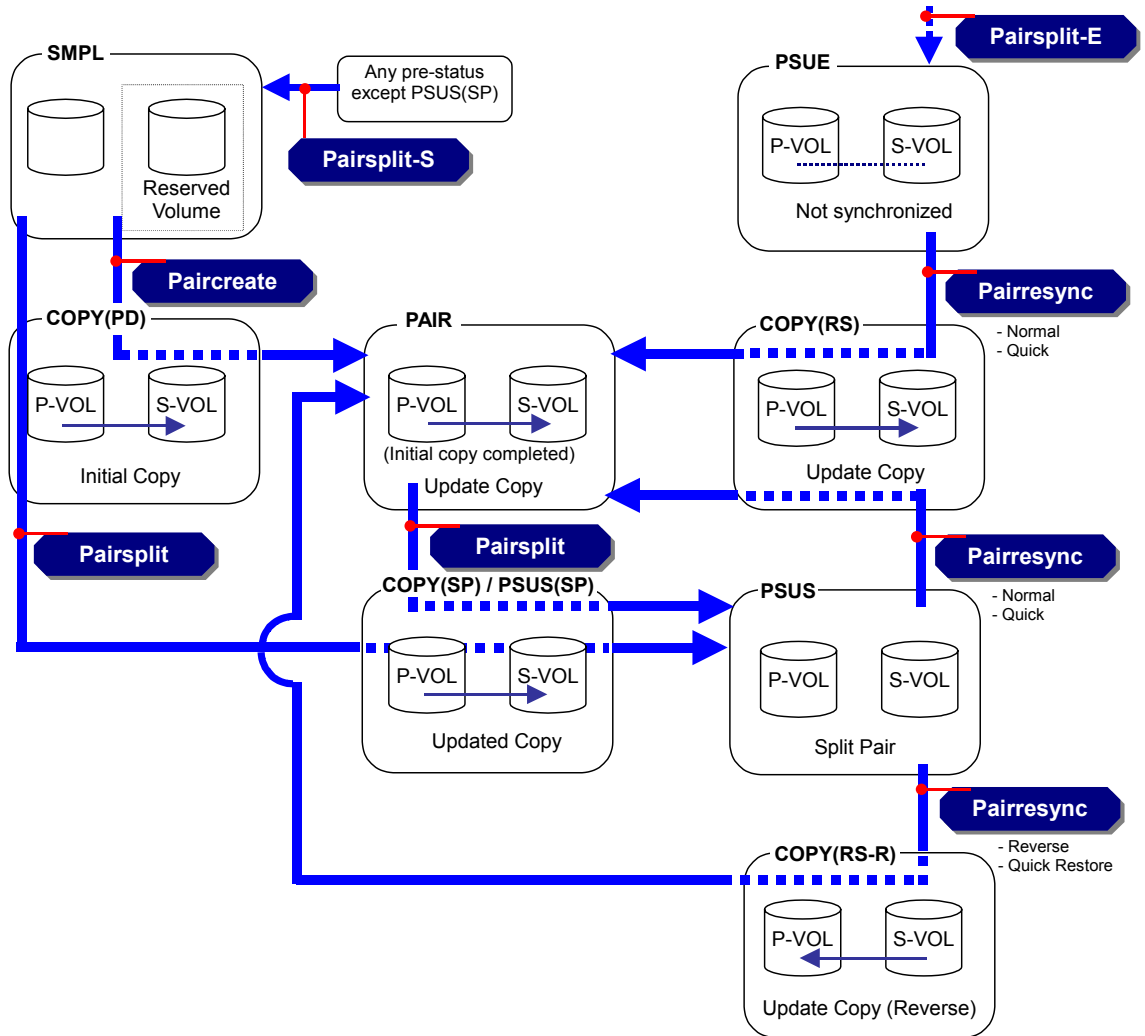

Figure 2.8   ShadowImage Pair Status Transitions

Table 2.8 lists and describes the ShadowImage pair status conditions. If a volume is not assigned to a ShadowImage pair, its status is SMPL. When you create a ShadowImage 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 9900V 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) or PSUS(SP) for quick pairsplit. 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 or quick restore mode for a pairresync operation, 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 delete a pair (pairsplit-S), the pair status changes to SMPL.

Table 2.8   ShadowImage Pair Status

Pair Status	Description	S-VOL Access
SMPL	The volume is not assigned to a ShadowImage pair. The 9900V accepts read and write I/Os for all SMPL volumes which are not reserved.	N/A (there is no S-VOL yet).
COPY(PD)	The initial copy operation is in progress. The 9900V continues to accept read and write operations for the P-VOL but stops accepting write operations for the S-VOL. No update copy operations are performed.	Read only.
PAIR	The initial copy operation is complete, and the 9900V starts performing asynchronous update copy operations from the P-VOL to the S-VOL as needed. The P-VOL and S-VOL of a duplex pair (PAIR status) may not be identical. The 9900V rejects all write I/Os for S-VOLs with the status PAIR.	Read only.
COPY(SP)	The status becomes COPY(SP) when the steady split mode is selected for the pairsplit operation. All P-VOL updates prior to the pairsplit command are being copied to the S-VOL. When these updates are complete, the split S-VOL is identical to the state of the P-VOL when the split started. The 9900V rejects all write I/Os for COPY(SP) S-VOLs.	Read only.
PSUS(SP)	The status becomes PSUS(SP) when the quick split mode is selected for the pairsplit operation. Only the P-VOL differential data is being copied to the S-VOL in background. The 9900V accepts writes for PSUS(SP) S-VOLs. The PSUS(SP) pairs cannot be deleted.	Read and write. The S-VOL can be mounted.
PSUS	The 9900V stops performing update copy operations for PSUS (split) pairs, and starts accepting write I/Os for PSUS S-VOLs. The 9900V keeps track of all updates to the split 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 9900V does not accept write I/Os for COPY(RS) S-VOLs. When a split pair is resynchronized in normal mode, the 9900V copies only the P-VOL differential data to the S-VOL. When a PSUE (suspended) pair is resynchronized, the 9900V copies the entire P-VOL to the S-VOL. No update copy operations are performed during the pairresync operation.	Read only.
COPY(RS-R)	The 9900V does not accept write I/Os for COPY(RS-R) S-VOLs. When a split pair is resynchronized in reverse or quick restore mode, the 9900V copies only the S-VOL differential data to the P-VOL. No update copy operations are performed during the reverse or quick restore pairresync operation.	Read only.
PSUE	The 9900V continues accepting read and write I/Os for a PSUE (suspended) P-VOL, but does not perform update copy operations to a PSUE S-VOL. The 9900V 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.

Chapter 3   Preparing for ShadowImage Operations

3.1   System Requirements

ShadowImage operations involve the 9900 V Series (9900V) subsystem containing the primary and secondary volumes and the licensed ShadowImage feature enabled on the 9900V Remote Console. The system requirements for ShadowImage are:

- Hitachi Lightning 9900™ V subsystem. All 9900V hardware, microcode, and software required for ShadowImage operations must be installed and enabled.

- **ShadowImage Remote Console Software:**
  – The **9900V Hitachi Remote Console – Storage Navigator** software is required for 9900V ShadowImage operations (see section 3.2). The ShadowImage Remote Console software is a component of the 9900V Hitachi Remote Console – Storage Navigator.
  – The **ShadowImage license key code** is required to enable the ShadowImage option on the 9900V subsystem (see section 3.3). A separate license code is required for each 9900V.

  Note: Administrator access to the 9900V Remote Console software is required to perform ShadowImage operations. Users without administrator access can only view HPAV information.

  Note: You must operate the remote console in modify mode to perform ShadowImage operations. Users in view mode can only view ShadowImage information.

- ShadowImage feature enabled on the 9900V subsystem, (s) and the Java applet program downloaded from the 9900V SVP to the remote console (see section 3.2).

3.2   Enabling the ShadowImage Option

You must enable the ShadowImage option on the 9900V subsystem using the 9900V Remote Console software. For instructions on using the 9900V Remote Console software and enabling the ShadowImage option, please refer to the *Hitachi Freedom Storage™ Lightning 9900™ V Series Hitachi Remote Console – Storage Navigator User's Guide* (MK-92RD101).

3.3   Preparing for ShadowImage Operations

To ensure that you and your 9900V subsystem(s) are ready for ShadowImage operations, you should perform the following tasks to prepare for ShadowImage operations:

- ShadowImage operations affect the I/O performance of the 9900V subsystem because of the copy operations to the S-VOLs. If you have not already done so, you should consider the relative importance of the subsystem's I/O performance and the ShadowImage backup copies. For example, assigning three S-VOLs to each P-VOL takes more resources than assigning only one or two. You can also use the copy pace option to control the impact of the ShadowImage initial copy operations. Using a slower copy pace minimizes the impact of ShadowImage operations on I/O performance, while a faster copy pace produces copies more quickly but may affect I/O performance.

- If you are using more than one 9900V data management feature (e.g., ShadowImage, TrueCopy, Open Volume Management, FlashAccess) at the same time in the same 9900V subsystem, please contact the Hitachi Data Systems Support Center to ensure that your 9900V subsystem is optimized for your configuration of concurrent operations (e.g., sufficient cache). Each 9900V feature can affect the performance of the 9900V subsystem and/or the operation of other features. For example, ShadowImage and TrueCopy operations both involve initial copy operations and update copy operations to the secondary/remote volumes in addition to the host I/O workload.

- Identify the volumes (LUs) that you will be using for ShadowImage operations. For each volume, write down the full SCSI path (port, target ID (TID), LUN), whether the volume will be a P-VOL or S-VOL, and the other volume(s) in its pair (see Table 3.1 for a sample table). The Hitachi LUN Manager™ software displays this information. The volumes which will be P-VOLs will remain fully accessible to all hosts throughout normal ShadowImage operations, but the volumes which will be S-VOLs will need to be unmounted before being reserved for ShadowImage operations.

Table 3.1   Sample Table for ShadowImage Configuration Information

CU#	Port	TID:LUN	L1 P-VOL?	Associated L1 S-VOL(s)	L1 S-VOL?	Assoc. L1 P-VOL	L2 P-VOL?	Associated L2 S-VOL(s)	L2 S-VOL?	Assoc. L2 P-VOL
0	1A	0:00	Yes	1B-0:00, 2A-0:00, 2B-0:00	No	--	No	--	No	--
0	1A	0:01	Yes	1B-0:01, 2A-0:01, 2B-0:01	No	--	No	--	No	--
etc.										
0	1B	0:00	No	--	Yes	1A-0:00	Yes	3A-0:00, 3A-0:01	No	--
0	1B	0:01	No	--	Yes	1A-0:01	Yes	3B-0:00, 3B-0:01	No	--
etc.										
0	2A	0:00	No	--	Yes	1A-0:00	Yes	4A-0:00, 3B-0:01	No	--
0	2A	0:01	No	--	Yes	1A-0:01	Yes	4B-0:00, 3B-0:01	No	--
etc.										
0	3A	0:00	No	--	No	--	No	--	Yes	1B-0:00
0	3A	0:01	No	--	No	--	No	--	Yes	1B-0:00

3.4   Combining ShadowImage with Other Data Management Operations

ShadowImage supports concurrent operations with the following data management functions:

- **Open Volume Management (Virtual LUN and LUN Expansion)**. Virtual LUN volumes can be assigned to ShadowImage pairs, provided that the S-VOL has the same capacity as the P-VOL. If you need to perform Open Volume Management operations on an existing ShadowImage P-VOL or S-VOL, you must delete the pair first to return the volume to SMPL status.

  LUSE volumes can be assigned to ShadowImage pairs, provided that the P-VOL and S-VOL have the same LU type and the same number of LDEVs (same size). If you need to perform LUSE operations on an existing ShadowImage P-VOL or S-VOL, you must delete the pair first to return the volume to SMPL status.

- **LUN Management (including LUN Security)**. LUN Security operations do not affect ShadowImage operations. Volumes which are under secure ports and/or which are assigned to World Wide Name (WWN) groups and/or LUN groups can also be assigned to ShadowImage pairs. Volumes which are assigned to ShadowImage pairs can also be assigned to secure ports, WWN groups, and/or LUN groups for LUN Security.
  Note: ShadowImage S-VOLs cannot be accessed by any host except when the pair is split.

- **FlashAccess**. FlashAccess volumes can be assigned to ShadowImage pairs, and FlashAccess operations can be performed on ShadowImage P-VOLs and S-VOLs.

  Caution: See section 2.3.5 for important information on performing quick restore operations on FlashAccess volumes.

- **Hitachi TrueCopy**. TrueCopy volumes can be assigned to ShadowImage pairs, and ShadowImage volumes can be assigned to TrueCopy pairs. See section 3.4.1 for important information on ShadowImage and TrueCopy shared volume configurations.

  Note: ShadowImage is recommended for intra-subsystem copy operations. If ShadowImage is not installed, TrueCopy (synchronous only) can be used to copy within the same 9900V subsystem. This TrueCopy configuration requires at least one external ESCON® cable loop (minimum of two is recommended).

3.4.1   Combining ShadowImage and TrueCopy Operations

ShadowImage and TrueCopy can function together in the same 9900V subsystem to provide both internal and remote backup for your important data.

Note: Combination of ShadowImage L1 and L2 pairs with TrueCopy volumes is allowed. Node volumes and leaf volumes are both considered *secondary volumes* (S-VOLs) by TrueCopy.

Note: Reverse resync and quick restore operations cannot be performed on ShadowImage/ TrueCopy shared volume pairs.

The configuration shown in Figure 3.1 is an example of a volume which is functioning as both a TrueCopy P-VOL and a ShadowImage P-VOL. This configuration allows you to:

- Use ShadowImage to provide on-site backup copies of TrueCopy P-VOLs, and/or

- Use TrueCopy to provide remote backup copies of ShadowImage P-VOLs.
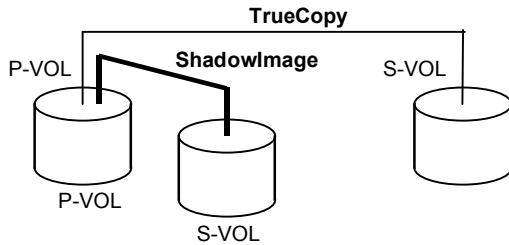
Figure 3.1   ShadowImage and TrueCopy: Shared P-VOL/P-VOL

The configuration shown in Figure 3.2 is an example of a volume which is functioning as both a TrueCopy S-VOL and a ShadowImage P-VOL. This configuration allows you to use ShadowImage to provide remote copies of TrueCopy S-VOLs.
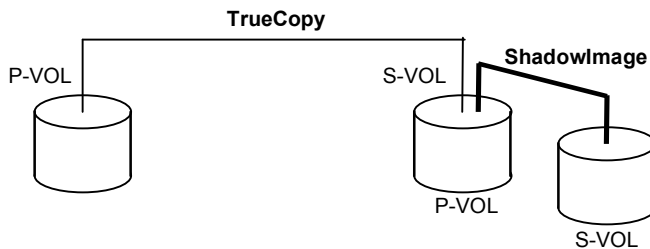
Figure 3.2   ShadowImage and TrueCopy: Shared P-VOL/S-VOL

The configuration shown in Figure 3.3 is an example of a volume which is functioning as both a TrueCopy P-VOL and a ShadowImage P-VOL, while the S-VOL of the same TrueCopy pair is also functioning as the P-VOL of another ShadowImage pair. This configuration allows you to:

- Use ShadowImage to provide on-site backup copies of TrueCopy P-VOLs and S-VOLs, and/or

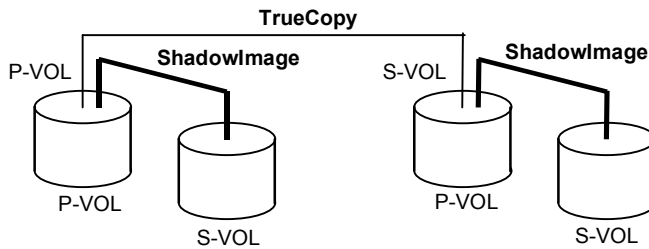- Use TrueCopy to provide remote backup of ShadowImage P-VOLs.

Figure 3.3   ShadowImage and TrueCopy: Shared P-VOL/P-VOL and P-VOL/S-VOL

The configuration shown in Figure 3.4 is an example of a volume functioning as both a ShadowImage S-VOL and a TrueCopy P-VOL. This configuration allows you to use TrueCopy to provide asynchronous remote copy. *Note:* This configuration does not allow ShadowImage and TrueCopy to copy at the same time. Create the ShadowImage pair first, and then split the pair before creating the TrueCopy pair. You must suspend the TrueCopy pair to resync the ShadowImage pair. The TrueCopy pair status cannot be changed when the ShadowImage pair is in the PSUS(SP) status.
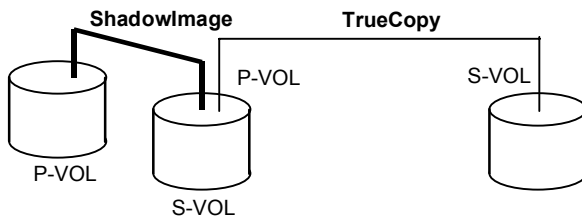
Figure 3.4   ShadowImage and TrueCopy: Shared S-VOL/P-VOL

3.5   Starting up the ShadowImage Feature

After you have enabled the feature for the 9900V Remote Console and prepared for ShadowImage operations, you are ready to start up the ShadowImage feature:

1. Start up and log on to the Remote Console.

2. Start a Web browser on the Remote Console, and display the storage device list.

3. Log on to the SVP of the 9900V subsystem on which you will perform ShadowImage operations. The Remote Console-Storage Navigator main panel opens (see section 4.1).

4. Click the **ShadowImage** button on the Remote Console-Storage Navigator main panel to open the ShadowImage main panel (see Figure 4.2). The ShadowImage main panel displays the name of the connected 9900V subsystem, the currently selected port, and all of the volumes (LUs) installed under the current port.

5. You are now ready to perform ShadowImage operations. You will first reserve the volumes that you plan to use as ShadowImage S-VOLs (see section 4.3 for instructions), and then you will start adding the ShadowImage pairs (see section 4.5 for instructions).

Chapter 4   Performing ShadowImage Operations

4.1   The Remote Console – Storage Navigator Main Panel

The Remote Console-Storage Navigator main panel (see Figure 4.1) opens automatically after a user logs in to the SVP. This main panel displays the user ID of the currently logged-in user, subsystem name, RC-SN version, and provides access to all general RC-SN functions.

Refer to the *Hitachi Lightning 9900™ V Series Remote Console - Storage Navigator User's Guide* for descriptions on this main panel.
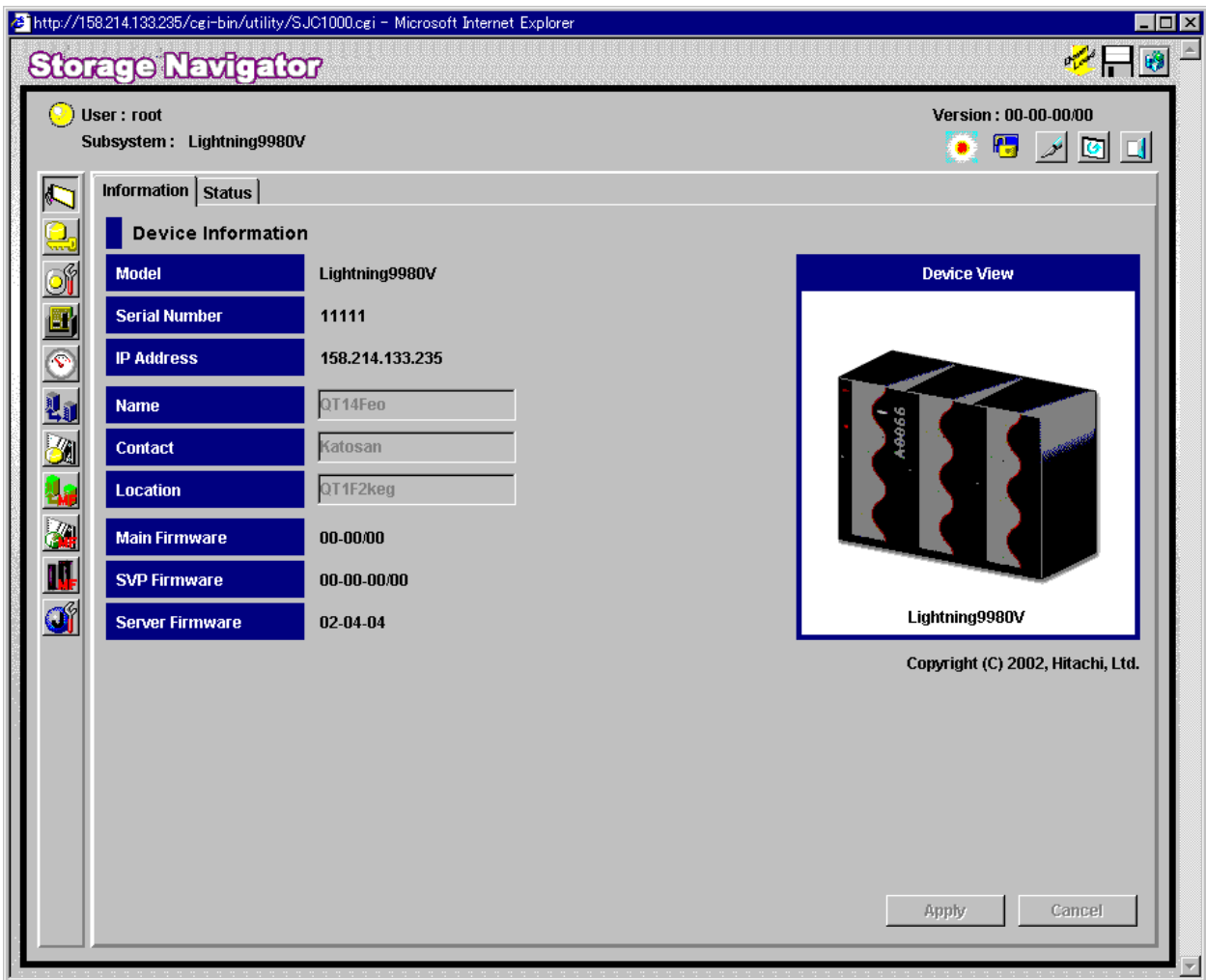
Figure 4.1   The Remote Console-Storage Navigator Main Panel

4.2   The ShadowImage Main Panel

The ShadowImage main panel (see Figure 4.2) displays the ShadowImage volume and pair information for the selected port of the connected 9900 V Series (9900V) subsystem and allows you to perform all ShadowImage operations. To open the ShadowImage main panel, connect to the desired 9900V subsystem from the Remote Console, and then select the **ShadowImage** button (🖼) on the RC-SN main panel. There are three tabs on the ShadowImage main panel: **Main**, **History**, and **Options** tabs.
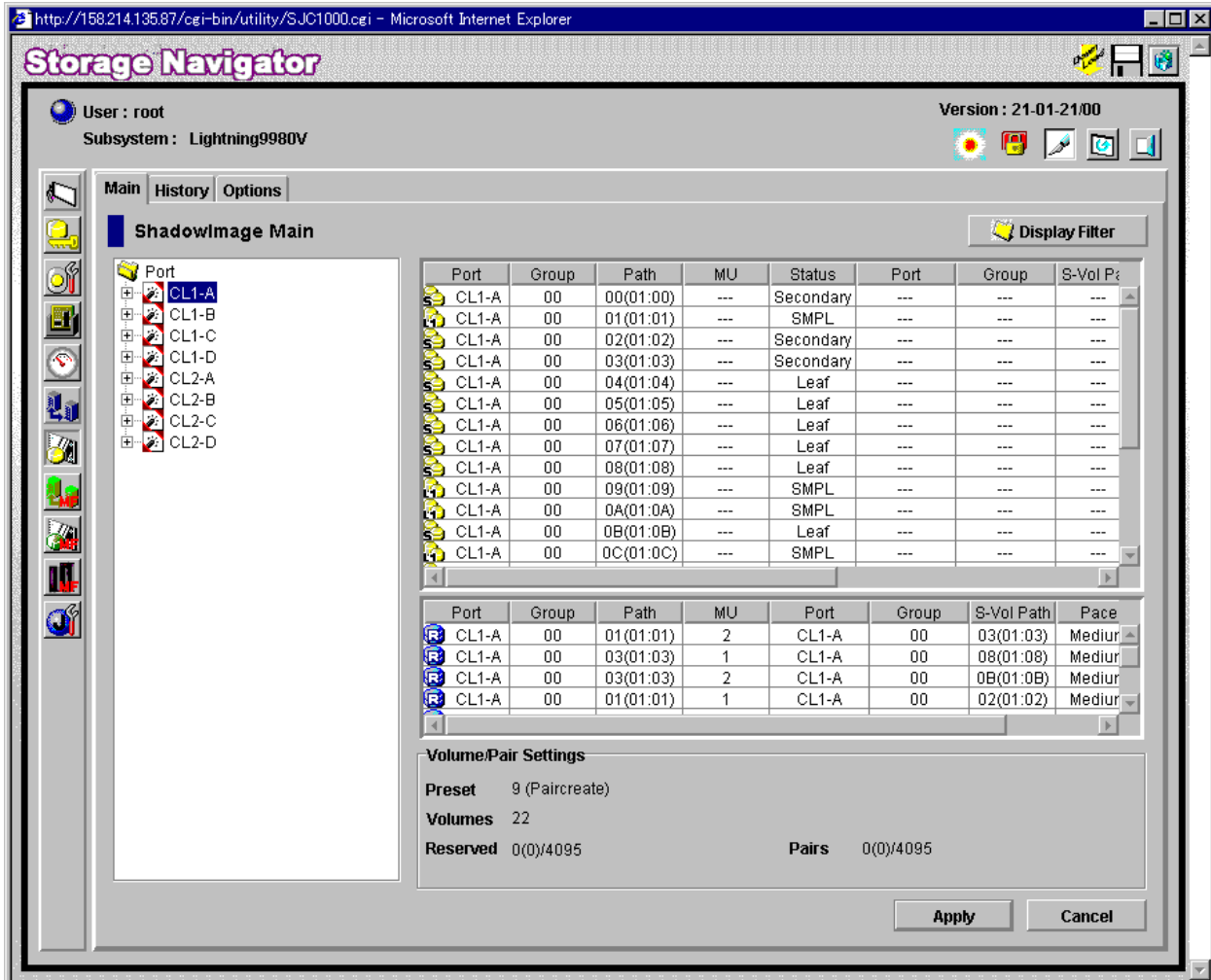
Figure 4.2   ShadowImage Main Panel

The ShadowImage main panel has the following features:

■   The **Tree View** box, which is on the left of the ShadowImage main panel, allows you to select the desired port, host group, or defined P-VOL (pair). *Note:* You can filter the volumes or volume pairs displayed in the **Volume List** box on the upper right side of the ShadowImage main panel, by selecting a port, a host group or a volume (P–VOL) at a time. To display all volumes and pairs, select **Port** on the top of the **Tree View** box.

■ The **Volume List** box, which is on the upper right of the ShadowImage main panel, displays all available volumes on the port, host group, or P-VOL that you select in the **Tree View** box. You can sort the volumes by port, group, path, MU#, status, port (S-VOL), group (S-VOL), S-VOL path, copy pace, progress of copying, volume emulation type, and capacity. You can also filter the volumes by reserve attribute, by pair condition, and pair status, on the Display Filter panel (see Figure 4.6). To open the Display Filter panel, click the **Display Filter** button, or select the **Display Filter** command.

■ The following icons indicate the status of a volume or pair on the ShadowImage panels:

   – : L1 pair

   – : L2 pair

   – : S-VOL (Node volume: **Secondary**, Leaf volume: **Leaf**)

   – : Reserved volume

   – : An error occurred during operations. This error icon is displayed in the **Preset Volume List** box on the ShadowImage main panel.

■ The **Display Filter** button allows you to filter the volumes displayed in the **Volume List** box.

■ The **Preset Volume List** box, which is under the **Volume List** box, displays the specified operations (volume/pair information). These operations have not been performed in the 9900V subsystem. *Note:* The **Preset Volume List** box allows you to hold multiple settings of the same operation (e.g., paircreate) only. You cannot display different types of operations (e.g., pairsplit and pairresync) in the **Preset Volume List** box at the same time. You can also cancel the operations in the **Preset Volume List** box.

■ The **Volume/Pair Settings** box displays:

   – **Preset:** The number of operations (volume/pair information), which have not been performed in the 9900V subsystem. The preset operations are displayed in the **Preset Volume List** box (see Figure 4.7), which is located below the **Volume List** box. You must click the **Apply** button to perform the specified operations displayed in the **Preset Volume List** box.

   – **Volume:** The total number of volumes defined in the 9900V subsystem.

   – **Reserve:** X(Y)/Z, where
       X = total number of ShadowImage reserved volumes
       Y = total number of ShadowImage reserved vols
       Z = maximum allowable number of reserved volumes

   – **Pair:** X(Y)/Z, where X = total number of ShadowImage pairs
       Y = total number of ShadowImage pairs
       Z = maximum number of pairs (ShadowImage/HIHSM)

   Note: The value (Y) does not include HIHSM pairs. If HIHSM pairs exist, it is possible for the ShadowImage paircreate operation to fail even when (Y) is less than 4,095.

- The **Apply** button performs the ShadowImage operations displayed in the **Preset Volume List** box in the 9900V subsystem. If the specified operations complete successfully, the **Preset Volume List** box will be cleared. If an error occurs during an operation, an icon () is displayed, and the failed operation will remain in the **Preset Volume List** box. You can display the error code and message for the failed operation by selecting the **Detail** command.

- The **Cancel** button cancels all operations specified in the **Preset Volume List** box.

- The **Refresh** button () updates the information displayed on the ShadowImage main panel.

- The **Exit** button () exits the ShadowImage program and closes the Remote Console-Storage Navigator main panel.

To perform ShadowImage operations for the desired volume(s), select one or more volumes in the **Volume List** box, right-click using the mouse to display the popup menu commands (**Detail**, **Paircreate**, **Pairsplit**, **Pairresync**, **Pairsplit-E**, **Pairsplit-S**, **Change Reserve**, **S-Vol Path**, and **Display Filter**), and then click the desired command (see section 4.2.1).

For the **History** and **Options** tabs of the ShadowImage main panel, refer to sections 4.10 and 4.11.

4.2.1 The Volume List Box

The **Volume List** box (see Figure 4.3) displays volume/pair information based on the filter options you select in the **Tree View** box (along the left side of the panel). You can also filter the volumes by reserve attribute, by pair condition, and by pair status using the Display Filter button.

	Port	Group	Path	MU	Status	Port	Group	S-Vol Path
	CL1-A	00	00(02:00)	0	PAIR	CL1-A	00	03(02:03)
	CL1-A	00	01(02:01)	0	PSUE	CL1-A	00	04(02:04)
	CL1-A	00	01(02:01)	1	PAIR	CL1-A	00	06(02:06)
	CL1-A	00	02(02:02)	0	PAIR	CL1-A	00	05(02:05)
	CL1-A	00	04(02:04)	1	PAIR	CL1-A	00	09(02:09)
	CL1-A	00	07(02:07)	0	PSUS	CL1-A	00	0C(02:0C)
	CL1-A	00	07(02:07)	1	PSUE	CL1-A	00	0E(02:0E)
	CL1-A	00	07(02:07)	2	PSUS	CL1-A	00	15(02:15)
	CL1-A	00	08(02:08)	0	PSUS	CL1-A	00	0F(02:0F)
	CL1-A	00			PSUS	CL1-A	00	10(02:10)
	CL1-A	00			PSUS	CL1-A	00	16(02:16)
	CL1-A	00			PSUS	CL1-A	00	14(02:14)
	CL1-A	00			SMPL	---	---	---

Detail
Paircreate
Pairsplit
Pairresync
Pairsplit-E
Pairsplit-S
Change Reserve
S-Vol Path
Display Filter

Figure 4.3   The Volume List Box Displaying Volumes (L1 pairs)

The **Volume List** box lists all installed volumes (LUs) on the selected port and displays the following information for each volume:

- **Port**: The port ID (cluster and channel number) of each volume.

- **Group**: The host group of each volume.

- **Path**: The CU:LDEV (control unit image:logical device ID) of each volume.

- **MU**: The MU number of a ShadowImage cascade pair formed with the volume.

- **Status**: The ShadowImage pair status of the volume pair: **SMPL**, **COPY(PD)**, **PAIR**, **PSUS**, **COPY(RS)**, **PSUE**, **COPY(SP)**, **COPY(RS-R)** ,**PSUS(SP)**, **Secondary**, **Leaf**.

- **Port**: The port ID (cluster and channel number) of the first S-VOL of each volume. If there is no S-VOL, **---** is displayed. To display detailed information on the L2 pairs, double-click the corresponding S-VOL in the **Volume List** box.

- **Group**: The host group of the S-VOL. If there is no S-VOL, **---** is displayed.

- **S-Vol Path**: The CU:LDEV (control unit image:logical device ID) of the S-VOL. If there is no S−VOL, **---** is displayed.

- **Progress**: If the volume pair is in the **COPY** status, the progress (%) of copying is displayed (e.g., **0%**, **45%**). If the pair is in **PSUS**, **PSUE**, or **PAIR** status, **---** is displayed. If there is no S-VOL, **---** is also displayed.

- **Type**: The device emulation type (e.g., OPEN-3, OPEN-9).

- **Capacity**: The storage capacity of the volume in MB.

You can perform ShadowImage operations for the desired volume(s) in the **Volume List** box, by using the following popup menu commands:

Table 4.1   List of ShadowImage Popup Menu Commands

Command	Feature
Detail	Opens the Detail panel that displays information for the selected volume or pair (see Figure 4.4).
Paircreate	Opens the Paircreate panel, which allows you to create (add) new ShadowImage pairs (see Figure 4.10).
Pairsplit	Opens the Pairsplit panel, which allows you to split ShadowImage pairs (see Figure 4.11).
Pairresync	Opens the Pairresync panel, which allows you to resynchronize ShadowImage pairs (see Figure 4.12).
Pairsplit-E	Opens the Pairsplit-E panel, which allows you to suspend ShadowImage pairs (see Figure 4.13).
Pairsplit-S	Opens the Pairsplit-S panel, which allows you to delete ShadowImage pairs (see Figure 4.14).
Change Reserve	Opens the Set/Reset Reserve Attribute panel allows you to set/reset the ShadowImage reserve attribute (see Figure 4.8 and Figure 4.9).
S-Vol Path	Opens the S-Vol Path panel (see Figure 4.5), which displays the S-VOL's port, group, and path (LUN) of the selected pair.
Display Filter	Opens the Display Filter panel, which allows you to filter the volumes displayed in the **Volume List** box.

4.2.2   The Detail Panel

The Detail panel displays information for the selected volume or pair. To open the Detail panel, select a pair or volume in the **Volume List** box on the ShadowImage main panel, right-click to see the menu commands, and then select the **Detail** command. If the P-VOL of the selected pair has two or more S-VOLs that share the same P-VOL, all S-VOLs are displayed on the Detail panel.
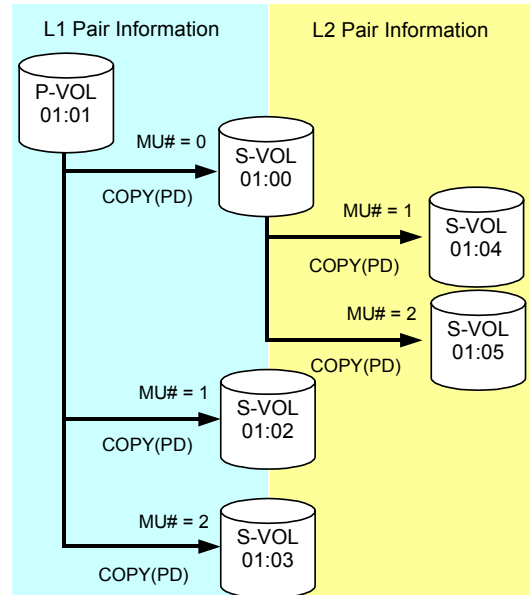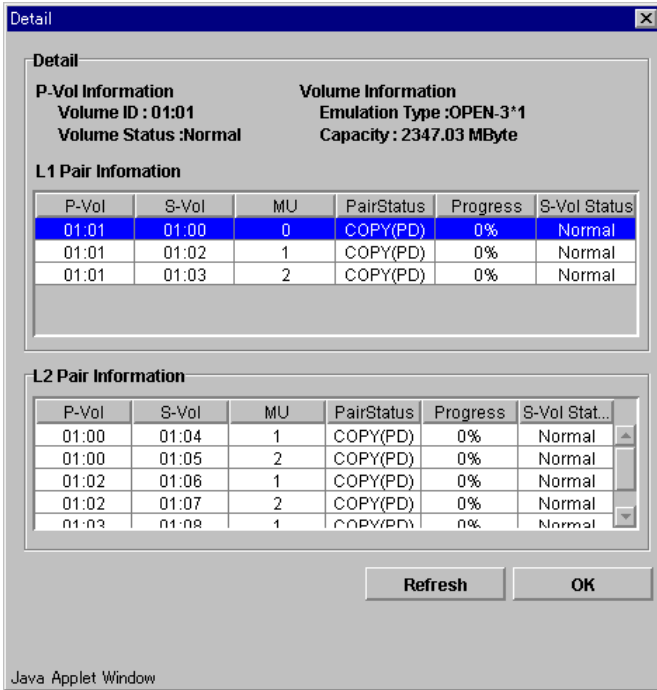
Figure 4.4   The Detail Panel Displaying Pair Information (L1 and L2 Pairs)

The Detail panel has the following features:

- The **Detail** box displays the following information:
    - **P-Vol Information**: the P-VOL's CU:LDEV and LDEV status.
    - **Volume Information**: the LDEV emulation type and capacity.
    - The **L1 Pair Information** box displays the CU:LDEV of both the P-VOL and S-VOL of the L1 pair, MU number, pair status, progress of copying, first path to the S-VOL.

- The **L2 Information** box displays the CU:LDEV of both the P-VOL and S-VOL of the L2 pair, MU number, pair status, progress of copying, first path to the S-VOL.

- The **Refresh** button updates the information on the Detail panel.

- The **OK** button closes the Detail panel.

4.2.3   The S-Vol Path Panel

The S-Vol Path panel displays information on the selected pair (all paths defined for the
S–VOL). To open the S-Vol Path panel, select one or more pair in the **Volume List** box on
the ShadowImage main panel, right-click to display the popup menu commands, and then
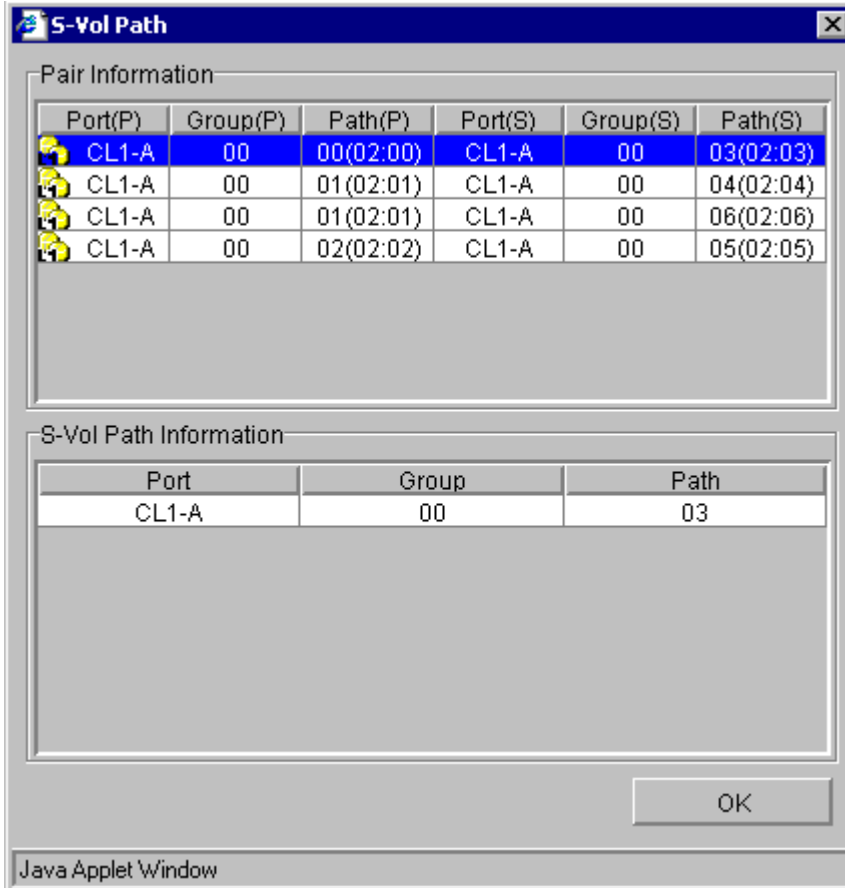select the **S-Vol Path** command. *Note:* You cannot select SMPL volumes.

Figure 4.5   The S-Vol Path Panel

The S-Vol Path panel has the following features:

- The **Pair Information** box displays the port ID (cluster name and channel number), host
  group and LUN of the P-VOL, and the port ID, host group and LUN of the first S-VOL.

- The **S-Vol Path Information** box displays details (the port ID, host group and LUN of the
  all S-VOLs) of the P-VOL selected in the **Pair Information** box.

- The **OK** button closes the S-Vol Path panel.

4.2.4   The Display Filter Panel

The Display Filter panel allows you to "filter" the volumes displayed in the **Volume List** box by reserve attribute, by pair condition, and by pair status. To open the Display Filter panel, click the **Display Filter** button on the ShadowImage main panel. You can also open the Display Filter panel using the **Display Filter** command in the popup menu.
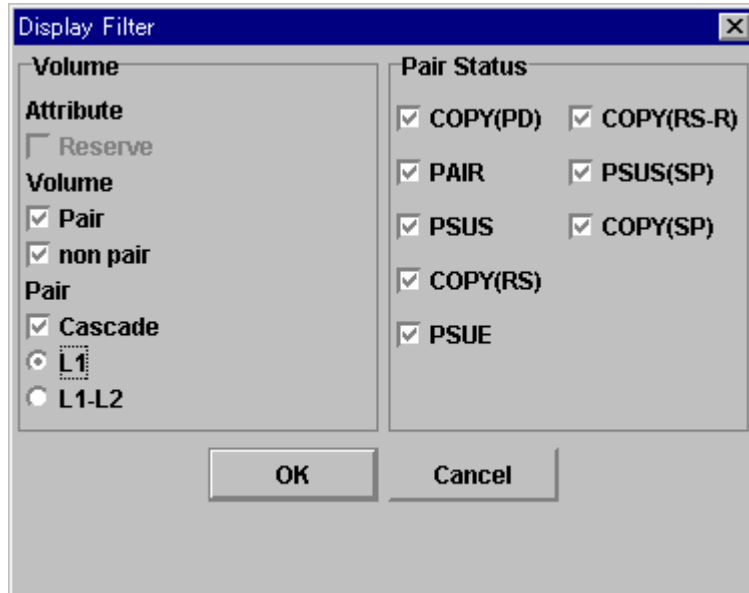

Figure 4.6   The Display Filter Panel

The Display Filter panel has the following features:

- The **Volume** box:

  – The **Reserve** check box allows you to display reserved or unreserved volumes. If you select the **Reserve** check box, only reserved volumes are displayed in the **Volume List** box. If you clear the **Reserve** check box, only unreserved volumes are displayed. *Note:* If you select the **Reserve** check box, you cannot select any other check boxes.

  – The **Pair** check box allows you to display paired volumes.

  – The **non pair** check box allows you to display non-paired volumes.

  – The **Cascade** check box allows you to filter the pairs in the **Volume List** box by cascade level. You can select either of the following radio buttons:

  L1: Displays L1 pairs only.

  L1-L2: Displays both L1 and L2 pairs.

  Note: If you select **Cascade**, you cannot select **Reserve**. If you select **L1-L2**, you cannot select any other check boxes.

- The **Pair Status** box is available only when you select the **Pair** check box in the **Volume** box, and allows you to filter the pairs displayed in the **Volume List** box by pair status: **COPY(PD)**, **PAIR**, **PSUS**, **COPY(RS)**, **PSUE**, **COPY(RS-R)**, **PSUS(SP)**, and **COPY(SP)**.

  Note: All check boxes are selected by default.

- The **OK** button applies the settings, and closes the Display Filter panel.

- The **Cancel** button resets the settings, and closes the Display Filter panel.

Note: The filter settings are only effective within the current ShadowImage operations. If you switch to another option program (e.g., LUN Management and TrueCopy), or click a button on the toolbar on the Remote Console-Storage Navigator main panel, the settings will be reset.

4.2.5 The Preset Volume List Box

The **Preset Volume List** box (see Figure 4.7) is located below the **Volume List** box, and lists the specified operations (volume/pair information), which have not been performed in the 9900V subsystem. *Note:* The **Preset Volume List** box allows you to hold multiple settings of the same operation (e.g., paircreate) only. You cannot display different types of operations (e.g., pairsplit and pairresync) in the **Preset Volume List** box at the same time. You can also cancel the operations in the **Preset Volume List** box.

	Port	Group	Path	MU	Port	Group	S-Vol Path	Pace
	CL1-A	00	00(02:00)	0	CL1-A	00	06(02:06)	Medium
	CL1-A	00	00(02:00)	2	CL1-A	00	09(02:09)	Medium
	CL1-A	00	00(02:00)	1	CL1	Delete		08(02:08)	Medium
	CL1-A	00	01(02:01)	0	CL1	Delete All		0A(02:0A)	Medium
	CL1-A	00	03(02:03)	0	CL1	Detail		07(02:07)	Medium

Figure 4.7   The Preset Volume List Box Displaying Settings (Operations)

The **Preset Volume List** box displays the following information of specified operations:

- **Port**: The port ID (cluster and channel number) of each volume.

- **Group**: The host group of each volume.

- **Path**: The CU:LDEV (control unit image:logical device ID) of each volume.

- **MU**: The MU number of a ShadowImage cascade pair formed with the volume.

- **Port**: The port ID (cluster and channel number) of the first S-VOL of each volume.

- **Group**: The host group of the S-VOL.

- **S-Vol Path**: The CU:LDEV (control unit image:logical device ID) of the S-VOL.

- **Pace**: The copying pace for all pairs being created: **Slower**, **Medium**, and **Faster**.

- **Code:** If the specified option in the **Preset Volume List** box is performed with the **Apply** button, but the operation fails, the reason code is displayed.

To perform the specified operations, you must click the **Apply** button on the ShadowImage main panel. When all the operations are performed successfully, the **Preset Volume List** box will be cleared. However, if some operations cannot be performed successfully, the failed operations will remain in the **Preset Volume List** box, and the error icon (🔴) is displayed. You can also cancel one or all operations by using the following popup menu commands:

■ The **Delete** command cancels the selected operation only. *Note:* To display the **Delete** command, select a volume or pair, and then right-click with the mouse.

■ The **Delete All** command cancels all operations displayed in the **Preset Volume List** box. *Note:* To display the **All Delete** command, deselect any volume or pair, and then right-click with the mouse.

■ The **Detail** command displays the Error panel, which displays the error code and message for the failed operation (see section 5.2). For the ShadowImage error codes see the *Remote Console – Storage Navigator Error Codes Guide*.

4.3   Setting the Reserve Attribute

The Set Reserve Attribute panel (see Figure 4.8) enables you to set the reserve attribute for (i.e., reserve) the volume(s) selected on the ShadowImage main panel. To open the Set Reserve Attribute panel, select one or more unreserved SMPL volumes in the **Volume List** box on the ShadowImage main panel, right click using the mouse to display the popup menu, and then select the **Change Reserve** command.
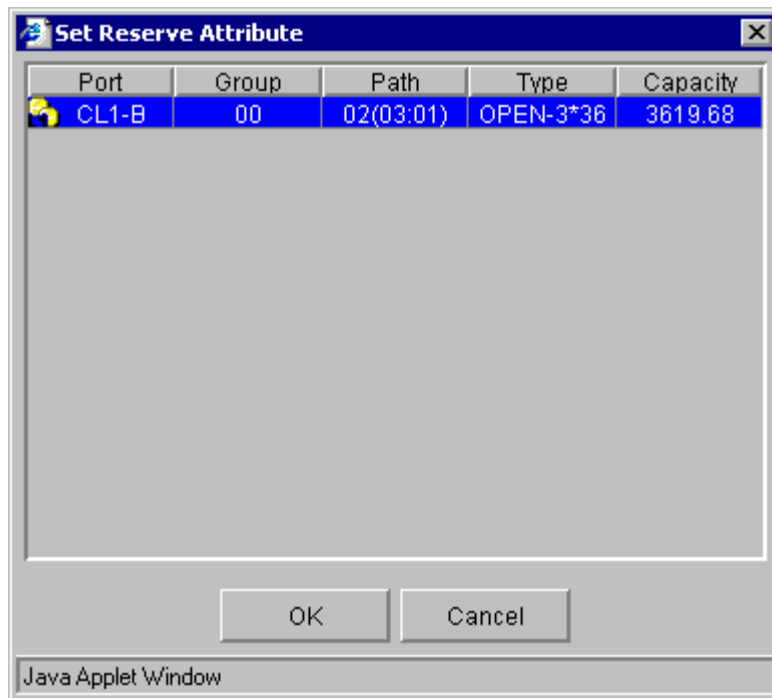

Figure 4.8   The Set Reserve Attribute Panel (Reserve)

The Set Reserve Attribute panel displays the unreserved volume(s) that you selected on the ShadowImage main panel. The **OK** button allows you to set the reserve attribute for unreserved volume(s). *Note:* The setting(s) will be displayed in the **Preset Volume List** box on the ShadowImage main panel. The **Cancel** button closes the Set Reserve Attribute panel without reflecting the settings. To apply the settings to the 9900V subsystem, click the **Apply** button on the ShadowImage main panel.

To reserve one or more volumes for use as ShadowImage S-VOLs (set the reserve attribute):

1. Unmount the volume(s) that you will be reserving. The 9900V will reject all write I/Os to reserved volumes (except when in the PSUS status).

2. On the ShadowImage main panel, select the desired port, host group, or LUN in the **Tree View** box.

3. Display unreserved SMPL volumes in the **Volume List** box (e.g., to display unreserved SMPL volumes, clear the **Reserve** and **Pair** check boxes, and select the **non pair** check box on the Display Filter panel).

4. Select the desired volume(s), right click to display the popup menu, and then select the **Change Reserve** command. The Set Reserve Attribute panel opens. If the **Change Reserve** command is not enabled, you selected paired volumes. Select only unreserved and unpaired volumes.

5. On the Set Reserve Attribute panel, select the volume(s) you want to reserve, and then select the **OK** button.

   The setting will be reflected in the **Preset Volume List** box on the ShadowImage main panel.

6. On the ShadowImage main panel, select the **Apply** button.

7. Verify that the settings are reflected in the 9900V subsystem (You can check the attribute using the **Display Filter** button).

4.4   Resetting the Reserve Attribute

The Reset Reserve Attribute panel (see Figure 4.9) enables you to reset the reserve attribute for (i.e., unreserve) the volume(s) selected on the ShadowImage main panel. To open the Reset Reserve Attribute panel, select one or more reserved SMPL volumes in the **Volume List** box on the ShadowImage main panel, right click using the mouse to display the popup menu, and then select the **Change Reserve** command.
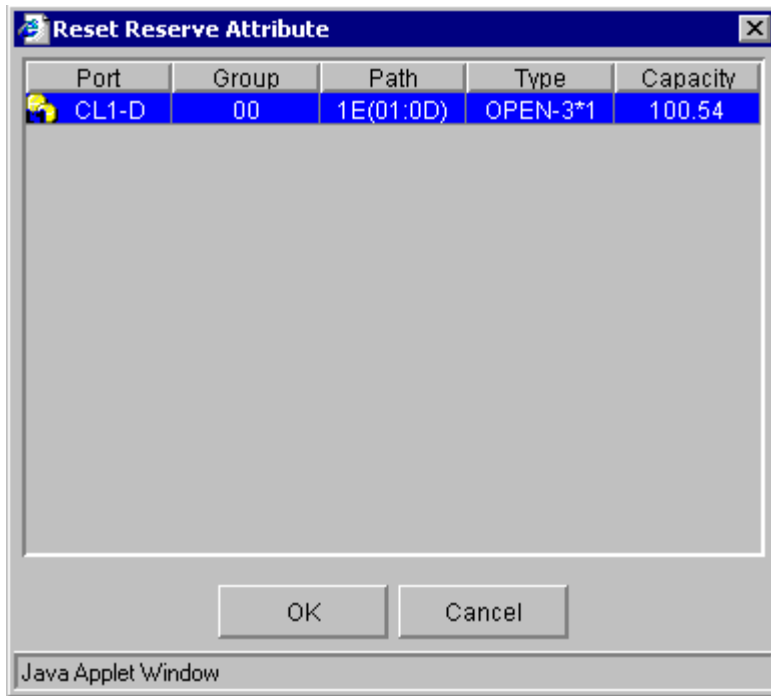

Figure 4.9   The Reset Reserve Attribute Panel (Unreserve)

The Reset Reserve Attribute panel displays the reserved volume(s) that you selected on the ShadowImage main panel. The **OK** button allows you to reset the reserve attribute for reserved volume(s). *Note:* The setting(s) will be displayed in the **Preset Volume List** box on the ShadowImage main panel. The **Cancel** button closes the Reset Reserve Attribute panel without reflecting the settings. To apply the settings to the 9900V subsystem, click the **Apply** button on the ShadowImage main panel.

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

1. Make sure that the volumes you want to unreserve are no longer assigned to ShadowImage pairs as S-VOLs. See section 4.9 for instructions on deleting ShadowImage pairs.

2. On the ShadowImage main panel, select the desired port, host group, or LUN in the **Tree View** box.

3. Display reserved SMPL volumes in the **Volume List** box (e.g., to display reserved SMPL volumes, click the **Display Filter** button to open the Display Filter panel, and then select the **Reserve** check box).

4. Select the desired volume(s), right click to display the popup menu, and then select the **Change Reserve** command. The Reset Reserve Attribute panel opens. If the **Change Reserve** command is not enabled, you selected paired volumes. Select only reserved and unpaired volumes.

5. On the Reset Reserve Attribute panel, select the volume(s) you want to unreserve, and then select the **OK** button.

    The setting will be reflected in the **Preset Volume List** box on the ShadowImage main panel.

6. On the ShadowImage main panel, select the **Apply** button.

7. Verify that the settings are reflected in the 9900V subsystem (You can check the attribute using the **Display Filter** button).

4.5 Creating ShadowImage Pairs (Paircreate)

> *WARNING:* The ShadowImage paircreate operation overwrites all existing data on the S-VOLs. The user is responsible for backing up the data on the S-VOLs before creating ShadowImage pairs.

The Paircreate panel (see Figure 4.10) displays the P-VOL and S-VOL information for the pair(s) being created (added) and allows you to select the S-VOL(s) for each P-VOL, set the copy pace for all pairs being created, and start the paircreate operation(s). To open the Paircreate panel, select one or more pairs or volumes in the **Volume List** box on the ShadowImage main panel, right click the selected volume(s) using the mouse to display the popup menu, and then select the **Paircreate** command.

Figure 4.10   The Paircreate Panel

The Paircreate panel displays the P-VOL and S-VOL information for each pair being created: port, host group, path (CU:LDEV), MU#, volume status, copy pace, progress, emulation type, and capacity. The S–VOL for each P-VOL is displayed only after being selected (using **Set** or **Change**). The **Copy Pace** box allows you to select the copy pace for all pairs being created: **Slower**, **Medium**, and **Faster**. *Note:* When the **Preset Volume List** box already holds some Paircreate settings, and you specify a different copy pace for new pairs in the Paircreate panel, the copy pace for the existing paircreate settings displayed in the **Preset Volume List** box will be also changed. The latest copy pace specified in the Paircreate panel is in effect before the settings are reflected to the subsystem. The **Select MU** box allows you to select the MU number for each pair being created: **0**, **1**, and **2** for L1 pairs, and **1** and **2** for L2 pairs. *Note:* You can select a MU number for a cascade pair. You cannot select the same MU number for different cascade pairs of the same P-VOL (root or node volume).

The **Select S-Vol** box allows you to filter the S-VOLs displayed in the S-VOL list. The **Port** and **Reserved** boxes allow you to display the available S-VOLs by port and by reserve attribute.

The **Set** button adds the selected L1 S-VOL to the selected L1 P-VOL. The **Change** button replaces the S-VOL of the selected pair in the list with the selected S-VOL. The **Cascade** button adds the selected L2 S-VOL to the selected L1 pair. To use the **Cascade** button, you must select an L1 pair. To remove any volumes from the P-VOL or S-VOL list, select the volumes, right click the selected volumes using the mouse, and then select the **Delete** command. The **OK** reflects the new pairs in the list to the **Preset Volume List** box on the ShadowImage main panel. *Note:* To create all pairs in the list, you must click the **Apply** button on the ShadowImage main panel. The **Cancel** button undoes the operations and closes the Paircreate panel.

Note: If you want to create new ShadowImage pairs and then split them immediately so that you can access the S-VOLs as soon as possible, use the pairsplit operation instead of the paircreate operation to establish and split new pairs at the same time (see section 4.6 for instructions).

To create one or more new ShadowImage (L1) pairs:

1. Make sure that the desired S-VOL(s) is/are unmounted.

2. On the ShadowImage main panel, select the desired port, host group, or P-VOL in the **Tree View** box to filter the volumes displayed in the **Volume List** box.

3. Select the desired P-VOL(s) for the new pair(s), right click the selected P-VOL(s) to display the popup menu, and then select the **Paircreate** command to open the Paircreate panel. *Note:* Do not select any reserved volumes.

4. Set the initial copy pace for all pairs being created: **Slower**, **Medium**, or **Faster**.

5. Verify that the Paircreate panel displays the desired P-VOL(s). If you want to remove any volumes from the list, select the volume(s), right click the volume(s), and then select the **Delete** command.

6. Select the S-VOL(s) for each P-VOL as follows:

    a) Select the desired P-VOL on the Paircreate panel.

    b) Select the MU number for the L1 pair being created: **0**, **1**, or **2**.

    c) Select the desired port, select the **Reserved** check box to display reserved volumes, and then select the desired S-VOL.

        Note: You can select an unreserved volume as the S-VOL. When you create the pair, the 9900V subsystem changes the reserve attribute to "reserved" automatically.

    d) Select the **Set** button to create (add) the S-VOL to the selected P-VOL. The S-VOL is now displayed next to the selected P-VOL.

    e) If you want to add a second and/or third S-VOL to the same P-VOL, repeat steps (b) through (d) to add each S-VOL to the selected P-VOL. Each pair to be created is displayed separately in the list of pairs on the Paircreate panel. *Note:* You cannot select the same MU number for different pairs.

Instructions continue on the next page.

7. Repeat step (6) until all desired pairs are displayed. Use the **Change** button to replace an S-VOL, use the **Set** button to add an S-VOL, and use the **Delete** command to remove pairs.

8. When the Paircreate panel displays the desired new pair(s), select the **OK** button to reflect all pairs (settings) in the list to the **Preset Volume List** box on the ShadowImage main panel.

9. On the ShadowImage main panel, click the **Apply** button to create the pair(s).

   When the initial copy operation(s) start, the ShadowImage main panel shows the new pairs with COPY(PD) status and the progress (%) of the initial copy operation(s).

10. Select the **Refresh** button () on the Remote Console – Storage Navigator panel to monitor the progress of the initial copy operation(s).

WARNING: The L2 paircreate operation overwrites all existing data on the L2 S-VOLs. The user is responsible for backing up the data on the S-VOLs before creating ShadowImage pairs.

To create one or more new L2 cascade pairs:

1. Make sure that the L2 S-VOLs are unmounted.

2. On the ShadowImage main panel, select the desired L1 pair(s) to which you want to add the L2 pair(s), right click the selected L1 pair(s) to display the popup menu, and then select the **Paircreate** command to open the Paircreate panel.

3. On the Paircreate panel, select the desired L1 pair, select the MU number (**1** or **2**), and then select the desired S-VOL for the new L2 pair.

4. Select the **Cascade** button to add the desired L2 pair to the list of pairs.

5. Repeat steps (4) and (5) until all desired L2 pairs are displayed. Use the **Change** button to replace an S-VOL, use the **Cascade** button to add an S-VOL, and use the **Delete** command to remove pairs.

6. When the Paircreate panel displays all desired new pairs, select the **OK** button to reflect all pairs (settings) in the list to the **Preset Volume List** box on the ShadowImage main panel.

7. On the ShadowImage main panel, click the **Apply** button to create the pair(s).

   When the initial copy operation(s) start, the ShadowImage main panel shows the new pairs with COPY(PD) status and the progress (%) of the initial copy operation(s).

8. Select the **Refresh** button () on the REMOTE CONSOLE-STORAGE NAVIGATOR main panel to monitor the progress of the initial copy operation(s).

4.6   Splitting ShadowImage Pairs (Pairsplit)

The Pairsplit panel (see Figure 4.11) displays volume and pair information for the volume(s) and/or pair(s) selected on the ShadowImage main panel and allows you to split existing ShadowImage pairs. The Pairsplit panel can also be used to simultaneously create and split new ShadowImage pairs (see section 2). To open the Pairsplit panel, select volume(s) or pair(s) in the **Volume List** box on the ShadowImage main panel, right click the selected volume(s) or pair(s) using the mouse to display the popup menu, and then select the **Pairsplit** command.
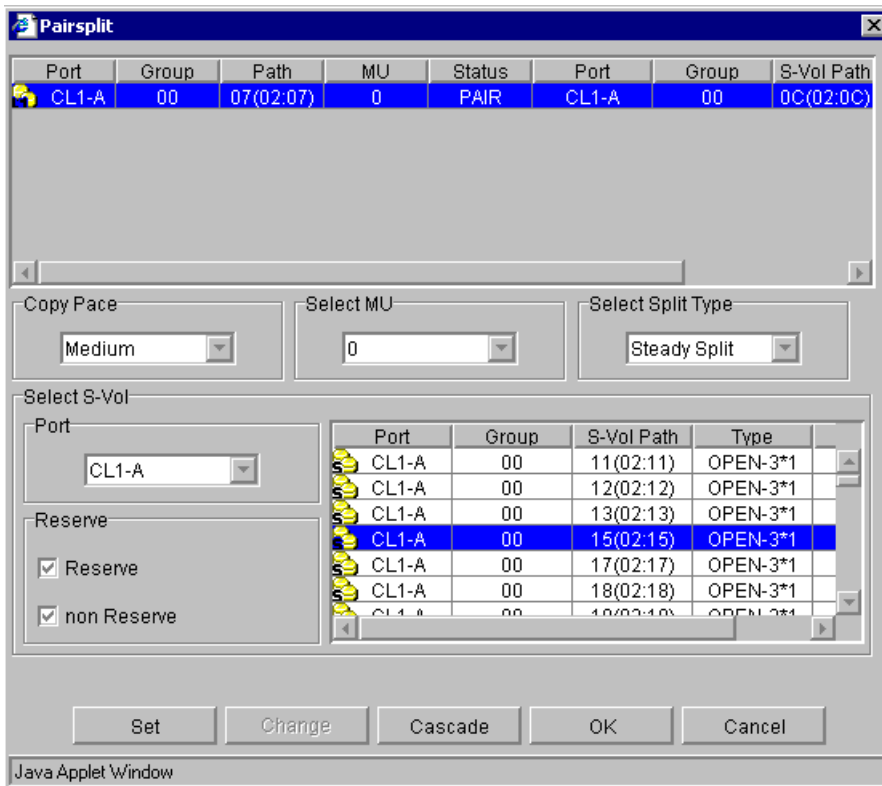
Figure 4.11   Pairsplit Panel

The Pairsplit panel lists the volume(s)/pair(s) selected on the ShadowImage main panel and shows the pair status and copy pace for each pair. The **Copy Pace** box allows you to select the copy pace for all pairs that you are splitting: **Slower**, **Medium**, or **Faster**. The **Select MU** box allows you to select the MU number for each pair: **0**, **1**, and **2** for L1 pairs, and **1** and **2** for L2 pairs. The **Select Split Type** box allows you to select the pairsplit type: **Quick Split** or **Steady Split**.

The **Select S-Vol** box allows you to filter the S-VOLs displayed in the S-VOL list. The **Port** and **Reserve** boxes allow you to display the available S-VOLs by port and by reserve attribute.

The **Volume** box displays the volume information for the selected volume/pair (port, TID, LUN, CU:LDEV, capacity, number of existing pairs) and allows you to add S-VOLs to the selected volume/pair. In the **S-VOL** box, the **Pair** options allow you to select an S-VOL automatically or manually: **Auto** = the SVP selects an S-VOL for the P-VOL, **Select** = you select an S-VOL for the P-VOL. When **Select** is selected, use the **Volume** and **Port** S-VOL display options to display the S-VOLs by port and by reserve attribute. (When **Pair-Auto** is selected, these options and the list box are disabled.)

The **Set** button adds the selected L1 S-VOL to the selected L1 P-VOL. The **Change** button replaces the S-VOL of the selected pair with the selected S-VOL. The **Cascade** button adds the selected L2 S-VOL to the selected L1 pair. To use the **Cascade** button, you must select a split (PSUS) L1 pair. To remove any volumes from the list, select the unneeded volumes, right click the selected volumes using the mouse, and then select the **Delete** command. The **OK** button splits all pairs displayed in the list and reflects the settings to the **Preset Volume List** box on the ShadowImage main panel. *Note:* You must click the **Apply** button on the ShadowImage main panel to start the pairsplit operation for the specified pair(s). The **Cancel** button undoes the operations and closes the Pairsplit panel.

To split one or more existing ShadowImage pairs:

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

    Caution: The P-VOL and S-VOL are synchronized only when the pair status changes from COPY(SP) or PSUS(SP) to PSUS. Due to the ShadowImage asynchronous update copy operations, this status transition can take several minutes.

2. On the ShadowImage main panel, select the desired port, host group, or P-VOL in the **Tree View** box to filter the volumes displayed in the **Volume List** box (e.g., to display unreserved SMPL volumes).

3. Select the pair(s) you want to split, right click the selected P-VOL(s) to display the popup menu, and then select the **Pairsplit** command to open the Pairsplit panel. You cannot split a suspended (PSUE) pair.

4. On the Pairsplit panel, set the copy pace (**Slower**, **Medium**, or **Faster**) for all pairs being split. *Note:* If you change the setting, the last setting will become effective.

5. Set the split type (**Quick Split** or **Steady Split**) for all pairs being split. *Note:* The split type is set for all pairs being split. If you change the setting, the latest setting is applied to all pairs.

6. When the Pairsplit panel displays the desired pair(s), select the **OK** button to reflect all pairs to the **Preset Volume List** box on the ShadowImage main panel. *Note:* Use the **Delete** command to remove any pairs from the list.

7. On the ShadowImage main panel, click the **Apply** button to split the pair(s).

    When the pairsplit operation(s) start, the ShadowImage main panel shows the new pairs with COPY(SP) or PSUS(SP) status and the progress (%) of the update copy operation(s). The PSUS status is displayed right away if there were no pending update copy operations.

8. Select the **Refresh** button () on the REMOTE CONSOLE-STORAGE NAVIGATOR main panel to monitor the progress of the pairsplit operation(s).

4.6.1   Creating and Splitting Pairs

The pairsplit operation can also be used to simultaneously create and split new ShadowImage pairs. In this case, the pairsplit operation changes the pair status from SMPL to COPY(SP) or PSUS(SP), copies all data on the P-VOL to the S-VOL, and then changes the pair status to PSUS.

To create and split one or more new ShadowImage pairs with a single remote console operation:

1. If you want the split S-VOLs to be identical to the P-VOLs, stop all write operations to the P-VOLs before creating and splitting the pairs. This ensures that there are no updates to the P-VOLs while the pairsplit operations are synchronizing the S-VOLs to the P-VOLs.

Caution: The P-VOL and S-VOL are synchronized only when the pair status changes from COPY(SP) or PSUS(SP) to PSUS. Due to the ShadowImage asynchronous update copy operations, this status transition can take several minutes.

2. On the ShadowImage main panel, select the desired port, host group, or P-VOL in the **Tree View** box to filter the volumes displayed in the **Volume List** box (e.g., to display unreserved SMPL volumes).

3. Select the volume(s) which will be the P-VOL(s) of the new pairs to be created and split, right click the selected P-VOL(s) to display the popup menu, and then select the **Pairsplit** command to open the Pairsplit panel.

4. Set the copy pace (**Slower**, **Medium**, or **Faster**) and split type (**Quick** or **Steady**) for all pairs being created and split.

5. Specify the S-VOL(s) as follows:

6. Select the desired P-VOL.

    a) From the **Select MU** box. select the MU number (**0**, **1**, or **2**) for the L1 pair to be created.

    b) Select the desired port, display either reserved or unreserved volumes, and then select the desired S-VOL. *Note:* You can select unreserved S-VOL, because the subsystem will automatically reserve the S-VOL.

    c) Select the **Set** button to add the S-VOL to the selected P-VOL. The S-VOL is now displayed next to the selected P-VOL.

    d) If you want to add another S-VOL to the same P-VOL, repeat steps (b) and (d) to add the next S-VOL to the selected P-VOL. Each pair to be created and split is displayed separately in the list of pairs. *Note:* You cannot select the same MU number for different pairs.

7. Repeat step (5) until the desired L1 pair(s) is/are displayed. Use the **Change** button to replace S-VOLs, the **Set** button to add L1 S-VOLs, and the **Delete** command to remove pairs.

8. If you also want to create and split L2 cascade pairs, add the L2 S-VOL(s) to the L1 pairs as follows:

   f) Select the desired L1 pair from the list of pairs to be created and split.

   g) Make sure that the desired L1 pairs are split (status=PSUS)

   h) From the Select MU box, select the MU number (1 or 2) for the L2 pair to be created.

   i) Select the Cascade button to add the L2 S-VOL to the selected L1 pair. The new L2 pair is now displayed.

   j) If you want to add another L2 S-VOL to the same L1 pair, repeat steps (g) and (j). Each L2 pair to be created and split is displayed separately in the list of pairs.

9. Repeat step (7) until the desired pair(s) is/are displayed. Use the **Change** button to replace S-VOLs, the **Cascade** button to add L2 S-VOLs, and the **Delete** command (shown by right clicking) to remove pairs.

10. When the Pairsplit panel displays the desired L1 and L2 pair(s), select the **OK** button to reflect the settings to the **Preset Volume List** box on the ShadowImage main panel.

11. On the ShadowImage main panel, click the **Apply** button to create and split the pair(s).

12. When the pairsplit operation(s) start, the ShadowImage main panel shows the new pairs with COPY(SP) or PSUS(SP) status.

13. Select the **Refresh** button () on the Remote Console-Storage Navigator main panel to monitor the progress of the pairsplit operation(s).

4.7   Resynchronizing ShadowImage Pairs (Pairresync)

The Pairresync panel (see Figure 4.12) displays pair information for the pair(s) selected on the ShadowImage main panel and allows you to resynchronize the pair(s). To open the Pairresync panel, select one or more PSUS, PSUS(SP), or PSUE pairs in the **Volume List** box on the ShadowImage main panel, right click the selected pair(s) using the mouse to display the popup menu, and then select the **Pairresync** command.
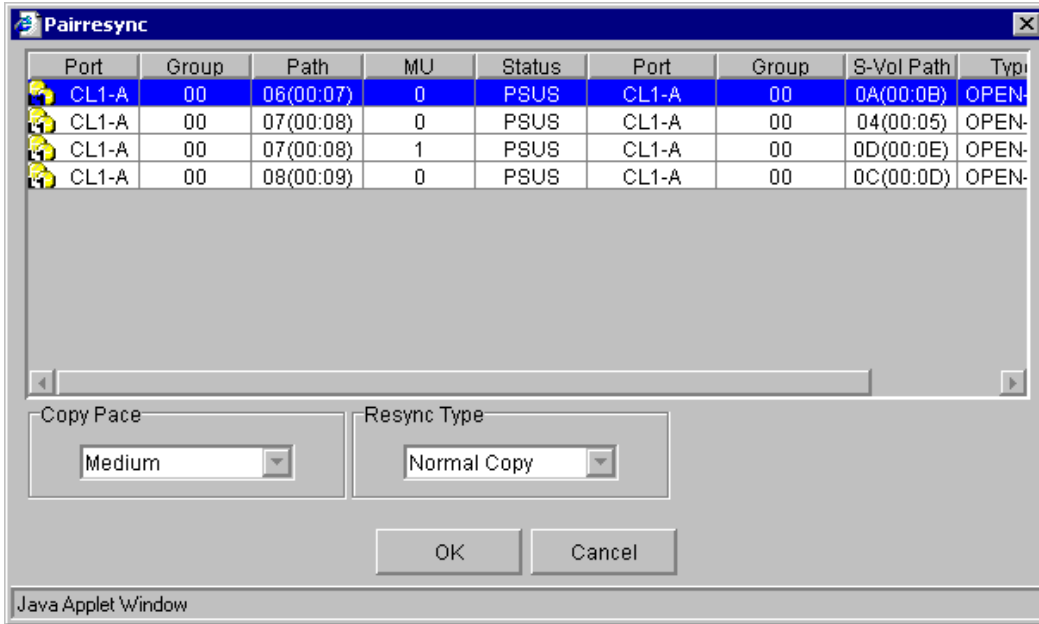

Figure 4.12   Pairresync Panel

The Pairresync panel lists the pair(s) selected on the ShadowImage main panel and shows the pair status and copy pace for each pair. The **Copy Pace** box allows you to select the copy pace for the pairs being resynchronized: **Slower**, **Medium**, or **Faster**. The **Resync Type** pull-down selection box allows you to select the pairresync type for the pairs being resynchronized: **Normal Copy**, **Quick Resync**, **Reverse Copy**, or **Quick Restore**.

The **OK** button adds the specified pair(s) to the **Preset Volume List** box on the ShadowImage main panel. *Note:* You must click the **Apply** button on the ShadowImage main panel to start the pairresync operation for the specified pair(s). The **Cancel** button exits the Pairresync panel and returns you to the ShadowImage main panel.

To resynchronize one or more ShadowImage pairs:

1. Unmount the split (PSUS) S-VOLs before starting the pairresync operations. When the pairresync operation starts, the 9900V will stop accepting write I/Os to the S-VOL.

2. On the ShadowImage main panel, select the desired port, host group, or P-VOL in the **Tree View** box to filter the volumes displayed in the **Volume List** box (e.g., to display only split and suspended ShadowImage pairs).

3. On the ShadowImage main panel, select the pair(s) you want to resync, right click the selected pair(s) to display the popup menu, and then select the **Pairresync** command to open the Pairresync panel.

4. On the Pairresync panel, select the pair(s), and select the desired copy pace (**Slower**, **Medium**, or **Faster**) and resync type (**Normal Copy**, **Quick Resync**, **Reverse Copy**, or **Quick Restore**) for each pair. Reverse and quick restore pairresync cannot be performed on pairs in the PSUE or PSUS(SP) status, or on L2 cascade pairs.

   WARNING: Make sure to select the correct resync direction (normal/quick, or reverse/quick restore).

   Caution: During the quick restore operation, the RAID levels, HDD types, and FlashAccess settings are swapped. To avoid performance impact due to quick restore operations:

   a) Make sure that the P-VOL and S-VOL have the same RAID level and HDD type before performing the quick restore operation. If you want to restore the original RAID levels after quick restore, stop host I/Os to the pair, split the pair, perform the quick restore operation for that pair again, and then restart the host I/Os to the pair.

   b) Because the FlashAccess settings are exchanged during a quick restore operation, you must perform one of the two following operations. If you do not, the change of location of the cache residence areas may cause I/O performance to the FlashAccess data to be down.

      – Set the same FlashAccess settings (locations) for the P-VOL and S-VOL before performing the quick restore operation.

      – Release the FlashAccess settings of the P-VOL and S-VOL before the quick restore operation, and then reset the FlashAccess settings of the P-VOL and S-VOL after the pair changes to PAIR status as a result of the quick restore operation.

   Note: If you do not want to resynchronize the P-VOL and S-VOL after the quick restore operation, you must set the Swap&Freeze option before performing the quick restore operation (see sections 2.4.1 and 4.11).

5. Select the **OK** button to reflect the settings to the **Preset Volume List** box on the ShadowImage main panel.

6. Repeat steps (4) through (5) until the **Preset Volume List** box on the ShadowImage main panel displays the desired pairs (settings). *Note:* Make sure to vary the S-VOL(s) offline before starting pairresync operations.

7. On the ShadowImage main panel, select the **Apply** button to resync the specified pair(s).

   The ShadowImage main panel now displays the result(s) of the pairresync operation(s) (i.e., pair status changed to COPY(RS), COPY(RS-R), or PAIR).

8. Select the **Refresh** button () on the Web Console main panel to monitor the progress of the pairresync operation(s).

4.8   Suspending ShadowImage Pairs (Pairsplit-E)

The Pairsplit-E panel (see Figure 4.13) displays pair information for the pair(s) selected on the ShadowImage main panel and allows you to suspend the pair(s). To open the Pairsplit-E panel, select one or more pairs (except SMPL and PSUE pairs) in the **Volume List** box on the ShadowImage main panel, right click the selected pair(s) using the mouse to display the popup menu, and then select the **Pairsplit-E** command.
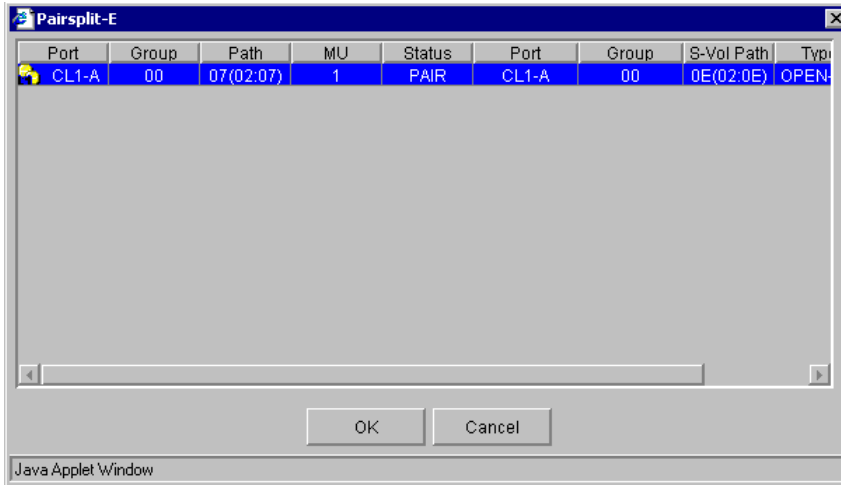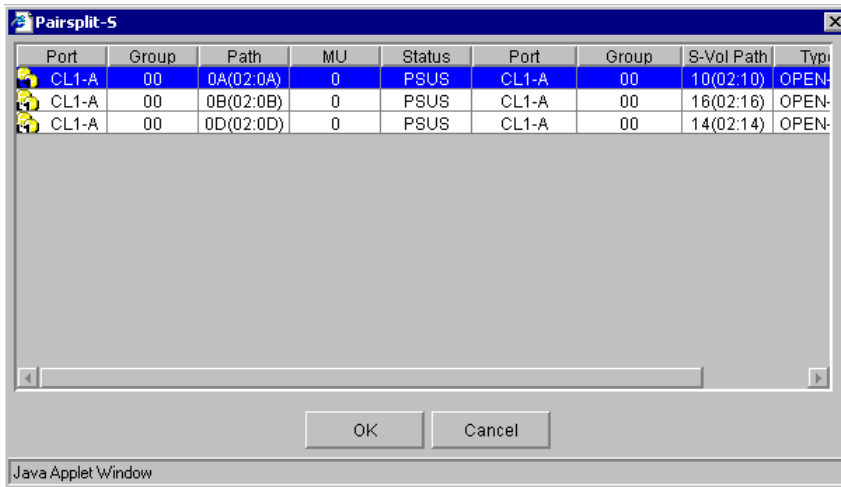

Figure 4.13   Pairsplit-E Panel

The Pairsplit-E panel lists the pair(s) selected on the ShadowImage main panel and shows the pair status and copy pace for each pair. The **OK** button suspends the selected pair(s). The **Cancel** button closes the Pairsplit-E panel and returns you to the ShadowImage main panel.

To suspend one or more ShadowImage pairs:

1. On the ShadowImage main panel, select the desired port, host group, or P-VOL in the **Tree View** box to filter the volumes displayed in the **Volume List** box.

2. Select the pair(s) that you want to suspend (or the volume(s) whose pairs you want to suspend), right click the selected pair(s) to display the popup menu, and select the **Pairsplit-E** command to open the Pairsplit-E panel.

3. On the Pairsplit-E panel, select the pair(s) you want to suspend, and select the **OK** button to reflect the settings to the **Preset Volume List** box on the ShadowImage main panel.

    Note: To remove pair(s) from the list, select the unneeded pair(s), right click while selecting the pair(s), and then select the **Delete** command.

4. Repeat steps (2) and (3) to suspend additional pairs in the list.

5. On the ShadowImage main panel, select the **Apply** button to suspend the specified pair(s).

6. The ShadowImage main panel now displays the result(s) of the pairsplit-E operation(s) (i.e., pair status changed to PSUE).

7. Select the **Refresh** button () on the Remote Console-Storage Navigator main panel to display the latest information.

4.9 Deleting ShadowImage Pairs (Pairsplit-S)

The Pairsplit-S panel (see Figure 4.14) displays pair information for the pair(s) selected on the ShadowImage main panel and allows you to delete the pair(s). To open the Pairsplit-S panel, select one or more pairs (except SMPL and PSUS(SP) pairs) in the **Volume List** box on the ShadowImage main panel, right click the selected pair(s) using the mouse to display the popup menu, and then select the **Pairsplit-S** command.

Figure 4.14   Pairsplit-S Panel

The Pairsplit-S panel lists the pair(s) selected on the ShadowImage main panel and shows the pair status and copy pace for each pair. The **OK** button deletes the selected pair(s). The **Cancel** button closes the Pairsplit-S panel and returns you to the ShadowImage main panel.

To delete one or more ShadowImage pairs:

1. If you want to synchronize the P-VOL and S-VOL before deleting the pair:

    a) Wait until all write I/Os to the P-VOL are complete, and then take the P-VOL offline to prevent the P-VOL from being updated during or after the pairsplit-S operation.

    b) After the P-VOL is offline, suspend the pair to copy all pending updates to the S-VOL.

    c) When the pair status changes to PSUS, the P-VOL and S-VOL are synchronized.

2. On the ShadowImage main panel, select the desired port, host group, or P-VOL in the **Tree View** box to filter the volumes displayed in the **Volume List** box.

3. On the Pairsplit-E panel, select the pair(s) you want to suspend, and select the OK button to reflect the settings to the Preset Volume List box on the ShadowImage main panel.

    Note: To remove pair(s) from the list, select the unneeded pair(s), right click while selecting the pair(s), and then select the **Delete** command.

4. On the Pairsplit-S panel, select the pair(s) you want to delete, and select the **OK** button to reflect the settings to the **Preset Volume List** box on the ShadowImage main panel.

5. On the ShadowImage main panel, select the **Apply** button to delete the specified pair(s) or volume(s).

    The ShadowImage main panel now displays the result(s) of the pairsplit-S operation(s).

6. Select the **Refresh** button () on the Web Console main panel to display the latest information.

4.10   Viewing ShadowImage Pair Status and History

The History panel (see Figure 4.15) displays current ShadowImage pair status information as well as ShadowImage pair history information for the selected port. To open the History panel, select the **History** tab on the ShadowImage main panel.
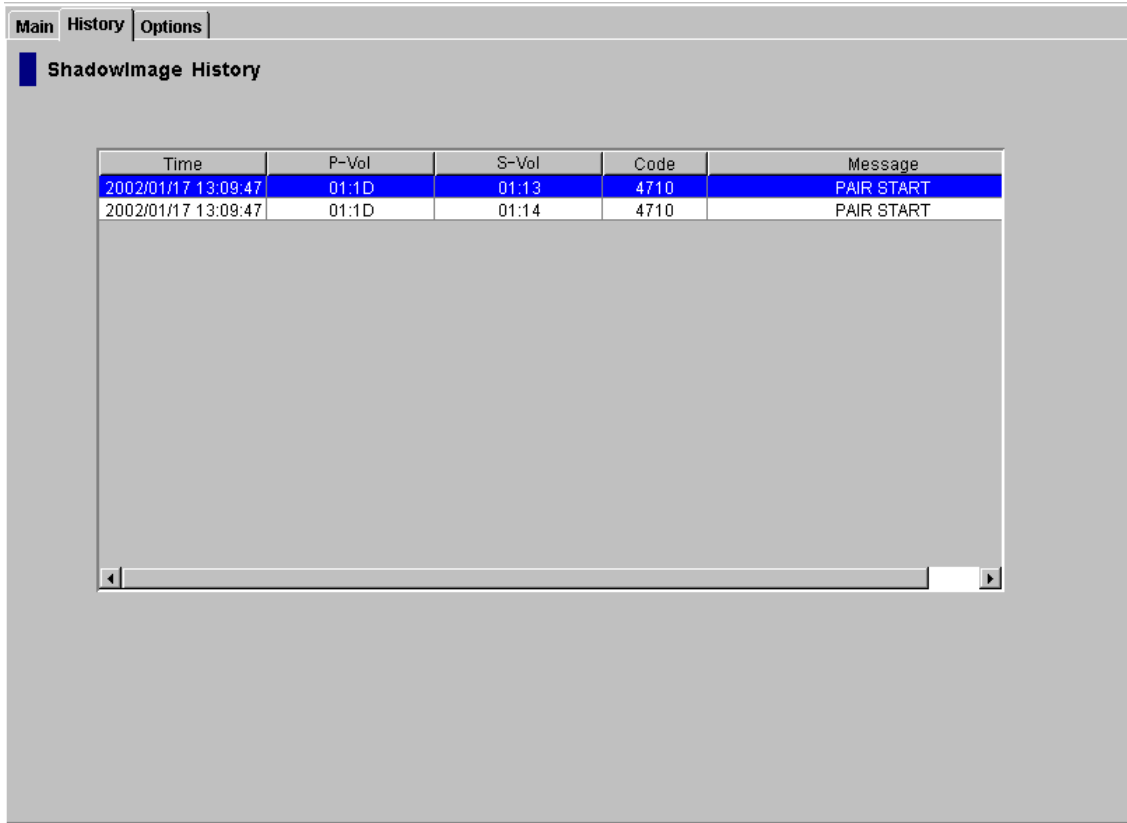
Figure 4.15   The History Panel

The **ShadowImage History** box displays the following information:

- ShadowImage pair activity listed by: date and time, P-VOL and S-VOL ID (CU:LDEV), ShadowImage code and message (see Table 4.2). The **Time** button sorts the list by date and time. The **P-Vol** and **S-Vol** buttons sort the list by **P-VOL** or **S-VOL**. The **Code** button sorts by code number. The **Message** button sorts according to message type.

- The **Refresh** button ( ) on the REMOTE CONSOLE-STORAGE NAVIGATOR main panel updates all information on the History panel.

Table 4.2   ShadowImage Status & History Reference Codes and Messages

Code	Message	Description
4710 - 471F	PAIR START	The ShadowImage initial copy operation started.
4720 - 472F	PAIR END	The ShadowImage initial copy operation ended, and the pair status changed to PAIR.
4730 - 473F	PSUS START	The ShadowImage pairsplit operation started, and the pair status changed to COPY(SP) or PSUS(SP).
4740 - 474F	PSUS END	The ShadowImage pairsplit operation ended, and the pair status changed to PSUS.
4750 - 475F	COPY(RS) START COPY(RS-R) START	The ShadowImage pairresync operation started, and the pair status changed to COPY(RS) or COPY(RS-R).
4760 - 476F	COPY(RS) ENF COPY(RS-R) END	The ShadowImage pairresync operation ended, and the pair status changed to PAIR.
4780 - 478F	SMPL	The ShadowImage pairsplit-S operation was performed, and the pair status changed to SMPL.
4790 - 479F	PSUE	The ShadowImage pairsplit-E operation was performed, and the pair status changed to PSUE.
47A0 - 47AF	COPY WARNING END	A copy ended with a warning.
47B0 - 47BF	COPY ABNORMAL END(PVOL BLOCKADE)	A copy ended abnormally due to P-VOL blockade.
47C0 - 47CF	COPY ABNORMAL END(SVOL BLOCKADE)	A copy ended abnormally due to S-VOL blockade.
47D0 - 47DF	COPY ABNORMAL END	A copy ended abnormally (reason other than above).
47E7	COMPULSION PAIR SUSPEND	A pair was suspended compulsorily.

4.11   Setting ShadowImage Options

You can set options for ShadowImage on the Options panel (see Figure 4.16). Select the **Options** tab on the ShadowImage main panel to open the Options panel. On the Options panel, select and/or clear the check boxes to set options.
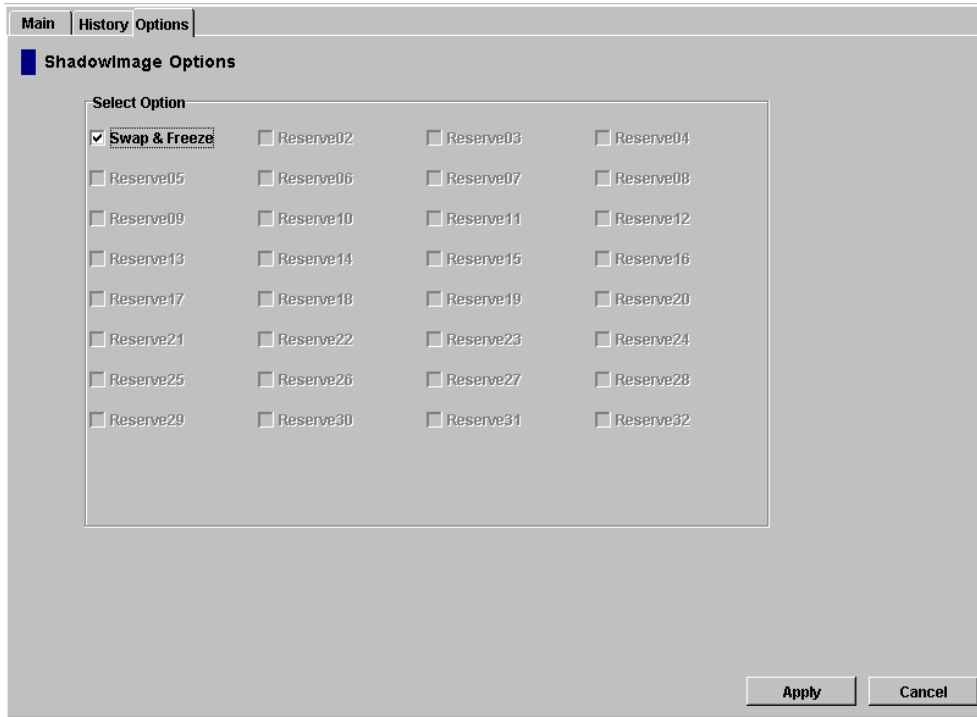

Figure 4.16   The Options Panel

The **Select Option** box displays the check boxes of the ShadowImage options. *Note:* The Swap&Freeze option is the only option currently supported, but more options will be supported in the future. Refer to section 2.4 for further information.

The **Apply** button applies the option setting(s) in the **Select Option** box.

To set a ShadowImage option (Swap&Freeze option):

1.   On the ShadowImage main panel, select the **Options** tab to display the Options panel.

     When the Options panel is opened, it shows the current status of the option.

2.   Select the check box you want to set. *Note:* If you do not want to set any option, clear all check boxes in the **Select Option** box.

3.   Select the **Apply** button.

     You can now perform a ShadowImage operation with the specified option.

Chapter 5   Troubleshooting

5.1   Troubleshooting

If you have a problem with the 9900 V Series (9900V) remote console or Remote Console – Storage Navigator software, please refer to the *Hitachi Lightning* 9900™ V *Series Remote Console-Storage Navigator User's Guide* (MK-92RD101) for troubleshooting information. If a ShadowImage error code or message is displayed on the 9900V remote console, please refer to section 5.2 for a description of the ShadowImage error codes and recommended corrective action. If you need to call the Hitachi Data Systems Support Center, please refer to section 5.3 for instructions.

Table 5.1 provides general troubleshooting instructions for ShadowImage operations.

Table 5.1   General ShadowImage Troubleshooting

Error	Corrective Action
The Remote Console hangs, or ShadowImage operations do not function properly.	Make sure all ShadowImage requirements and restrictions are met.
	Make sure the 9900V subsystem is powered on and fully functional (NVS, cache, DFW). Please refer to the *Hitachi 9900V User and Reference Guide* for operational and troubleshooting information for the 9900V subsystem.
	Check all input values and parameters to make sure that you entered the correct information on the ShadowImage screens (e.g., P-VOL and S-VOL IDs).
The volume pairs are not displaying correctly.	Make sure the correct CU image is selected.
A ShadowImage error message is displayed on the Remote Console.	Refer to section 5.2 for a description of the error code.
There is a problem with the Remote Console.	Save the Java log file on the Remote Console, and report to the Hitachi Technical Support Center.
	For Windows 2000, the Java log file is in the following place: c:\Documents and Settings\login user ID\plugin131.trace
	Exit the Web browser, close all other applications, and then restart the PC. If the problem persists, verify that the PC's operating system and LAN hardware and software are properly configured.
The ShadowImage pair status is incorrect (or unexpected).	The pair may have been suspended or deleted from the UNIX®/PC server host using Hitachi Command Control Interface (CCI). If not, the 9900V detected an error condition during ShadowImage operations. Check the Remote Console error log. If necessary, call the Hitachi Support Center for assistance.
There is a pinned track on a ShadowImage volume.	If a pinned track occurs on a ShadowImage P-VOL or S-VOL, the 9900V will suspend the pair. Please contact your Hitachi Data Systems representative for assistance in recovering pinned tracks.
Only the Exit and Refresh buttons are effective when accessing the SVP from the Remote Console.	The SVP might not be ready or perform some write processes from the other system. Wait for a while, and then select the Refresh button.

5.2 ShadowImage Error Panel

The ShadowImage software displays error messages on the Remote Console when error conditions occur during ShadowImage operations. The ShadowImage Error panel (see Figure 5.1) displays the ShadowImage error code and message. To display the Error panel, select the failed volume in the **Preset Volume List** box on the ShadowImage main panel, right click to display the popup menu, and then select the **Detail** button. Please refer to the manual *Remote Console-Storage Navigator Error Codes* for the list of error codes and corrective actions.
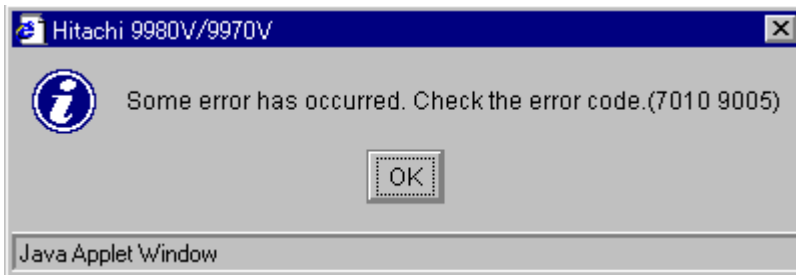
Figure 5.1   Error Panel

5.3   Calling the Support Center

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

- The 9900V Remote Console configuration information saved on diskette using the FD Dump Tool (see the *Hitachi Lightning 9900™ V Series Hitachi Remote Console – Storage Navigator User's Guide* for instructions),

- The circumstances surrounding the error or failure,

- The exact content of any error messages displayed on the host system(s),

- The ShadowImage (or other) error code(s) displayed by the 9900V Remote Console software, and

- The reference codes and severity levels of the recent service information messages (SIMs).

The worldwide Hitachi Data Systems Support Centers are:

- Hitachi Data Systems North America/Latin America
  San Diego, California, USA
  1-800-348-4357

- Hitachi Data Systems Europe
  Contact Hitachi Data Systems Local Support

- Hitachi Data Systems Asia Pacific
  North Ryde, Australia
  011-61-2-9325-3300

Acronyms and Abbreviations

ACP	array control processor
CU	control unit (logical control unit)
DASD	direct-access storage device
DFW	DASD fast write
DKA	disk adapter
DKCMAIN	Disk Controller Main
ESCON®	Enterprise System Connection (IBM trademark for optical channels)
GT	Hitachi Graph-Track
HCC	Hitachi CruiseControl
HMBR	Hitachi Multiplatform Backup/Restore
HRX	Hitachi RapidXchange
LAN	local-area network
LDEV	logical device
LU	logical unit
LUN	logical unit number
MU	mirror unit
NVS	nonvolatile storage
PC	personal computer
PDEV	physical device
P-VOL	primary volume
RAID	redundant array of independent disks
R-SIM	remote service information message
SI	ShadowImage
SI390	ShadowImage – S/390®
SIM	service information message
SM	shared memory
SMPL	simplex
S-VOL	secondary volume
SVP	service processor
TC	TrueCopy
TC390	TrueCopy – S/390®
TID	target ID
WWN	world wide name

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