HITACHI
DATA SYSTEMS

Hitachi Freedom Storage™ Lightning 9900™

Open ShadowImage (HOMRCF) User's Guide

Document Revision Level

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- MK-90RD031-S1 (STR RAID400 document).
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Changes in this Revision

- Added the quick split option for pairsplit operations (sections 2.3.4 and 4.7).
- Added the PSUS(SP) pair status for quick split operations (sections 2.3.4 and 2.5).
- Added the quick resync option for pairresync operations (sections 2.3.5 and 4.8).
- Added the quick restore option for pairresync operations (sections 2.3.5 and 4.8, Table 2.2, Table 2.3, Table 2.4, Table 2.7, Figure 2.5, Figure 2.7).
- Added a note on Volume List box (section 4.1.1).
- Other corrections:
  Sections 2.1.1, 2.3.3, 2.3.4, 3.1, 3.2, 3.4.1, 4.4, 4.6, 4.7, 4.8, Appendix A.
  Figures 2.6, 3.3, 3.9, 4.1.
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Preface

The *Hitachi Lightning 9900™ Open ShadowImage (HOMRCF) User's Guide* describes and provides instructions for performing Open ShadowImage operations on the 9900 subsystem using the Hitachi Open Multiple RAID Coupling Feature (HOMRCF) remote console software. 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 Hitachi Lightning 9900™ array subsystem and the 9900 Remote Console PC,
- the user has read and understands both the *Hitachi Lightning 9900™ User and Reference Guide* and the *Hitachi Lightning 9900™ Remote Console User's Guide*, and
- the user is familiar with the Windows 98/NT 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 "9900" refers to the entire Hitachi Lightning 9900™ subsystem family, unless otherwise noted. Please refer to the *Hitachi Lightning 9900™ User and Reference Guide* (MK-90RD008) for further information on the 9900 disk array subsystems, or contact your Hitachi Data Systems account team. For further information on the 9900 Remote Console PC, please refer to the *Hitachi Lightning 9900™ Remote Console User's Guide* (MK-90RD003), or contact your Hitachi Data Systems account team.

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

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

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Chapter 1 Overview of Hitachi Copy Solutions

1.1 Hitachi ShadowImage and Open ShadowImage

The Hitachi ShadowImage and Open ShadowImage features enable you to maintain subsystem-internal copies of all user data on the Hitachi Lightning 9900™ RAID storage subsystem for purposes such as data backup or duplication. The RAID-protected duplicate volumes are created within the same 9900 subsystem as the primary volume at hardware speeds. ShadowImage is used for S/390® data, and Open ShadowImage is used for UNIX®-based and PC server data. Open ShadowImage can provide up to nine duplicates of one primary volume. Hitachi ShadowImage and Open ShadowImage are key components of the Hitachi Data Systems CARE Copy suite solution (see section 1.2).

This document describes and provides instructions for performing Open ShadowImage operations using the 9900 Remote Console PC. The licensed Hitachi Open Multiple RAID Coupling Feature (HOMRCF) software on the 9900 Remote Console PC displays the Open ShadowImage information and allows you to perform Open ShadowImage operations. The 9900 Remote Console PC is attached to the 9900 subsystems via the 9900-internal local-area network (LAN). The Remote Console PC communicates and exchanges data directly with the service processor (SVP) of each attached 9900 subsystem. For further information on the 9900 Remote Console PC and RMCMAIN software, refer to the *Hitachi Lightning 9900™ Remote Console PC User's Guide*.

Open 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, Open 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. Hitachi ShadowImage also supports reverse resynchronization for maximum flexibility.

Open ShadowImage operations can be performed in conjunction with Hitachi Open Remote Copy (HORC) operations (see section 1.3) to provide additional remote copies of Open ShadowImage volumes. Open ShadowImage also supports the Virtual LUN (Custom Volume Size, CVS) and FlashAccess (Dynamic Cache Residency, DCR) features of the 9900 subsystem, ensuring that all user data can be duplicated by Open ShadowImage operations. See section 3.4 for further information on combining Open ShadowImage with these and other data management features.

Open 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 Open ShadowImage (or HORC) operations, please refer to the *Hitachi Lightning 9900™ Command Control Interface (CCI) User and Reference Guide.*

This document does not cover ShadowImage operations for S/390® data. For information and instructions on performing ShadowImage operations for S/390® data, please refer to the *Hitachi Lightning 9900™ ShadowImage (HMRCF) User's Guide.*

Note: The use of the 9900 HOMRCF remote console software and all other features and products is governed by the terms of your license agreement(s) with Hitachi Data Systems.

1.2 CARE Software Solutions

Hitachi Data Systems' CARE software solutions, which include the Copy suite, Availability suite, Resource suite, and Exchange suite, deliver enterprise-wide coverage of online data duplication and relocation, data access and protection, and storage resource management. The Copy suite components are designed for data replication, protection, and sharing and include Open ShadowImage, Hitachi Open Remote Copy (HORC), and Hitachi Online Data Migration (HODM). For further information on the CARE software solutions, please contact your Hitachi Data Systems account team, or visit Hitachi Data Systems online at http://www.hds.com.

Note: Hitachi Open ShadowImage and the CARE Copy suite are available under a Hitachi Data Systems service agreement. The HOMRCF and HORC remote console software products are available under license from Hitachi Data Systems.

1.3 Hitachi Open Remote Copy (HORC)

The Hitachi Open Remote Copy (HORC) feature of the Hitachi Lightning 9900™ subsystem enables you to create and maintain remote copies of the UNIX®-based and PC server data stored on the 9900 subsystem for data backup and disaster recovery purposes. HORC operations can be performed across distances of up to 43 km (27 miles) using standard ESCON® support. Long-distance HORC solutions are provided, based on user requirements and workload characteristics, using approved channel extenders and communication lines.

Hitachi Open ShadowImage (HOMRCF) operations can be used in conjunction with HORC to provide multiple copies of logical units (LUs) at both your main and remote sites. Section 3.4.1 provides important information on combining HOMRCF and HORC operations. This user's guide does not cover HORC operations. Please refer to the *Hitachi Lightning 9900™ Hitachi Open Remote Copy (HORC) User and Reference Guide* for further information on HORC.

Important: If you are using more than one 9900 data management feature (e.g., HOMRCF, HORC, CVS, DCR) at the same time in the same 9900 subsystem, please contact your Hitachi Data Systems account team to ensure that your 9900 subsystem is optimized for your configuration of concurrent operations (e.g., sufficient cache and shared memory). Each 9900 feature can affect the performance of the 9900 subsystem and/or the operation of the other features. For example, HOMRCF/HMRCF and HORC/HRC operations both involve initial copy operations and update copy operations to the secondary volumes (S-VOLs) in addition to the host I/O workload.

1.4 Hitachi Multiplatform Backup/Restore (HMBR)

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

1.5 HARBOR File-Level Backup/Restore

The HARBOR File-Level Backup/Restore multiplatform feature of the 9900 subsystem enables users to perform mainframe-based file-level backup/restore operations on the open-system data stored on the multiplatform 9900 subsystem. The HARBOR File-Level Backup/Restore features an integrated architecture and includes:

- A host component on MVS,
- Integrated clients for desktops and servers,
- LAN-based distributed storage servers,
- High-speed HMDE file-level backup of open-system data, and
- Transparent network support.

Note: For further information on HARBOR File-Level Backup/Restore, please contact your Hitachi Data Systems account team.

Chapter 2 Overview of Open ShadowImage Operations

Hitachi Open ShadowImage is a storage-based hardware solution for duplicating logical volumes which reduces backup time and provides point-in-time backup. The Open ShadowImage primary volumes (P-VOLs) contain the original data; the Open 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 Open 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 Open ShadowImage Components

Open ShadowImage remote console operations involve the primary and secondary volumes in the Hitachi Lightning 9900™ subsystem and the HOMRCF software on the 9900 Remote Console PC. Figure 2.1 shows a typical Open ShadowImage configuration. The Open ShadowImage system components are:

- ShadowImage (HOMRCF) volume pairs (P-VOLs and S-VOLs) (see section 2.1.1), and
- HOMRCF software on the 9900 Remote Console PC (see section 2.1.2).

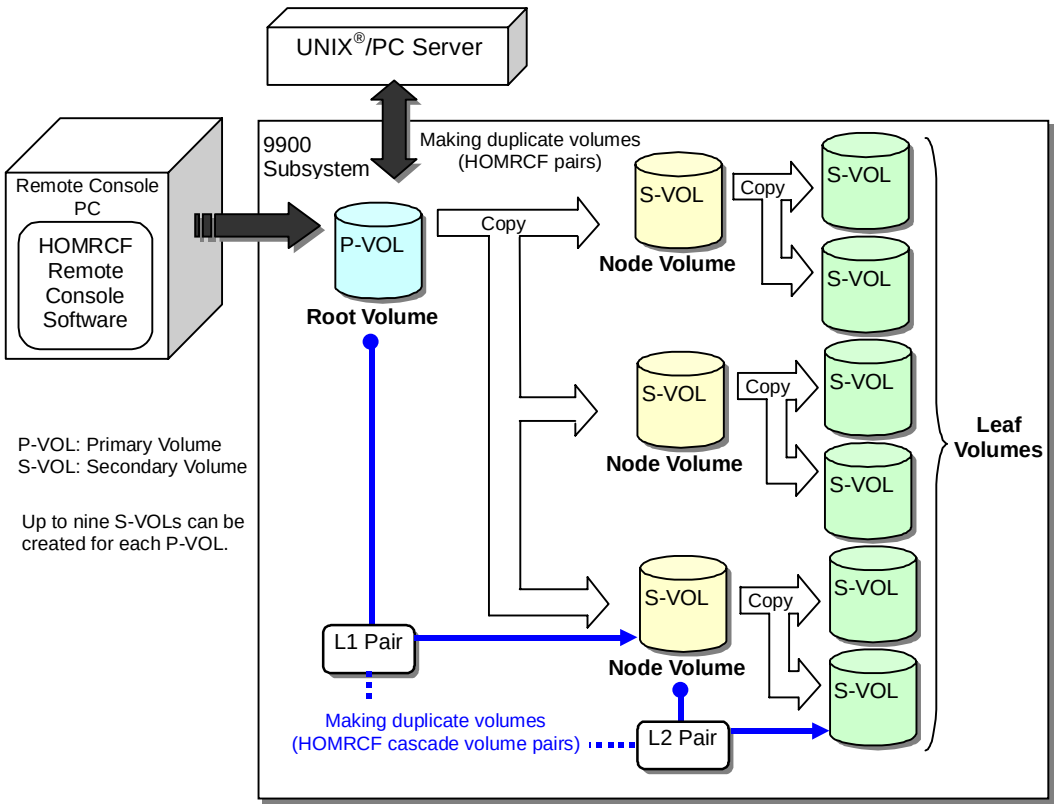

Figure 2.1 Open ShadowImage Components

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

The Hitachi Lightning 9900™ subsystem contains and manages both the original and copied Open ShadowImage data. ShadowImage supports a maximum of 2,047 pairs (2,047 P-VOLs and 2,047 S-VOLs = 4,094 volumes). When the CCI command device is defined, the maximum number of Open ShadowImage volumes in the 9900 subsystem is 4,095 (2,047 pairs). When Open ShadowImage pairs include size-expanded LUs, the maximum number of pairs decreases. When Open ShadowImage pairs include more than one S-VOL, the maximum number of P-VOLs 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 9900 subsystem. The Open ShadowImage P-VOLs are the primary volumes which contain the original data. The Open 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 Open ShadowImage operations, the P-VOLs remain available to all hosts for read and write I/O operations (except during reverse resync). The S-VOLs become available for host access only after the pair has been split.

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

Cascade Pairs

The Open ShadowImage cascade function allows you to add a second layer of pairs onto the first layer of original Open ShadowImage pairs. These two layers of pairs (L1 and L2) allow you to create and maintain up to nine copies of one original Open ShadowImage primary volume (P-VOL). See section 2.4 for further information on the cascade function.

2.1.2 HOMRCF Software on the 9900 Remote Console PC

The HOMRCF software for the 9900 Remote Console PC displays Open ShadowImage information and enables you to perform Open ShadowImage operations. The HOMRCF remote console software runs as a component of the RMCMAIN software, and communicates with the SVP of the connected subsystem via the 9900-internal LAN. The Remote Console PC can be attached to multiple 9900 subsystems. The Remote Console PC acquires status from and issues commands to both the Open ShadowImage P-VOLs and the HOMRCF S-VOLs.

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

2.2 Open ShadowImage Requirements

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

Table 2.1 Open ShadowImage (HOMRCF) 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. HOMRCF does not support multiplatform devices (e.g., 3390-3A, -3B, -3C).
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 Open ShadowImage cascade function.
Max number of pairs	2,047 pairs per 9900 subsystem (2,047 P-VOLs and 2,047 S-VOLs). When pairs include size-extended LUs, the maximum number of pairs decreases. When pairs include more than one S-VOL, the maximum number of P-VOLs decreases (e.g., for three S-VOLs per P-VOL: 4,094 ÷ 4 = 1023.
Max number of S-VOLs	2,047
Combinations of RAID levels (source-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 9900 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 an HOMRCF 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 HOMRCF pairs. If LDEV maintenance requires access to an HOMRCF LDEV, the pair must be deleted, and the **Reserve** attribute must be reset (unreserved).
Cache maintenance	If 9900 cache maintenance is performed during a period of high I/O usage, one or more HOMRCF pairs may be suspended. Reduce the I/O load before cache maintenance.
Point-in-time backup	For duplex pairs in PAIR status, host I/Os are copied to the S-VOL 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 an HOMRCF copy operation from completing, the 9900 will suspend the pair. If an LDEV failure occurs, the 9900 suspends the pair. If a PDEV failure occurs, HOMRCF pair status is not affected because of the RAID architecture.
Maintenance/upgrade	Under certain conditions, Open ShadowImage volume pairs may need to be re-established.

2.3 Open ShadowImage Operations

Open ShadowImage operations can be performed from the Remote Console PC using the HOMRCF software, 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™ Command Control Interface User and Reference Guide* (MK-90RD011). For information on Hitachi Data Systems configuration services (configuring and performing Open ShadowImage operations using 9900 SVP), please contact your Hitachi Data Systems account team.

2.3.1 Set Reserve Attribute Operation

The Open ShadowImage set reserve attribute operation reserves a volume so that it can be used as an Open ShadowImage S-VOL (node and leaf volumes). Reserved volumes can only be used as Open ShadowImage S-VOLs. The 9900 subsystem rejects all write operations to reserved volumes (unless in split (PSUS) status). You can reserve up to 2,047 volumes in one 9900 subsystem. The Set Reserve Attribute panel (see section 4.2) allows you to reserve volumes for use as Open ShadowImage S-VOLs.

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

2.3.2 Reset Reserve Attribute Operation

The Open 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 9900 will accept all subsequent I/O operations to the volume. The Reset Reserve Attribute panel (see section 4.3) allows you to unreserve volumes.

2.3.3 Paircreate Operation

The Open 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 reserved (if assigned automatically) and SMPL before being added to an Open ShadowImage pair. The Paircreate Dialog panel (see section 4.4) allows you to create new Open ShadowImage volume pairs.

Initial Copy Operation

The Open ShadowImage initial copy operation takes place when you create a new volume pair (see Figure 2.2). The Open 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 pair status changes to PAIR when the initial copy is complete.

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

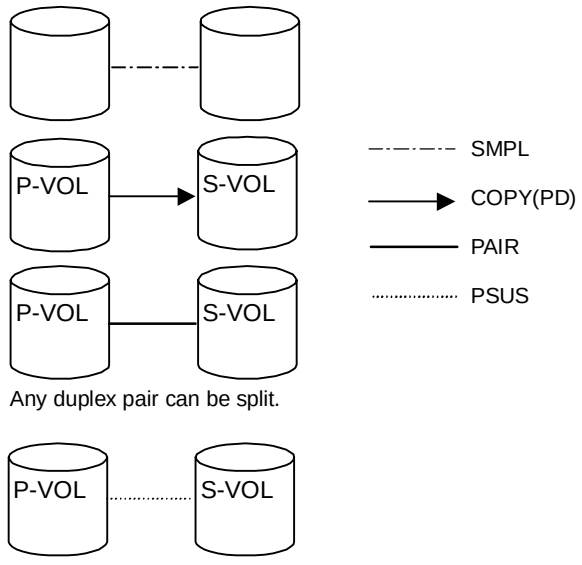

Figure 2.2 Adding a ShadowImage Pair

Update Copy Operation

The Open ShadowImage update copy operation updates the S-VOL of an HOMRCF 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 9900 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 an Open 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 an Open ShadowImage pair.

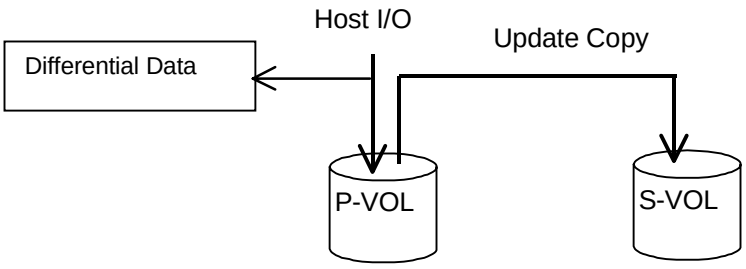

Figure 2.3 Update Copy Operation

Cascade Function

The Open ShadowImage cascade function allows you to create a second layer of HOMRCF volume pairs (L2) underneath the first layer of HOMRCF pairs (L1). Cascade pairs are created using the **Cascade** button on the Paircreate panel instead of the **Add** button (see section 4.4). This cascade layering scheme allows you to create up to nine copies of one HOMRCF P-VOL. See section 2.4 for further information on cascade pairs and the cascade function.

2.3.4 Pairsplit Operation

The Open ShadowImage split capability provides point-in-time backup of your data, and also facilitates real data testing by making the Open ShadowImage copies (S-VOLs) available for host access. The Open ShadowImage (HOMRCF) 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 4.7) allows you to split existing Open ShadowImage pairs, and also allows you to add and split new Open 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 9900 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 Open 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 9900 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 9900 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)

Open 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. The pair status during a quick pairresync operation is PSUS(SP) 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 9900 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 on RAID level swap: During the quick restore operation, the RAID levels and HDD types of the S-VOL and P-VOL are exchanged, if they have different RAID levels and/or HDD types. 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 the RAID level of the S-VOL to RAID-1. To avoid any performance impact due to the quick restore operation, 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.

  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.

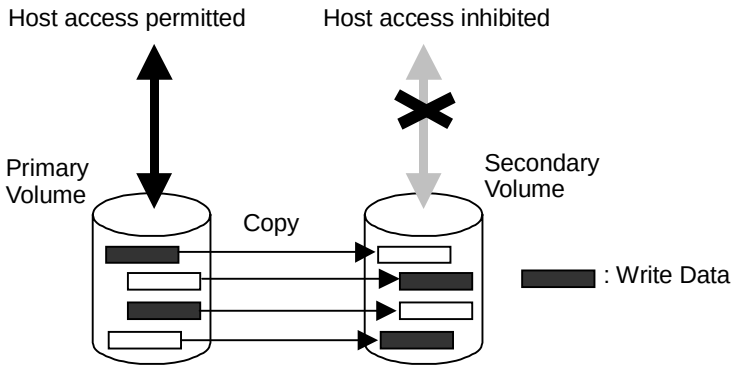

Figure 2.4 Normal and Quick Pairresync Operations

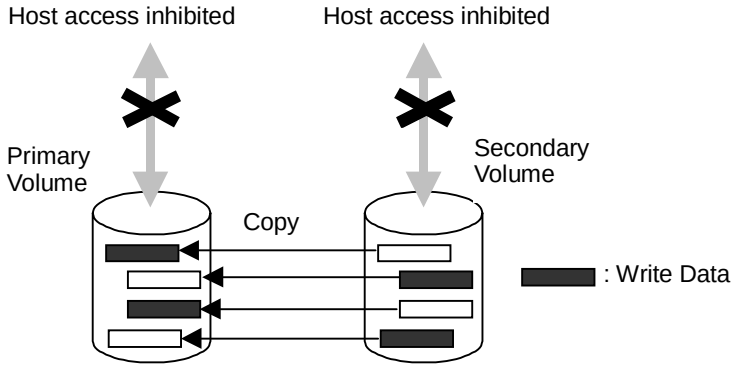

Figure 2.5 Reverse and Quick Restore Pairresync Operations

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 HOMRCF/HORC volume.	1. If the HOMRCF P-VOL is also a HORC P-VOL, the reverse and quick restore pairresync operations cannot be performed. (The command will be rejected.) 2. If the HOMRCF P-VOL is also a HORC S-VOL, the reverse and quick restore pairresync operations cannot be performed. (The command will be rejected.) 3. If the HOMRCF S-VOL is also a HORC P-VOL, the reverse and quick restore pairresync operations cannot be performed. (The command will be rejected.) 4. During the reverse or quick restore pairresync operation, a HORC pair cannot be created. The HORC paircreate command will be rejected when the HOMRCF 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 HOMRCF pair in a 1-to-n HOMRCF 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 HOMRCF pairs which share the same P-VOL does not change.

The Pairresync panel (see section 4.8) allows you to resynchronize split and suspended Open 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 9900 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 Open ShadowImage operations on subsystem I/O performance, while the faster pace resynchronizes the pair(s) as quickly as possible.

Open 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 9900 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 9900 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 9900 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. A reverse or quick restore pairresync operation cannot be performed on a suspended pair. The normal pairresync operation for suspended pairs is equivalent to and takes as long as the Open ShadowImage initial copy operation.

2.3.6 Pairsplit-E Operation (Suspend)

The Open ShadowImage pairsplit-E operation suspends the HOMRCF copy operations to the S-VOL of the pair. An HOMRCF pair can be suspended by the user at any time. When an HOMRCF pair is suspended (status = PSUE), the 9900 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 HOMRCF pair can be very fast, the pairresync operation for a suspended pair will take as long as the initial copy operation.

The 9900 subsystem will automatically suspend an Open ShadowImage pair when it cannot keep the pair mirrored for any reason. When the 9900 suspends a pair, sense information is generated to notify the host. The 9900 will automatically suspend a pair under the following conditions:

- When the Open ShadowImage volume pair has been suspended or deleted from the UNIX®/PC server host using the Hitachi Command Control Interface (CCI),
- When the 9900 detects an error condition related to an initial copy operation. When a volume pair with COPY(PD) status is suspended, the 9900 aborts the initial copy operation, changes the status of the P-VOL and S-VOL to SMPL, accepts all subsequent write I/Os to the P-VOL, and does not keep track of updates.
- When the 9900 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 pairresync) is marked as difference data.

The Pairsplit-E panel (see section 4.9) allows you to suspend Open ShadowImage pairs. When a pair is suspended, the status changes to PSUE. When the pairresync operation starts, the pair status changes to COPY(RS). (Reverse resync cannot be performed on suspended pairs.) The P-VOL remains fully accessible while suspended and during the pairresync operation.

2.3.7 Pairsplit-S Operation (Delete)

The Open ShadowImage pairsplit-S operation (delete pair) stops the HOMRCF copy operations to the S-VOL of the pair and changes the pair status of both volumes to SMPL. An Open 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 an Open ShadowImage pair, the S-VOL is still not available for write operations until the reserve attribute is reset.

The Pairsplit-S panel (see section 4.10) allows you to delete Open ShadowImage pairs. When an Open 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. To synchronize the volumes before deleting the pair, you must split the pair first (see section 4.10 for instructions). Or, you can also stop all write activity to the P-VOL first, wait until all pending update copy operations for the pair have been completed, and then delete the pair.

2.4 Cascade Function

The Open ShadowImage cascade function allows you to create a second layer of volume pairs underneath the first layer of HOMRCF pair(s). Figure 2.6 illustrates cascaded HOMRCF volume pairs. The first cascade layer (L1) is the original HOMRCF 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 HOMRCF 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 HOMRCF primary volume (P-VOL).

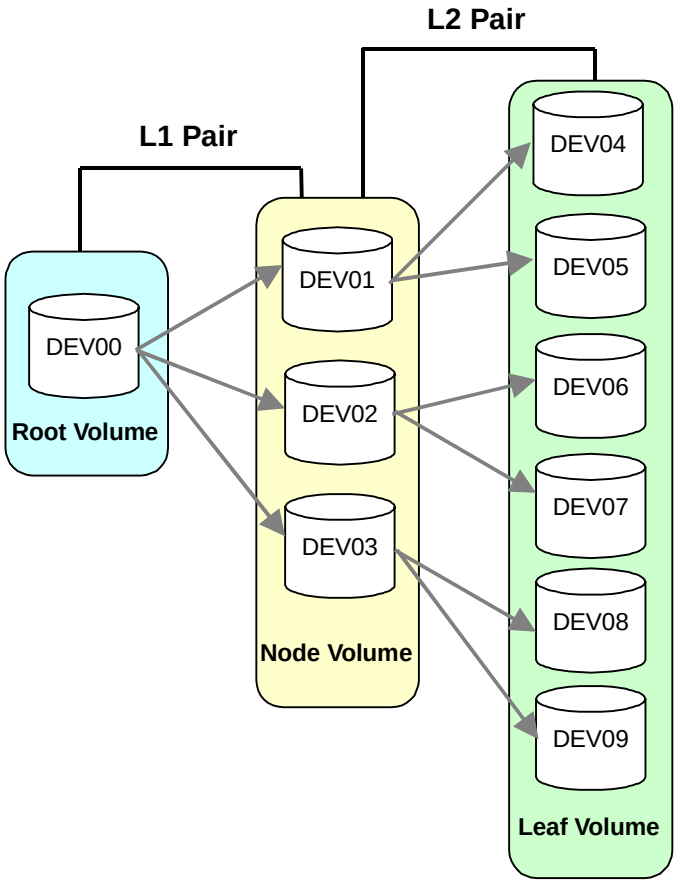

Figure 2.6 Cascade Pairs

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 2.6 above):

- The **root volume** is the P-VOL of the L1 pair, which is the original HOMRCF 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 2.3 shows the relationship between the L1 pair status and the availability of Open 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 2.4 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 HORC volumes is allowed; however, node volumes and leaf volumes are both considered *secondary volumes* (S-VOLs) by HORC.

Table 2.3 Relationship between L1 Pair Status and L2 Pair Operations

	L2 Pair Operations					
L1 Pair Status	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)	OK	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 2.4 Relationship between L2 Pair Status and L1 Pair Operations

	L1 Pair Operations					
L2 Pair Status	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. The read/write operation from the host can always be performed to the root volume regardless of the status of L1/L2 pairs. Table 2.5 indicates the relationship between read/write operation from the host to the node volume and the status of L1/L2 pairs. Table 2.6 indicates the relationship between read/write operation from the host to the leaf volume and the L2 pair status.

Table 2.5 Read/Write to Node Volume According to Status of L1/L2 Pairs

	L2 Pair Status					
L1 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 2.6 Read/Write to Leaf Volume According to L2 Pair Status

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

2.5 Pair Status

The HOMRCF remote console software displays the pair status of all Open ShadowImage volumes (LUs) on the specified port of the connected 9900 subsystem. Figure 2.7 illustrates the Open ShadowImage pair status transitions and the relationship between the pair status and the Open ShadowImage operations.

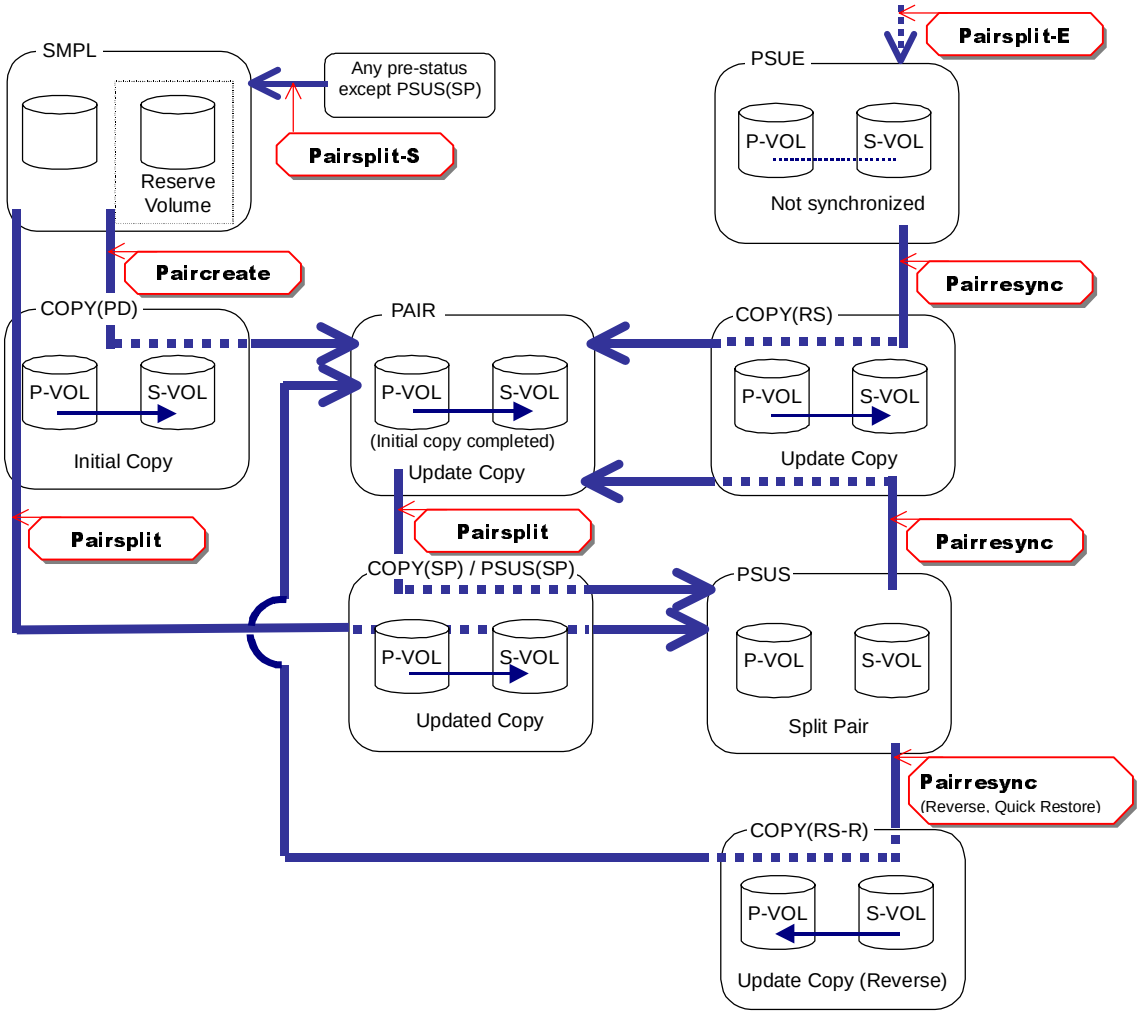

Figure 2.7 Open ShadowImage Pair Status Transitions

Table 2.7 lists and describes the Open ShadowImage pair status conditions. If a volume is not assigned to an HOMRCF pair, its status is SMPL. When you create an HOMRCF 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 9900 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 2.7 Open ShadowImage Pair Status

Pair Status	Description	S-VOL Access
SMPL	The volume is not assigned to an HOMRCF pair. The 9900 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 9900 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 9900 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 9900 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 9900 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 9900 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 9900 stops performing update copy operations for PSUS (split) pairs, and starts accepting write I/Os for PSUS S-VOLs. The 9900 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 9900 does not accept write I/Os for COPY(RS) S-VOLs. When a split pair is resynchronized in normal mode, the 9900 copies only the P-VOL differential data to the S-VOL. When a PSUE (suspended) pair is resynchronized, the 9900 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 9900 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 9900 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 9900 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 9900 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 Open ShadowImage Operations

3.1 System Requirements

Open ShadowImage operations involve the 9900 subsystem containing the primary and secondary volumes and the HOMRCF remote console software on the 9900 Remote Console PC. The system requirements for Open ShadowImage are:

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

  Important: If you are using more than one 9900 data management feature (e.g., HORC, HRC, HOMRCF, CVS, DCR) at the same time in the same 9900 subsystem, please contact the Hitachi Data Systems Support Center to ensure that your 9900 subsystem is optimized for your configuration of concurrent operations (e.g., sufficient cache and shared memory). Each 9900 feature can affect the performance of the 9900 subsystem and/or the operation of the other features. For example, HOMRCF/HMRCF and HORC/HRC operations both involve initial copy operations and update copy operations to the secondary (remote) volumes in addition to the host I/O workload.

- 9900 Remote Console PC and RMCMAIN software. Please refer to the *9900 Remote Console User's Guide* for instructions on installing and using the Remote Console PC and RMCMAIN software. Make sure that the RMCMAIN version provides full support for Open ShadowImage.

  Note: Administrator access to RMCMAIN is required to perform HOMRCF operations. Users without administrator access can only view HOMRCF information.

- HOMRCF remote console (RMCMAIN) license key code (enables the HOMRCF remote console software).

- HOMRCF SVP (DKCMAIN) license key code (enables HOMRCF option on the SVP).

3.2 Enabling the HOMRCF Feature

The user enables the remote HOMRCF option on the Remote Console PC and the HOMRCF option on each 9900 subsystem using the RMCMAIN and DKCMAIN license key codes for HOMRCF. ***Note:*** The RMCMAIN and DKCMAIN license key codes are identical. However, you must have separate DKCMAIN license key codes for each 9900 subsystem. You may not re-use the same DKCMAIN key code for multiple 9900 subsystems.

To enable the HOMRCF feature:

1. Check with your Hitachi Data Systems representative to verify that the correct microcode and SVP software are installed and enabled on the 9900 subsystems which will perform HOMRCF operations. Also make sure that your RMCMAIN software version is correct.
2. Make sure that the 9900 Remote Console PC and RMCMAIN software are installed and functioning properly. Refer to the *9900 Remote Console User's Guide* for instructions on installing the Remote Console PC and RMCMAIN software.
3. Enable the remote HOMRCF option on the Remote Console PC as follows:
   a) Start up and log in to the 9900 RMCMAIN software with administrator access.
   b) Select **Option…** to open the RMCMAIN Option Product panel (see Figure 3.1).
   c) On the Option Product panel, select **Remote HOMRCF**, and then select **Install…** to open the Input Key Code panel (see Figure 3.2).
   d) Enter the license key code in the **Key Code** text box, and then select **OK**.
   e) If the key code is accepted, the Program Product (P.P.) Confirmation panel opens (see Figure 3.3). Confirm the information displayed on this panel, and select **Install**. The Option Product panel now displays **[Install]** for the **Remote HOMRCF** option.
   f) Select **Close** on the Option Product panel to return to the Remote Console Main panel.
4. If not already done, add the attached 9900 subsystems to the Remote Console PC. Select **Controller…**, select **Add…**, enter the subsystem name, S/N, and IP address, and select **OK**. Then select the subsystem you just added on the Connection Control panel, and select **Entry**. Refer to the *9900 Remote Console User's Guide* for more detailed instructions.
5. Enable the HOMRCF option on each subsystem as follows:
   a) On the Connection Control panel, select the desired 9900 subsystem, and then select **Install…** to open the DKCMAIN Option Product panel (see Figure 3.4).
   b) Select **HOMRCF**, select **Install…**, enter the license key code for the selected subsystem on the Input Key Code panel, and select **OK**.
   c) Confirm the information displayed on the P.P. Confirmation panel, and select **Install** to enable the selected HOMRCF option on the selected subsystem. The DKCMAIN Option Product panel now displays **[Install]** for the HOMRCF option.
6. After enabling the HOMRCF option on all 9900 subsystems, you are now ready to prepare for HOMRCF operations (see the next section).

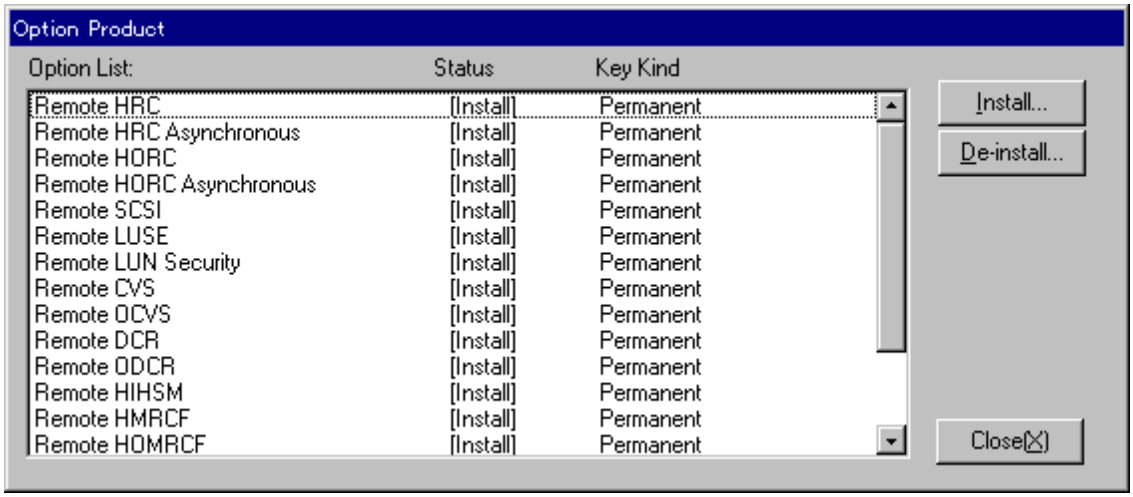

Figure 3.1 Enabling the Remote HOMRCF Option

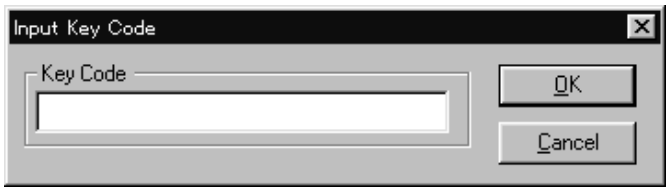

Figure 3.2 Entering the HOMRCF License Key Code

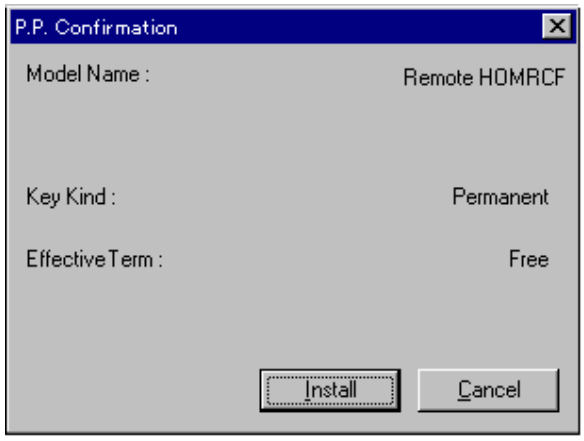

Figure 3.3 Confirming the HOMRCF Key Code

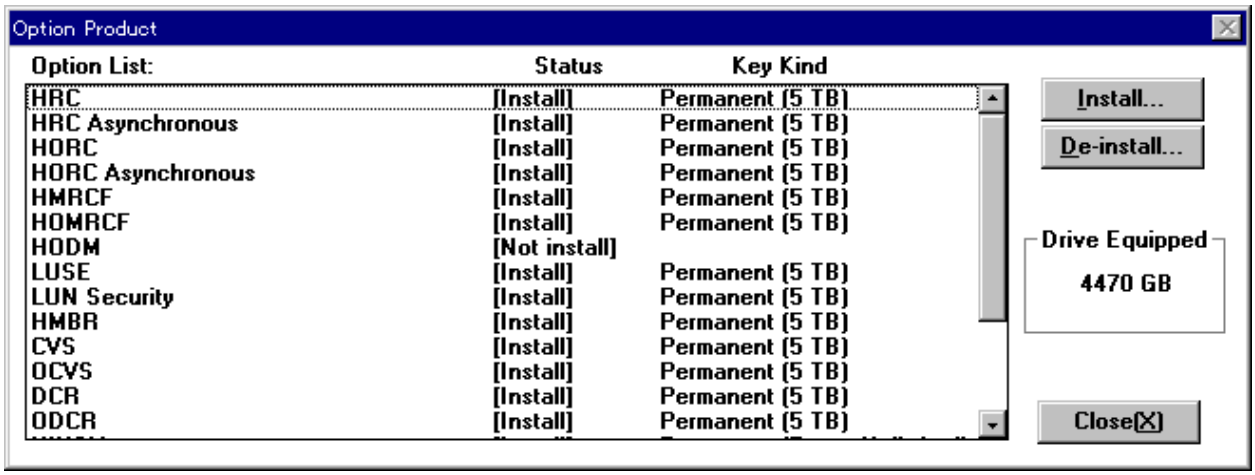

Figure 3.4 Enabling the HOMRCF Option on Each Subsystem

3.3 Preparing for Open ShadowImage Operations

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

- Open ShadowImage operations affect the I/O performance of the 9900 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 Open 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 Open ShadowImage initial copy operations. Using a slower copy pace minimizes the impact of Open 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 9900 data management feature (e.g., HORC, HOMRCF, CVS, DCR) at the same time in the same 9900 subsystem, please contact the Hitachi Data Systems Support Center to ensure that your 9900 subsystem is optimized for your configuration of concurrent operations (e.g., sufficient cache). Each 9900 feature can affect the performance of the 9900 subsystem and/or the operation of other features. For example, HOMRCF and HORC operations both involve initial copy operations and update copy operations to the secondary/target volumes in addition to the host I/O workload.
- Identify the volumes (LUs) that you will be using for Open 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™ remote console software displays this information. The volumes which will be P-VOLs will remain fully accessible to all hosts throughout normal Open ShadowImage operations, but the volumes which will be S-VOLs will need to be unmounted before Open ShadowImage operations.

Table 3.1 Sample Table for Open 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 Open ShadowImage with Other Data Management Operations

Open ShadowImage supports concurrent operations with the following data management functions:

- **LU Size Expansion (LUSE).** LUSE volumes can be assigned to HOMRCF 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 HOMRCF P-VOL or S-VOL, you must delete the pair first to return the volume to SMPL status.
- **Virtual LUN**. Virtual LUN (CVS) volumes can be assigned to HOMRCF pairs, provided that the S-VOL has the same capacity as the P-VOL. If you need to perform Virtual LUN operations on an existing HOMRCF P-VOL or S-VOL, you must delete the pair first to return the volume to SMPL status.
- **LUN Security**. LUN Security operations do not affect Open 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 HOMRCF pairs. Volumes which are assigned to HOMRCF pairs can also be assigned to secure ports, WWN groups, and/or LUN groups for LUN Security. ***Note:*** HOMRCF S-VOLs cannot be accessed by any host except when the pair is split.
- **FlashAccess**. FlashAccess volumes can be assigned to HOMRCF pairs, and FlashAccess operations can be performed on HOMRCF P-VOLs and S-VOLs.
- **Hitachi Open Remote Copy (HORC)**. HORC volumes can be assigned to HOMRCF pairs, and HOMRCF volumes can be assigned to HORC pairs. See section 3.4.1 for important information on HOMRCF and HORC shared volume configurations.

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

3.4.1 Combining Open ShadowImage and HORC Operations

Open ShadowImage (HOMRCF) and HORC can function together in the same 9900 subsystem to provide both internal and remote backup for your important data.
Note: Combination of HOMRCF L1 and L2 pairs with HORC volumes is allowed. Node volumes and leaf volumes are both considered *secondary volumes* (S-VOLs) by HORC.

The configuration shown in Figure 3.5 is an example of a volume which is functioning as both a HORC P-VOL and an HOMRCF P-VOL. This configuration allows you to:

- Use HOMRCF to provide on-site backup copies of HORC P-VOLs, and/or
- Use HORC to provide remote backup copies of HOMRCF P-VOLs.

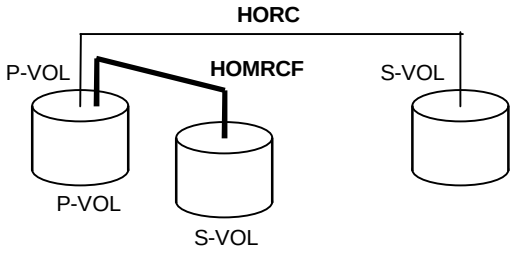

Figure 3.5 HOMRCF and HORC: Shared P-VOL/P-VOL

The configuration shown in Figure 3.6 (next page) is an example of a volume which is functioning as both a HORC S-VOL and an HOMRCF P-VOL. This configuration allows you to use HOMRCF to provide remote copies of HORC S-VOLs.

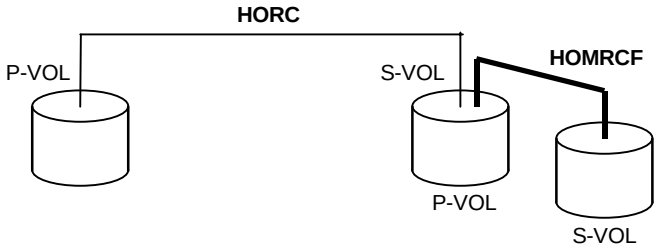

Figure 3.6 HOMRCF and HORC: Shared P-VOL/S-VOL

The configuration shown in Figure 3.7 is an example of a volume which is functioning as both a HORC P-VOL and an HOMRCF P-VOL, while the S-VOL of the same HORC pair is also functioning as the P-VOL of another HOMRCF pair. This configuration allows you to:

- Use HOMRCF to provide on-site backup copies of HORC P-VOLs and S-VOLs, and/or
- Use HORC to provide remote backup of HOMRCF P-VOLs.

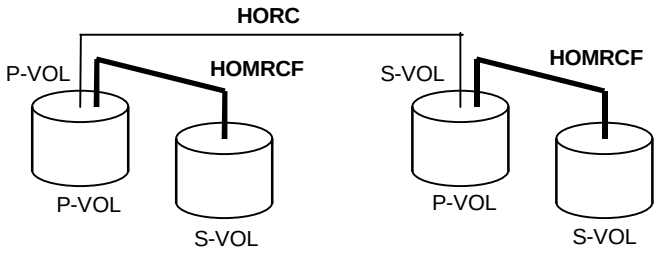

Figure 3.7 HOMRCF and HORC: Shared P-VOL/P-VOL and P-VOL/S-VOL

The configuration shown in Figure 3.8 is an example of a volume functioning as both an HOMRCF S-VOL and a HORC P-VOL. This configuration allows you to use HORC to provide asynchronous remote copy. ***Note***: This configuration does not allow HOMRCF and HORC to copy at the same time. Create the HOMRCF pair first, and then split the pair before creating the HORC pair. You must split the HORC pair to resync the HOMRCF pair. The HORC pair status cannot be changed when the HOMRCF pair is in the PSUS(SP) status.

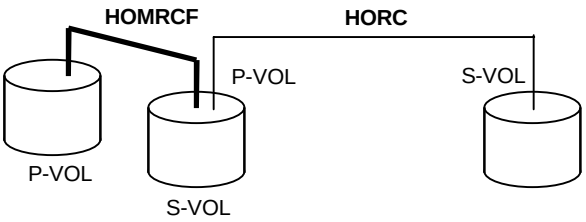

Figure 3.8 HOMRCF and HORC: Shared S-VOL/P-VOL

3.5 Starting up the HOMRCF Software

After you have installed the HOMRCF software on the 9900 Remote Console PC and prepared for Open ShadowImage operations, you are ready to start up the HOMRCF software:

1. If Hitachi GRAPH-Track™ (GT) is connected to the subsystem on which you will perform HOMRCF operations, you may want to disconnect GT from the subsystem. This will reduce the traffic on the 9900-internal LAN and decrease the chances of timeout errors.
2. Start up and log in to the RMCMAIN software with administrator access privileges.
3. Connect to the 9900 subsystem on which you will perform HOMRCF operations:
   a) From the Remote Console Main panel, select the **Connect…** button to open the Connection Control panel.
   b) Select the subsystem you want to connect to, and then select the **Connect** button to connect to the subsystem. The Option Select panel now opens (see Figure 3.9).
4. Select **HOMRCF** on the Option Select panel to open the HOMRCF main panel (see section 4.1). The HOMRCF main panel displays the name of the connected 9900, the ID of the currently selected port, and all of the volumes (LUs) installed on the current port.
5. You are now ready to perform Open ShadowImage (HOMRCF) operations. You will first reserve the volumes that you plan to use as HOMRCF S-VOLs (see section 4.2), and then you will start creating the HOMRCF pairs (see section 4.4).

Note: This panel displays differently depending on the version of the RMCMAIN software.

Figure 3.9 Option Select Panel

Chapter 4 Performing Open ShadowImage Operations

4.1 HOMRCF Main Panel

The HOMRCF main panel (see Figure 4.1) displays the Open ShadowImage (HOMRCF) volume and pair information for the selected port of the connected 9900 subsystem and allows you to perform all HOMRCF operations. To open the HOMRCF main panel, connect to the desired 9900 subsystem using the RMCMAIN software, and select the **HOMRCF** option.

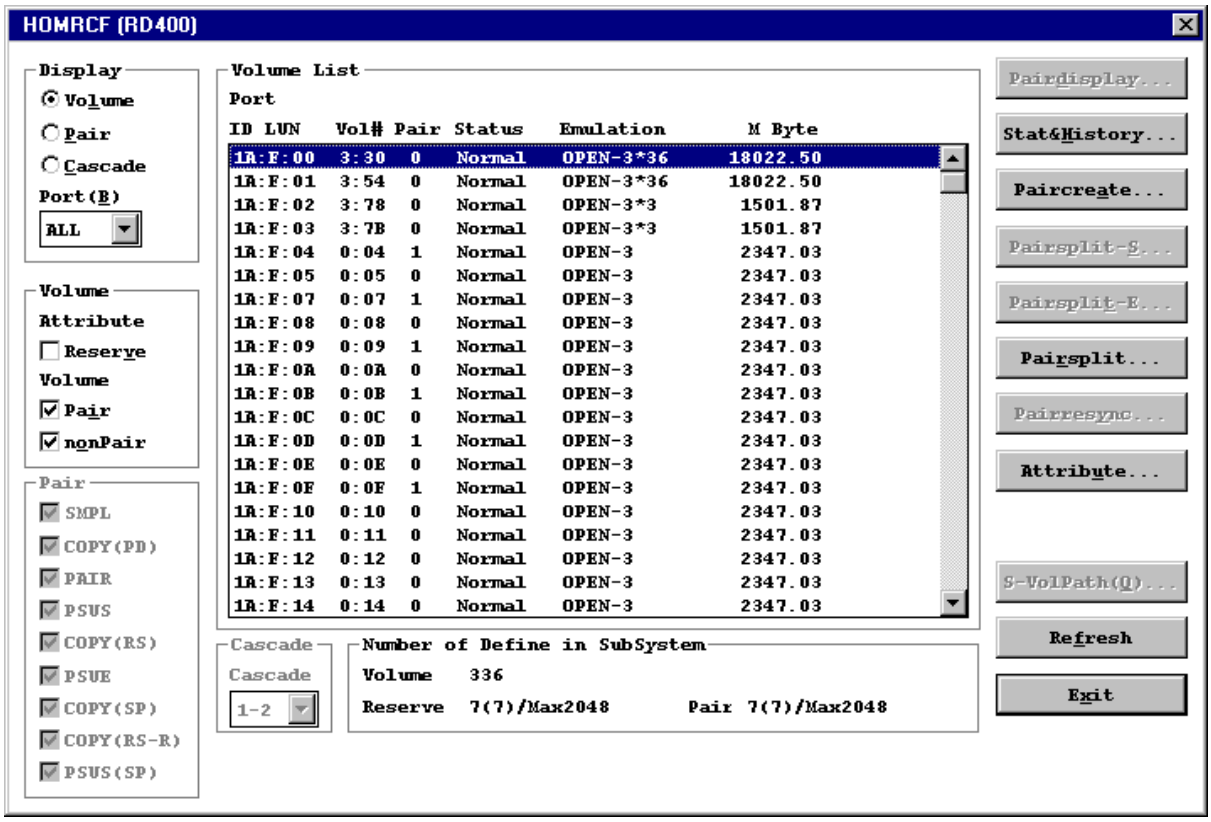

Figure 4.1 HOMRCF Main Panel

The **Display** box allows you to select either **Volume** display mode, **Pair** display mode, or **Cascade** display mode and also allows you to select the desired **Port** (including **ALL** ports).

The **Volume** box (enabled only when **Volume** display mode is selected) allows you to "filter" the volumes displayed in the **Volume List** box by reserve attribute and by pair condition. The **Attribute-Reserve** box allows you to display reserved or unreserved volumes. The **Volume-Pair** and **Volume-nonPair** boxes allow you to display paired and/or nonpaired volumes.

The **Pair** box (enabled when **Pair** display mode is selected) filters the pairs displayed in the **Volume List** box by pair status: **SMPL**, **COPY(PD)**, **PAIR**, **PSUS**, **COPY(RS)**, **PSUE**, **COPY(SP)**, **COPY(RS-R)** , **PSUS(SP)**. Only HOMRCF pairs in the selected state(s) will be displayed.

The **Cascade** box (enabled when **Cascade** mode is selected) allows you to filter the pairs in the **Volume List** box by cascade level: **1** displays L1 pairs only; **1-2** displays L1 and L2 pairs.

The **Number of Define in Subsystem** box (bottom center) displays:

- **Volume:** The total number of volumes defined in the 9900 subsystem.
- **Reserve:** X(Y)/MaxZ, where X = total number of HOMRCF reserved volumes
  Y = total number of HOMRCF and HMRCF reserved vols
  Z = maximum allowable number of reserved volumes
- **Pair:** X(Y)/MaxZ, where X = total number of HOMRCF pairs
  Y = total number of HOMRCF and HMRCF pairs
  Z = maximum number of pairs (HOMRCF/HMRCF/HIHSM)

  Note: The value (Y) does not include HIHSM pairs. If HIHSM pairs exist, it is possible for the HOMRCF paircreate operation to fail even when (Y) is less than 2,047.

The buttons on the right side of the HOMRCF main panel perform the following functions:

Pairdisplay...	displays the pair status for the selected volume(s)/pair(s).
Stat&History...	displays the pair status & history for the selected volume(s)/pair(s).
Paircreate...	allows you to create (add) new HOMRCF pairs.
Pairsplit-S...	allows you to delete HOMRCF pairs.
Pairsplit-E...	allows you to suspend HOMRCF pairs.
Pairsplit...	allows you to split HOMRCF pairs.
Pairresync...	allows you to resynchronize HOMRCF pairs.
Attribute...	allows you to set/reset the HOMRCF reserve attribute.
S-VOL Path...	displays the S-VOL SCSI paths for the selected pair(s) (see Figure 4.2).
Refresh	updates the information displayed on the HOMRCF main panel.
Exit	exits HOMRCF, and returns you to the RMCMAIN Option Select panel.

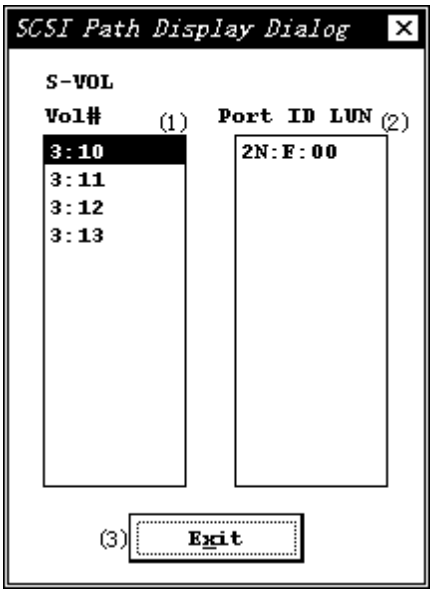

Figure 4.2 S-VOL Path Reference

4.1.1 Volume List Box

The **Volume List** box displays volume/pair information based on the filter options you select in the **Display**, **Volume**, and **Pair** boxes (along the left side of the panel). When you select the **Display-Volume** option, the **Volume List** box displays volume information, and the **Pair** display options become disabled. When you select the **Display-Pair** option, the **Volume List** box displays HOMRCF pair information, and the **Volume** display options become disabled. *Note:* You can select up to 512 volumes/pairs at a time in the **Volume List** box.

When **Display-Volume** is selected, the **Volume List** box lists all installed volumes (LUs) on the selected port and displays the following information for each volume (see Figure 4.3):

- **Port ID**: The port ID (cluster and channel number) of each volume.
- **LUN**: The TID:LUN (target ID:LU number) of each volume.
- **Vol #**: The CU:LDEV (control unit image:logical device ID) of each volume.
- **Pair**: The number of HOMRCF pairs formed with the volume.
- **Status**: The status of the volume: normal, blocked, format, correct, copying, or unknown.
- **Emulation**: The device emulation type (e.g., OPEN-3, OPEN-8, OPEN-9, OPEN-K).
- **M Byte**: The storage capacity of the volume in MB.

When **Display-Pair** is selected, the **Volume List** box lists all HOMRCF pairs on the selected port and displays the following information for each pair (see Figure 4.4):

- **P-VOL**: The P-VOL ID (port:TID:LUN, CU:LDEV) and volume status.
- **S-VOL**: The P-VOL ID (port:TID:LUN, CU:LDEV) and volume status.
- **Pair Status**: The HOMRCF pair status of the volume pair.

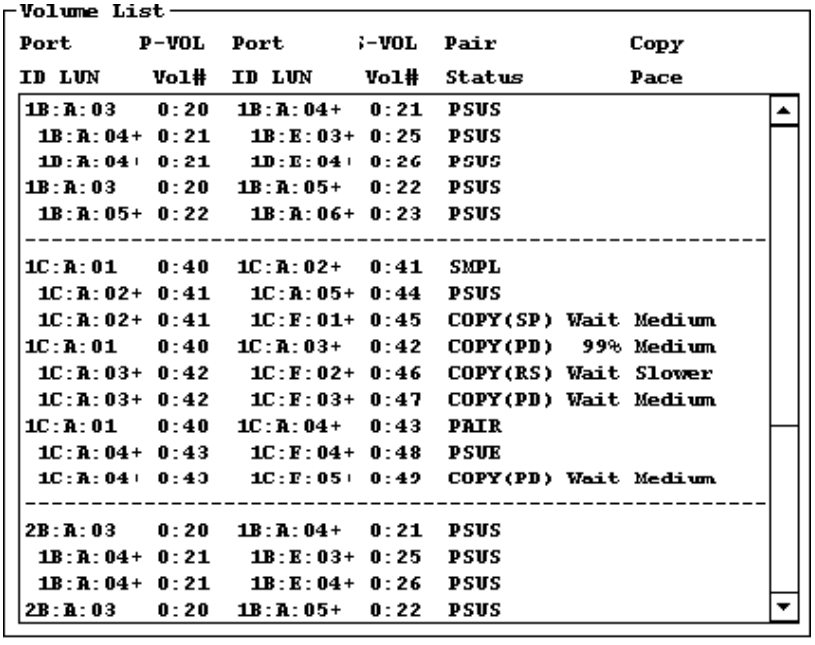

Figure 4.3 Volume List Box Displaying Volumes (Cascade display mode)

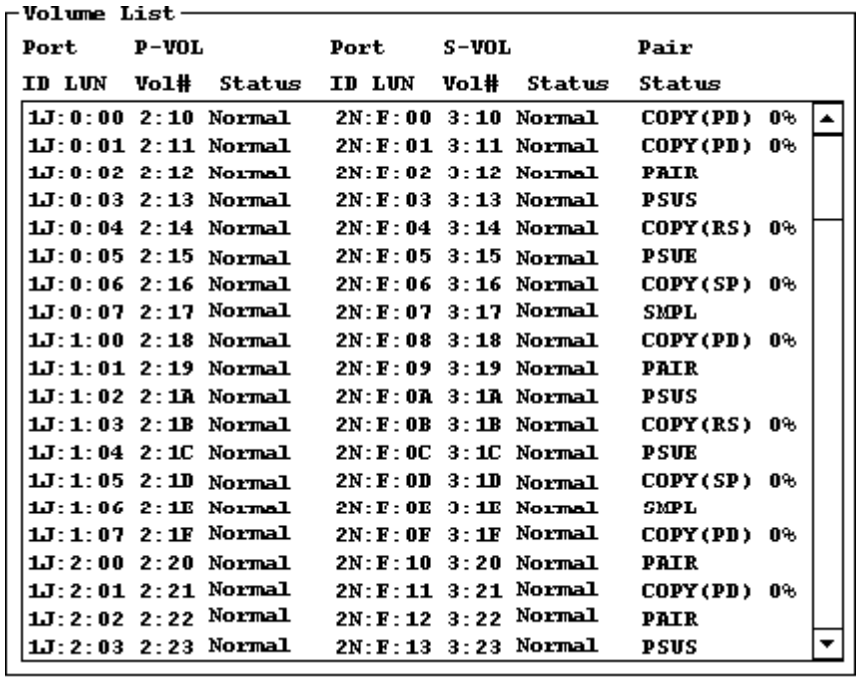

Figure 4.4 Volume List Box Displaying HOMRCF Pairs

4.2 Setting the Reserve Attribute

The Set Reserve Attribute panel (see Figure 4.5) enables you to set the reserve attribute for (i.e., reserve) the volume(s) selected on the HOMRCF main panel. The Set Reserve Attribute panel is opened by selecting the **Attribute…** button on the HOMRCF main panel.

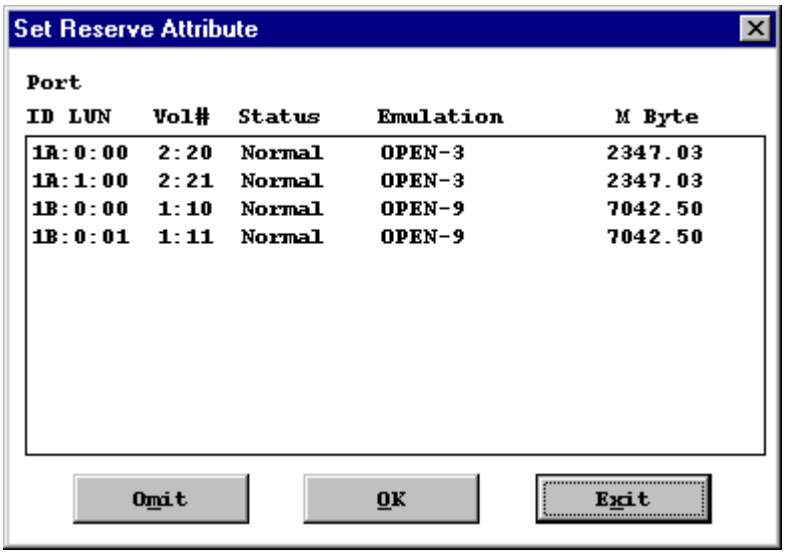

Figure 4.5 Set Reserve Attribute Panel

The Set Reserve Attribute panel displays the unreserved volume(s) that you selected on the HOMRCF main panel. The **Omit** button allows you to remove one or more volumes from the list. The **OK** button sets the reserve attribute for all volumes in the list. The **Exit** button closes the Set Reserve Attribute panel and returns you to the HOMRCF main panel.

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

1. Unmount the volume(s) that you will be reserving. The 9900 will reject all write I/Os to reserved volumes (except when in the PSUS status).
2. On the HOMRCF main panel, select the **Display-Volume** option to display volumes, and then select the desired port and volume display options (e.g., to display unreserved SMPL volumes, check **Volume-nonPair**, and uncheck **Attribute-Reserve** and **Volume-Pair**).
3. Select the volume(s) you want to reserve, and then select the **Attribute...** button to open the Set Reserve Attribute panel. If the **Attribute…** button is not enabled, you selected reserved volumes and/or paired volumes. Select only unreserved and unpaired volumes.
4. Verify that the Set Reserve Attribute panel displays the desired volume(s). If you want to remove any volumes from the list, select the volume(s), and select the **Omit** button.
5. When the Set Reserve Attribute panel displays the desired volume(s), select the **OK** button to set the reserve attribute for all volumes in the list.
6. HOMRCF displays a warning message reminding you to unmount the specified volume(s). Select **OK** to continue, or select **Cancel** to cancel your request to reserve the volume(s).
7. When the reserve operation(s) are complete, you are returned to the HOMRCF main panel.

4.3 Resetting the Reserve Attribute

The Reset Reserve Attribute panel (see Figure 4.6) enables you to reset the reserve attribute for (i.e., unreserve) the volume(s) selected on the HOMRCF main panel. The Reset Reserve Attribute panel is opened by selecting the **Attribute…** button on the HOMRCF main panel.

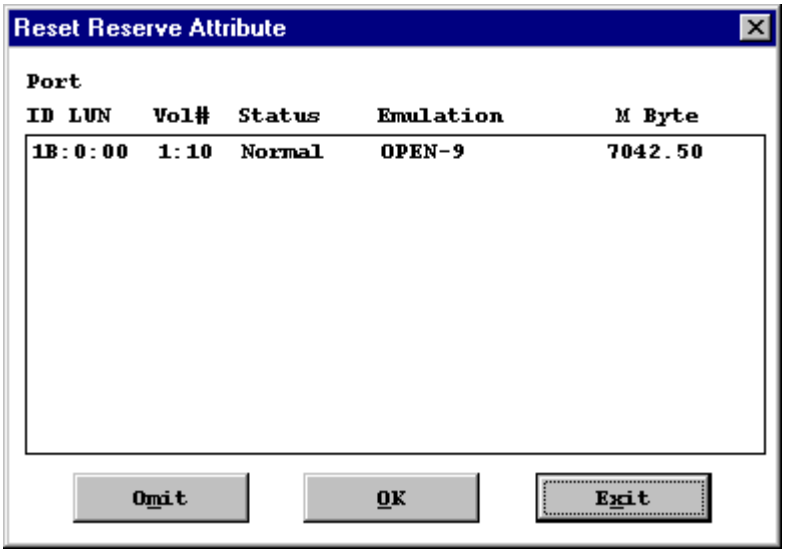

Figure 4.6 Reset Reserve Attribute Panel

The Reset Reserve Attribute panel displays the reserved volume(s) that you selected on the HOMRCF main panel. The **Omit** button allows you to remove one or more volumes from the list. The **OK** button resets the reserve attribute for all volumes in the list. The **Exit** button closes the Reset Reserve Attribute panel and returns you to the HOMRCF 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 HOMRCF pairs as S-VOLs. See section 4.10 for instructions on deleting HOMRCF pairs.
2. On the HOMRCF main panel, select the **Display-Volume** option to display volumes, and then select the desired port and volume display options (e.g., to display reserved SMPL volumes, check **Attribute-Reserve** and **Volume-nonPair**, and uncheck **Volume-Pair**).
3. Select the volume(s) you want to unreserve, and then select the **Attribute...** button to open the Reset Reserve Attribute panel. If the **Attribute…** button is not enabled, you selected both reserved and unreserved volumes. Select only reserved volumes.
4. Verify that the Reset Reserve Attribute panel displays the desired volume(s). If you want to remove any volumes from the list, select the volume(s), and select the **Omit** button.
5. Make sure that the Reset Reserve Attribute panel displays the desired volume(s), because there is no confirmation for the reset reserve attribute operation. When the list is correct, select the **OK** button to reset the reserve attribute for all volumes in the list.
6. When the reset operation(s) are complete, you are returned to the HOMRCF main panel.

4.4 Creating HOMRCF Pairs (Paircreate)

> ***WARNING:*** The HOMRCF 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 HOMRCF pairs.

The Paircreate Dialog panel (see Figure 4.7) 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). The Paircreate Dialog panel is opened by selecting the **Paircreate…** button on the HOMRCF main panel.

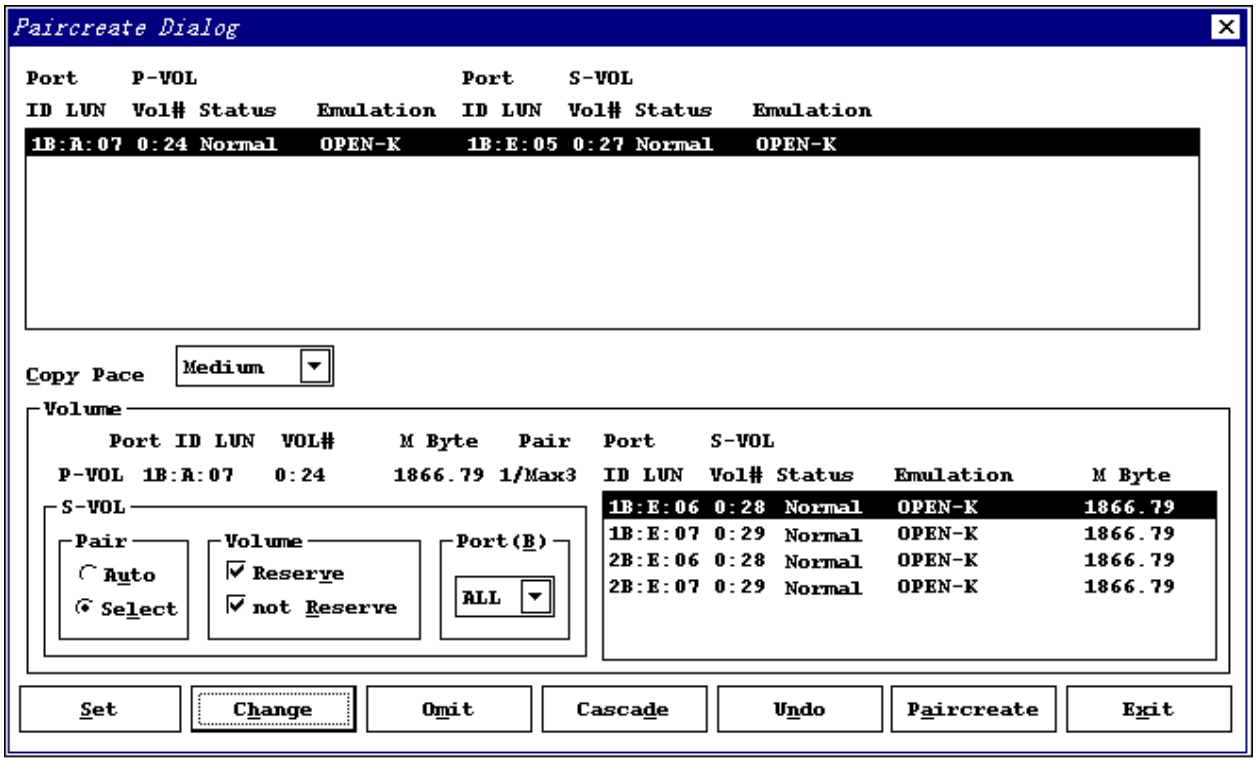

Figure 4.7 Paircreate Dialog Panel

The Paircreate panel displays the P-VOL and S-VOL information for each pair being created: port, TID, LUN, CU image, LDEV ID, volume status, and emulation type. The S-VOL for each P-VOL is displayed only after being selected (using **Set** or **Change**). The **Copy Pace** pull-down selection box allows you to select the copy pace for all pairs being created: **Slower**, **Medium**, and **Faster**.

The **Volume** box displays the detailed volume information for the selected pair: P-VOL ID (port, TID:LUN, CU:LDEV), storage capacity, and number of existing pairs. The **S-VOL** box (within the **Volume** box) allows 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 **Auto** is selected, the SVP selects the S-VOL from the set of reserved volumes by LUN (in ascending order, lowest to highest). When **Select** is selected, use the **Volume** and **Port** S-VOL display options 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 with the selected S-VOL. The **Omit** button deletes the selected volume(s)/pair(s) from the list. 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. The **Undo** button undoes the **Set** or **Change** command. The **Paircreate** button creates all pairs in the list. The **Exit** button closes the Paircreate panel.

Note: If you want to create new HOMRCF 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 4.7 for instructions).

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

1. On the HOMRCF main panel, select the **Display-Volume** option to display volumes, and then select the desired port and volume display options (e.g., to display unreserved SMPL volumes, check **Volume-nonPair**, and uncheck **Attribute-Reserve** and **Volume-Pair**).
2. Select the desired P-VOL(s) for the new pair(s), and then select the **Paircreate...** button to open the Paircreate Dialog panel. ***Note:*** Do not select any reserved volumes.
3. Set the initial copy pace for all pairs being created: **Slower**, **Medium**, or **Faster**.
4. Verify that the Paircreate Dialog panel displays the desired P-VOL(s). If you want to remove any volumes from the list, select the volume(s), and select the **Omit** button.
5. Select the S-VOL(s) for each P-VOL as follows:
   a) Select the desired P-VOL on the Paircreate Dialog panel.
   b) If you want the SVP to assign an S-VOL automatically, select the **Pair-Auto** option. S-VOLs are assigned from the set of reserved volumes by LDEV ID. If you want to select the S-VOL manually, select **Pair-Select**, select **Volume-Reserve** to display reserved volumes, select the desired port, and select the desired S-VOL.

      Note: You can select an unreserved volume as the S-VOL. When you create the pair, the 9900 changes the reserve attribute to "reserved" automatically.
   c) 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.
   d) If you want to add a second and/or third S-VOL to the same P-VOL, repeat steps (b) and (c) 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 Dialog panel.
   e) If you want to change an S-VOL for a pair which is already set, select the pair, select the desired S-VOL to replace the existing S-VOL, and select the **Change** button.
6. 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 **Omit** button to remove pairs.
7. When the Paircreate Dialog panel displays the desired new pair(s), select the **Paircreate** button to create all pairs in the list. When the confirmation panel appears, select **Yes** to create the pair(s), select **No** to cancel your request and return to the HOMRCF main panel, or select **Cancel** to cancel your request and return to the Paircreate Dialog panel.
8. When the initial copy operation(s) start, the Pairdisplay panel opens automatically to show the new pairs with COPY(PD) status. Select **Refresh** to monitor the progress of the initial copy operation(s), or select **OK** to return to the HOMRCF main panel.

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 HOMRCF pairs.

To create one or more new L2 cascade pairs:

1. Make sure that the desired L1 pairs are split (status = PSUS).
2. On the HOMRCF main panel, select the desired L1 pair(s) to which you want to add the L2 pair(s), and then select the **Paircreate…** button to open the Paircreate Dialog panel.
3. On the Paircreate panel, select the desired L1 pair, select the desired S-VOL for the new L2 pair, and then select the **Cascade** button to add the desired L2 pair to the list of pairs. The L2 pair is listed on a separate line showing the L1 S-VOL as the L2 P-VOL.
4. Repeat step (3) until all desired L2 pairs are displayed. Use the **Change** button to replace an S-VOL, use the **Set** button to add an S-VOL, and use the **Omit** button to remove pairs.
5. When the Paircreate Dialog panel displays all desired new pairs, select the **Paircreate** button to create all pairs in the list. When the confirmation panel appears, select **Yes** to create the pair(s), select **No** to cancel your request and return to the HOMRCF main panel, or select **Cancel** to cancel your request and return to the Paircreate Dialog panel.

4.5 Viewing HOMRCF Pair Status (Pairdisplay)

The Pairdisplay panel (see Figure 4.8) displays the pair status information for the pair(s) selected on the HOMRCF main panel. The Pairdisplay panel is opened by selecting the **Pairdisplay...** button on the HOMRCF main panel. The Pairdisplay panel also opens automatically when you create and split pairs.

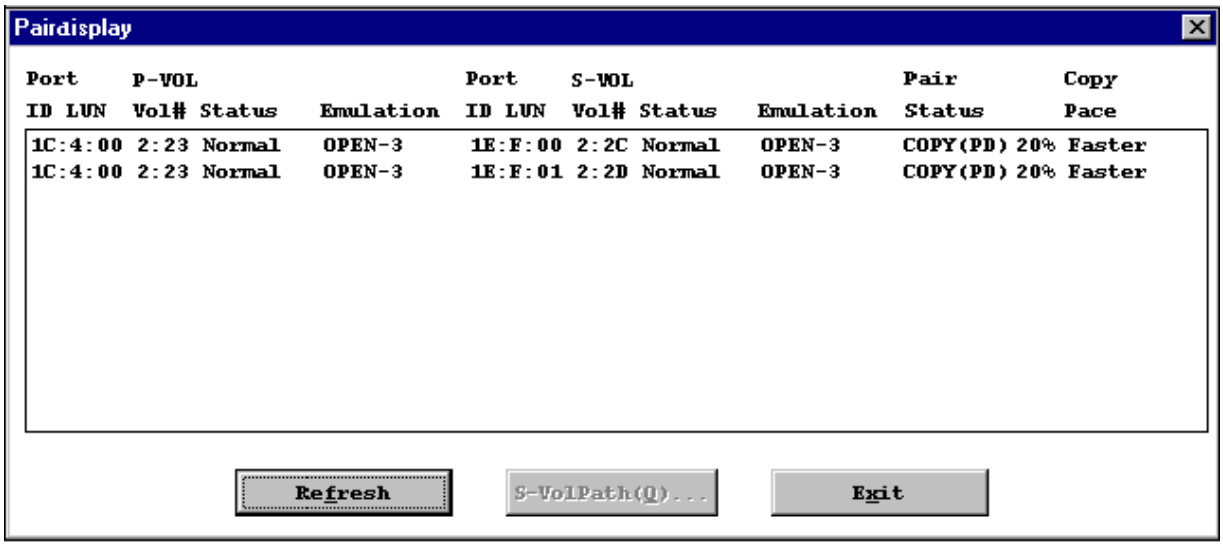

Figure 4.8 Pairdisplay Panel

The Pairdisplay panel displays the following information for the selected volume(s)/pair(s):

- P-VOL and S-VOL ID (port:TID:LUN, CU:LDEV) and volume status.
- HOMRCF pair status: **SMPL**, **COPY(PD)**, **PAIR**, **COPY(SP)**, **PSUS(SP)**, **PSUS**, **COPY(RS)**, **COPY(RS-R)**, **PSUE**.
- Copy pace is displayed only when the pair status is COPY(PD), COPY(SP), PSUS(SP), COPY(RS), or COPY(RS-R): **Slower**, **Medium**, or **Faster**.

The **Refresh** button updates the information displayed on the Pairdisplay panel. The **S-VOL Path…** button displays the S-VOL SCSI paths for the selected pair(s). The **Exit** button exits the Pairdisplay panel and returns you to the HOMRCF main panel.

To display the pair status of one or more HOMRCF pairs:

1. On the HOMRCF main panel, select either **Display-Volume** or **Display-Pair** to display either volumes or pairs, and then select the desired port and volume/pair display options.
2. Select the desired volume(s)/pair(s) in the **Volume List** box, and select the **Pairdisplay...** button to open the Pairdisplay panel. ***Note***: Do not select any SMPL volumes.
3. Use the **Refresh** button as needed to update the information displayed on the Pairdisplay panel. Use the **S-VOL Path…** button as needed to view S-VOL SCSI paths.
4. When you are done monitoring the status of the volume(s)/pair(s), select the **Exit** button to return to the HOMRCF main panel.

4.6 Viewing HOMRCF Pair Status & History

The Status & History panel (see Figure 4.9) displays current HOMRCF pair status information as well as HOMRCF pair history information for the selected port. The Status & History panel is opened by selecting the **Stat&History** button on the HOMRCF main panel.

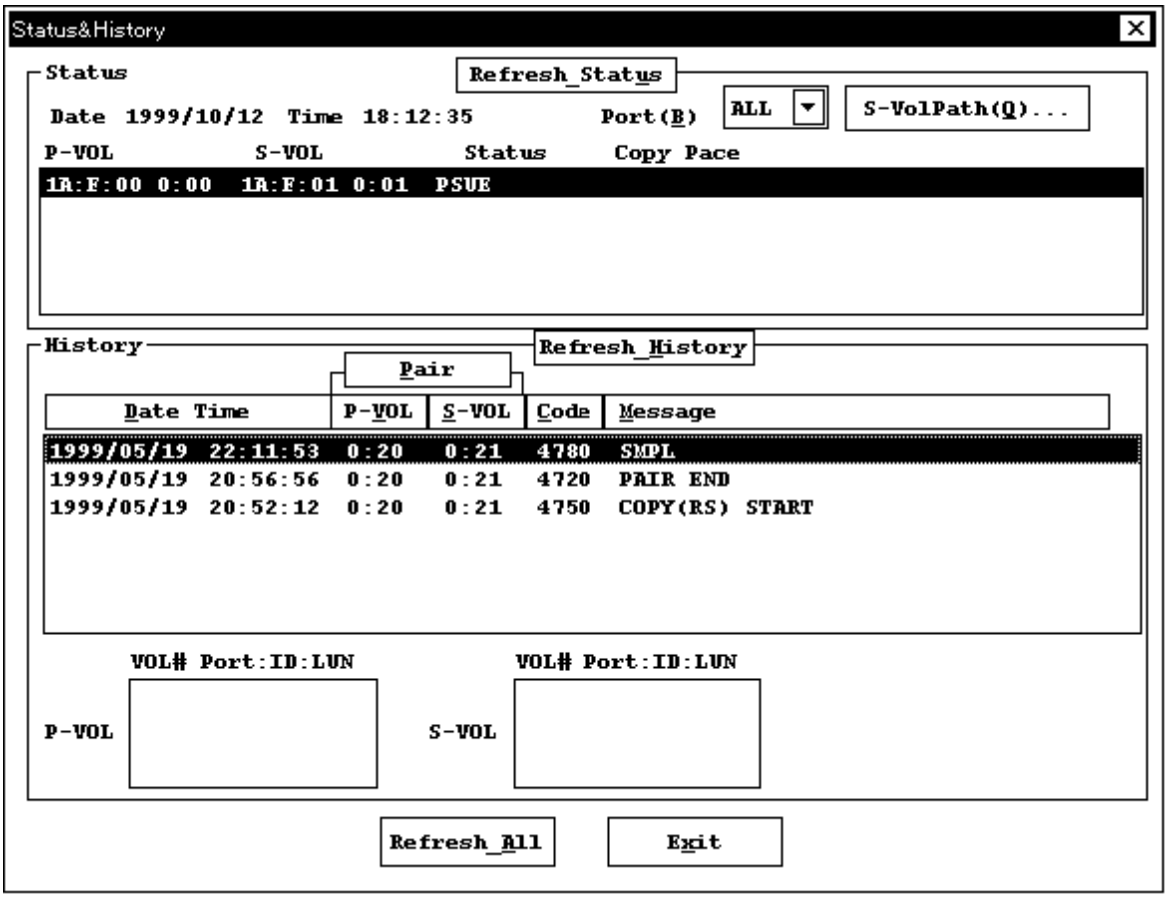

Figure 4.9 Status & History Panel

The **Status** box displays the following information for the selected port: all HOMRCF pairs (P-VOL ID, S-VOL ID, pair status, copy pace), the **Date** and **Time** that the information was acquired (panel opened/refreshed). The **Refresh Status** button updates the information in the **Status** box. The **S-VOL Path…** button displays S-VOL SCSI paths for the selected pair(s).

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

- HOMRCF pair activity listed by: date and time, P-VOL and S-VOL ID (CU:LDEV), and HOMRCF code and message (see Table 4.1). The **Date 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, and the **Message** button sorts according to message type.
- The **P-VOL** box displays the port number, target ID, and LUN of all volumes currently set as HOMRCF P-VOLs.
- The **S-VOL** box displays the port number, target ID, and LUN of all volumes currently set as HOMRCF S-VOLs.

The **Refresh History** button refreshes the pair history information for the selected port. The **Refresh All** button updates all information on the Status & History panel. The **Exit** button exits the Status & History panel and returns you to the HOMRCF main panel.

Table 4.1 HOMRCF Status & History Reference Codes and Messages

Code	Message	Description
4710 - 471F	PAIR START	The HOMRCF initial copy operation started.
4720 - 472F	DUPLEX END	The HOMRCF initial copy operation ended, and the pair status changed to PAIR.
4730 - 473F	SPLIT START	The HOMRCF pairsplit operation started, and the pair status changed to COPY(SP) or PSUS(SP).
4740 - 474F	SPLIT END	The HOMRCF pairsplit operation ended, and the pair status changed to PSUS.
4750 - 475F	RESYNC START	The HOMRCF pairresync operation started, and the pair status changed to COPY(RS) or COPY(RS-R).
4760 - 476F	RESYNC END	The HOMRCF pairresync operation ended, and the pair status changed to PAIR.
4780 - 478F	PAIR DELETE	The HOMRCF pairsplit-S operation was performed, and the pair status changed to SMPL.
4790 - 479F	PAIR SUSPEND	The HOMRCF pairsplit-E operation was performed, and the pair status changed to PSUE.
47A0 - 47AF	COPY WARNING END	A copy ended with a warning.
47D0 - 47DF	COPY ABNORMAL END	A copy ended abnormally (reason other than above).
47E7	COMPULSION PAIR SUSPEND	A pair was suspended compulsorily.
47E9	HOMRCF SM INITIALIZATION START	The initialization of the HMRCF/HOMRCF extension table was started (SM = shared memory).
47EA	HOMRCF SM INITIALIZATION END	The initialization of the HMRCF/HOMRCF extension table was completed (SM = shared memory).
47EB	HOMRCF SM INITIALIZATION FAILED	The initialization of the HMRCF/HOMRCF extension table failed (SM = shared memory).
7FF1 - 02	COPY ABNORMAL END (MULTIPLE PAIRS)	Multiple copies ended abnormally. This reference code is reported at a five-minute interval (one report per five minutes). If a pair ended abnormally, the pair status changed to PSUE.
FFFF	Reference Code unknown	The reference code is unknown.

4.7 Splitting HOMRCF Pairs (Pairsplit)

The Pairsplit panel (see Figure 4.10) displays volume and pair information for the volume(s) and/or pair(s) selected on the HOMRCF main panel and allows you to split existing HOMRCF pairs. The Pairsplit panel can also be used to simultaneously create and split new HOMRCF pairs (see section 4.7.1). The Pairsplit panel is opened by selecting **Pairsplit...** on the HOMRCF main panel.

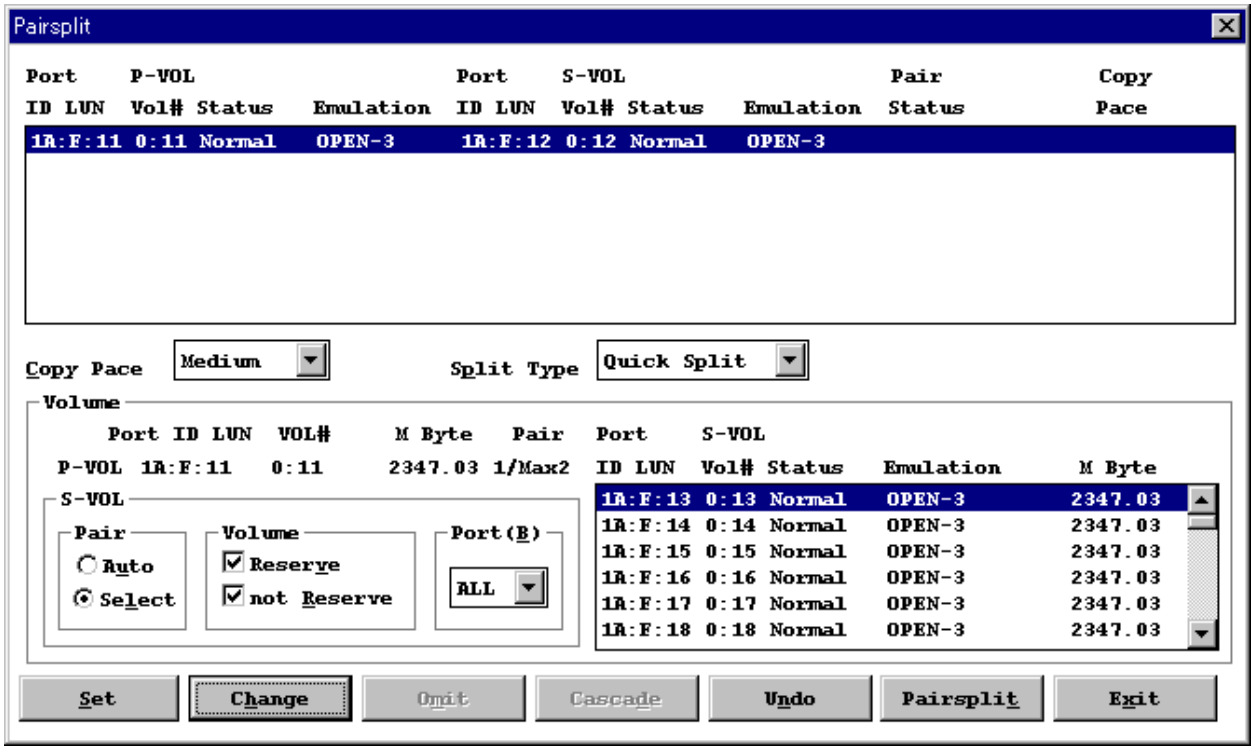

Figure 4.10 Pairsplit Panel

The Pairsplit panel lists the volume(s)/pair(s) selected on the HOMRCF main panel and shows the pair status and copy pace for each pair. The **Copy Pace** pull-down selection box allows you to select the copy pace for all pairs that you are splitting: **Slower**, **Medium** , or **Faster**. The **Split Type** pull-down selection box allows you to select the pairsplit type: **Quick Split** or **Steady Split**.

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 **Omit** button deletes the selected volume(s)/pair(s) from the list. 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. The **Undo** button undoes the **Set** or **Change** command. The **Pairsplit** button splits all pairs displayed in the list. The **Exit** button closes the Pairsplit panel.

To split one or more existing HOMRCF 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.
2. On the HOMRCF main panel, select the **Display-Pair** option to display pairs, and then select the desired port and pair display options.
3. Select the pair(s) you want to split, and then select the **Pairsplit…** button to open the Pairsplit panel. You cannot split a suspended (PSUE) pair.
4. Set the copy pace (**Slower**, **Medium**, or **Faster**) and split type (**Quick** or **Steady**) for all pairs being split.
5. Verify that the Pairsplit panel displays the desired pair(s). If you want to remove any pairs from the list, select the pair(s), and select the **Omit** button.
6. When the Pairsplit panel displays the desired pair(s), select the **Pairsplit** button to split all pairs in the list. When the confirmation panel appears, select **Yes** to split the pair(s), select **No** to cancel your request and return to the HOMRCF main panel, or select **Cancel** to cancel your request and return to the Pairsplit panel.
7. When the pairsplit operation(s) start, the Pairdisplay panel opens automatically to show the new pairs with COPY(SP) or PSUS(SP) status. The PSUS status is displayed right away if there were no pending update copy operations. Select **Refresh** to monitor the progress of the pairsplit operation(s), and select **OK** to return to the HOMRCF main panel.

4.7.1 Creating and Splitting Pairs

The pairsplit operation can also be used to simultaneously create and split new HOMRCF 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 HOMRCF 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.
2. On the HOMRCF main panel, select the **Display-Volume** option to display volumes, and then select the desired port and volume display options (e.g., to display unreserved SMPL volumes, check **Volume-nonPair** and uncheck **Attribute-Reserve** and **Volume-Pair**).

3. Select the volume(s) which will be the P-VOL(s) of the new pairs to be created and split, and then select the **Pairsplit…** button 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:
   a) Select the desired P-VOL.
   b) If you want the SVP to select the S-VOL automatically, select the **Pair-Auto** option. If you want to select the S-VOL manually, select **Pair-Select**, select **Volume-Reserve** or **Volume-not Reserve** to display either reserved or unreserved volumes, select the desired port, and then select the desired 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 (c) 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.
6. 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 **Omit** button to remove pairs.
7. If you also want to create and split L2 cascade pairs, add the L2 S-VOL(s) to the L1 pairs as follows:
   a) Select the desired L1 pair from the list of pairs to be created and split.
   b) If you want the SVP to select the S-VOL automatically, select the **Pair-Auto** option. If you want to select the S-VOL manually, select **Pair-Select**, select **Volume-Reserve** to display reserved volumes, select the desired port, and select the desired S-VOL.
   c) Select the **Cascade** button to add the L2 S-VOL to the selected L1 pair. The new L2 pair is now displayed.
   d) If you want to add another L2 S-VOL to the same L1 pair, repeat steps (b) and (c). Each L2 pair to be created and split is displayed separately in the list of pairs.
8. 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 **Omit** button to remove pairs.
9. When the Pairsplit panel displays the desired L1 and L2 pair(s), select the **Pairsplit** button to create and split all pairs in the list. When the confirmation panel appears, select **Yes** to create and split the pair(s), select **No** to cancel your request and return to the HOMRCF main panel, or select **Cancel** to cancel your request and return to the Pairsplit panel.
10. When the pairsplit operation(s) start, the Pairdisplay panel opens automatically to show the new pairs with COPY(SP) or PSUS(SP) status. Select **Refresh** to monitor the progress of the pairsplit operation(s), and select **Exit** to return to the HOMRCF main panel.

4.8 Resynchronizing HOMRCF Pairs (Pairresync)

The Pairresync panel (see Figure 4.11) displays pair information for the pair(s) selected on the HOMRCF main panel and allows you to resynchronize the pair(s). The Pairresync panel is opened by selecting the **Pairresync...** button on the HOMRCF main panel.

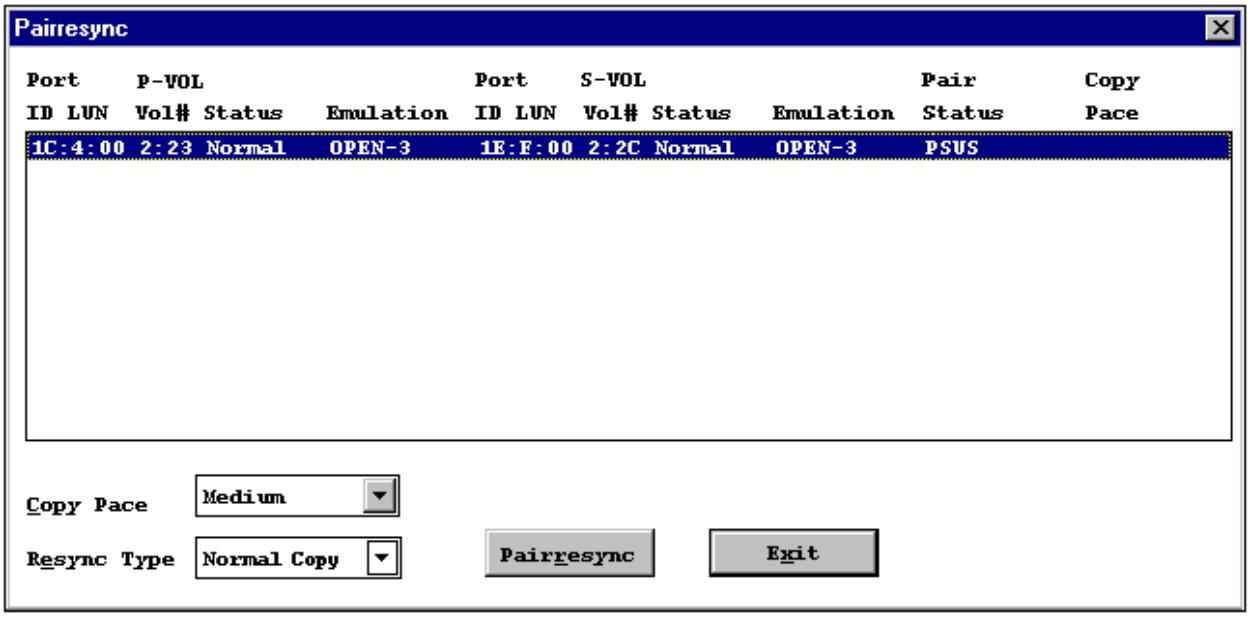

Figure 4.11 Pairresync Panel

The Pairresync panel lists the pair(s) selected on the HOMRCF main panel and shows the pair status and copy pace for each pair. The **Copy Pace** pull-down selection 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 **Pairresync** button starts the pairresync operation for the specified pair(s). The **Exit** button exits the Pairresync panel and returns you to the HOMRCF main panel.

To resynchronize one or more HOMRCF pairs:

1. Unmount the split (PSUS) S-VOLs before starting the pairresync operations. When the pairresync operation starts, the 9900 will stop accepting write I/Os to the S-VOL.
2. On the HOMRCF main panel, select the **Display-Pair** option to display HOMRCF pairs, and then select the desired port and pair display options (e.g., select the **Pair-Split** and **Pair-Suspend** display options to display only split and suspended HOMRCF pairs).
3. On the HOMRCF main panel, select the pair(s) you want to resync, and select the **Pairresync…** button to open the Pairresync panel.

4. On the Pairresync panel, select the pair(s) you want to resync, select the desired **Copy Pace** (slower, medium, or faster) and **Resync Type** (normal, quick, reverse, or quick restore) for these pairresync operations, and then select the **Pairresync** button to start the specified pairresync operation for the selected pair(s). Reverse/quick restore pairresync cannot be performed on suspended pairs (PSUE) or L2 cascade pairs.

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

   Note on RAID Swap for Quick Restore: During the quick restore operation, the RAID levels and HDD types of the S-VOL and P-VOL are exchanged, if they have different RAID levels and/or HDD types. To avoid any performance impact due to the quick restore operation, 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.

5. HOMRCF displays a warning panel to remind you to vary the S-VOL(s) offline before starting pairresync operations. Make sure the S-VOL(s) are offline, and select **OK**.

6. When the confirmation panel appears, select **Yes** to resync the specified pair(s), select **No** to cancel your request and return to the HOMRCF main panel, or select **Cancel** to cancel your request and return to the Pairresync panel.

7. The Pairresync panel now displays the result(s) of the pairresync operation(s) (i.e., pair status changed to COPY(RS), COPY(RS-R), or PAIR). Repeat steps (4) through (6) to resync additional pairs in the list, or select **Exit** to return to the HOMRCF main panel.

4.9 Suspending HOMRCF Pairs (Pairsplit-E)

The Pairsplit-E panel (see Figure 4.12) displays pair information for the pair(s) selected on the HOMRCF main panel and allows you to suspend the pair(s). The Pairsplit-E panel is opened by selecting the **Pairsplit-E…** button on the HOMRCF main panel.

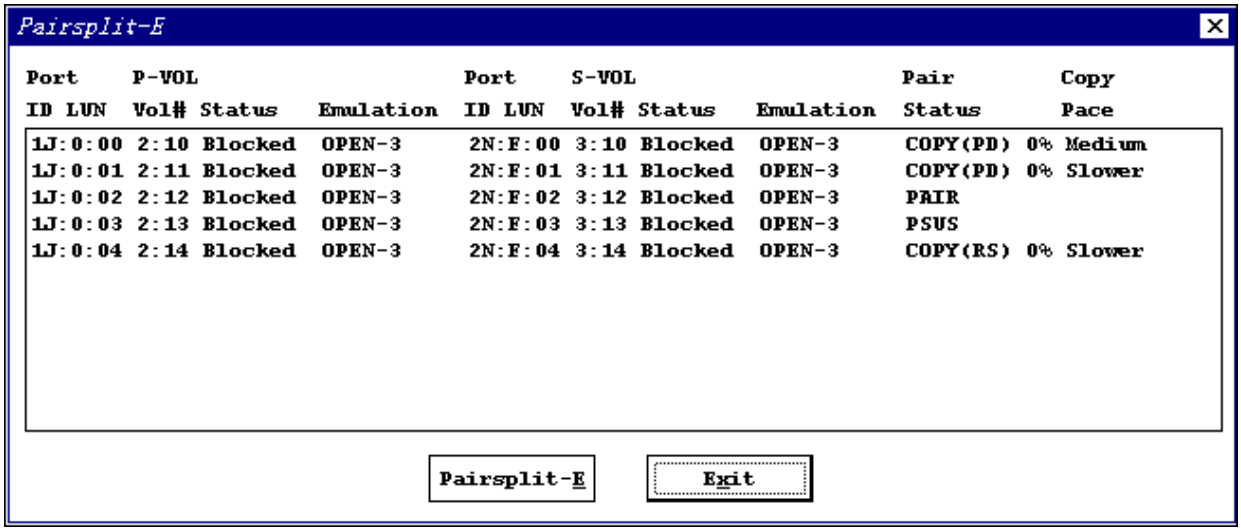

Figure 4.12 Pairsplit-E Panel

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

To suspend one or more HOMRCF pairs:

1. On the HOMRCF main panel, select the **Display-Volume** or **Display-Pair** option to display volumes or pairs, and then select the desired port and volume/pair display options.
2. Select the pair(s) that you want to suspend (or the volume(s) whose pairs you want to suspend), and select the **Pairsplit-E...** button to open the Pairsplit-E panel.
3. On the Pairsplit-E panel, select the pair(s) you want to suspend, and select the **Pairsplit-E** button.
4. When the confirmation panel appears, select **Yes** to suspend the selected pair(s), select **No** to cancel your request and return to the HOMRCF main panel, or select **Cancel** to cancel your request and return to the Pairsplit-E panel.
5. The Pairsplit-E panel now displays the result(s) of the suspend operation(s) (i.e., pair status changed to PSUE). Repeat steps (3) and (4) to suspend additional pairs in the list, or select **Exit** to return to the HOMRCF main panel.

4.10 Deleting HOMRCF Pairs (Pairsplit-S)

The Pairsplit-S panel (see Figure 4.13) displays pair information for the pair(s) selected on the HOMRCF main panel and allows you to delete the pair(s). The Pairsplit-S panel is opened by selecting the **Pairsplit-S...** button on the HOMRCF main panel.

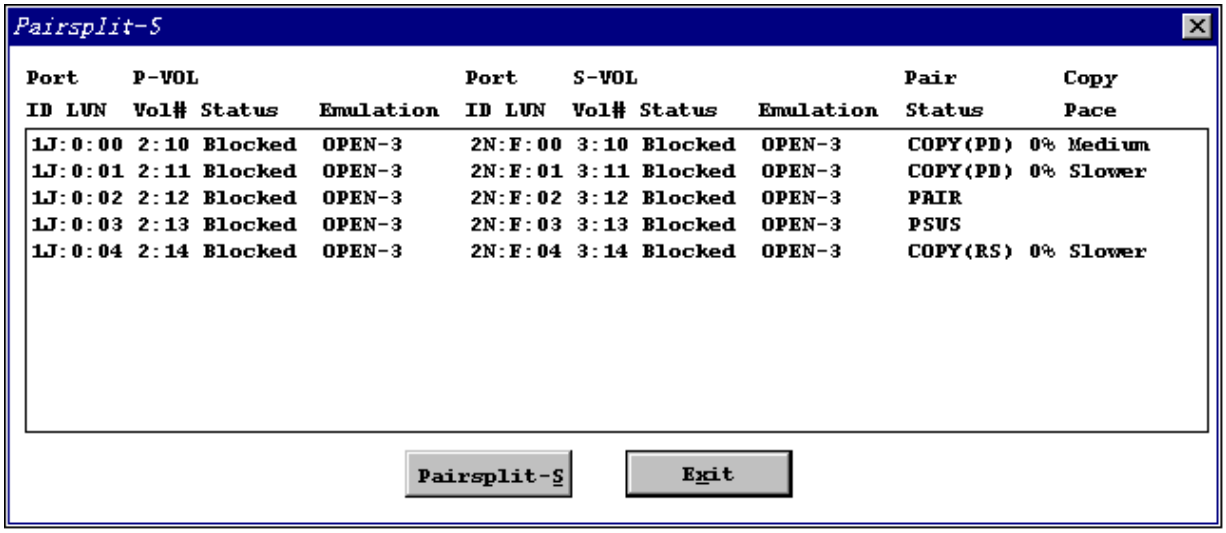

Figure 4.13 Pairsplit-S Panel

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

To delete one or more HOMRCF 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, split 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 HOMRCF main panel, select the **Display-Volume** or **Display-Pair** option to display volumes or pairs, and then select the desired port and volume/pair display options.
3. Select the pair(s) that you want to delete (or the volume(s) whose pairs you want to delete), and then select the **Pairsplit-S...** button to open the Pairsplit-S panel.

   Note: Pairs with PSUS(SP) status cannot be deleted.
4. On the Pairsplit-S panel, select the pair(s) you want to delete, and select the **Pairsplit-S** button. When the confirmation panel appears, select **Yes** to delete the selected pair(s), select **No** to cancel your request and return to the HOMRCF main panel, or select **Cancel** to cancel your request and return to the Pairsplit-S panel.
5. If you deleted all pairs on the Pairsplit-S panel, you are returned to the HOMRCF main panel. If not, the Pairsplit-S panel displays the remaining pair(s). Repeat step (4) to delete additional pairs, or select **Exit** to return to the HOMRCF main panel.

Chapter 5 Troubleshooting

5.1 Troubleshooting

If you have a problem with the 9900 Remote Console PC or RMCMAIN software, please refer to the *Hitachi Lightning 9900™ Remote Console User's Guide*. If an HOMRCF error code or message is displayed on the 9900 Remote Console PC, please refer to section 5.2 for a description of the HOMRCF 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 HOMRCF operations.

Table 5.1 General HOMRCF Troubleshooting

Error	Corrective Action
The Remote Console PC hangs, or HOMRCF operations do not function properly.	Make sure all HOMRCF requirements and restrictions are met. Make sure the 9900 subsystem is powered on and fully functional (NVS, cache, DFW). Please refer to the *Hitachi Lightning 9900™ User and Reference Guide* (MK-90RD008) for operational and troubleshooting information for the 9900 subsystem. Check all input values and parameters to make sure that you entered the correct information on the HOMRCF screens (e.g., P-VOL and S-VOL IDs). Disconnect Hitachi GRAPH-Track™ from the subsystem before connecting with the RMCMAIN/HOMRCF software.
If any channel Ready LED indicators (on the 9900 control panel) are off or flashing.	Please call the Hitachi Data Systems Support Center for assistance.
The volume pairs are not displaying correctly.	Make sure the correct CU image is selected.
An R-SIM (remote service information message) warning is displayed on the 9900 Remote Console PC.	Locate the SIM using the RMCMAIN R-SIM panel (see the *9900 Remote Console User's Guide* for instructions). Refer to the *Hitachi Lightning 9900™ User and Reference Guide* for a listing of 9900 SIMs.
An HOMRCF error message is displayed on the Remote Console PC.	Refer to section 5.2 for a description of the error code.
There is a problem with the Remote Console PC or HOMRCF remote console software.	Make sure that the problem is not being caused by the PC or LAN hardware or software. Try restarting the PC and reconnecting to the subsystem. If the problem persists, please call the Hitachi Data Systems Support Center for assistance.
The HOMRCF 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 9900 detected an error condition during HOMRCF operations. Check the R-SIMs reported to the Remote Console PC. If necessary, call the Hitachi Data Systems Support Center for assistance.
There is a pinned track on an HOMRCF volume.	If a pinned track occurs on an HOMRCF P-VOL or S-VOL, the 9900 will suspend the pair. Please contact your Hitachi Data Systems representative for assistance in recovering pinned tracks.

5.2 HOMRCF Error Codes

The HOMRCF software displays error messages on the Remote Console PC when error conditions occur during HOMRCF operations. The HOMRCF Error List panel (see Figure 5.1) displays the ID (CU number and LDEV ID; also port, TID, and LUN) of the affected volume and the HOMRCF error code and message. Table 5.2 lists and describes the HOMRCF error codes and provides instructions for resolving each error condition.

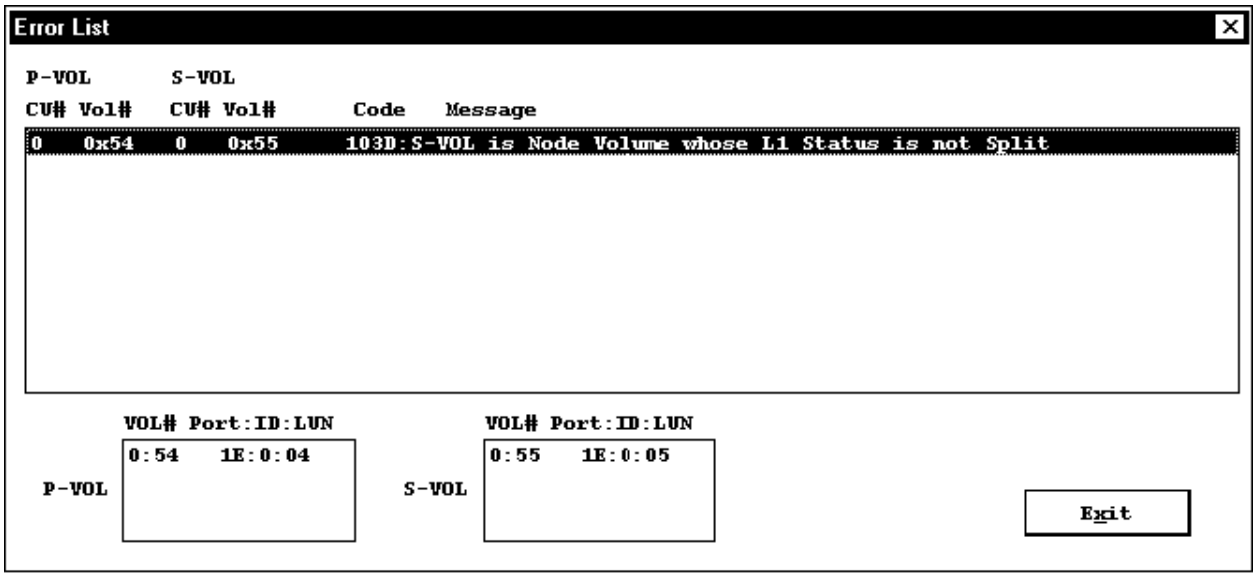

Figure 5.1 Error List Panel

Table 5.2 HOMRCF Error Codes

Error Code	Description	Corrective Action
0401	A locking time-out was detected during an internal processing.	A retry may result in a normal termination. Retry about five seconds later.
0402	A command (Pair, Split, or Reserve Volume) could not be completed because it was not in the SMPL status internally.	A retry may result in a normal termination. Retry about five seconds later.
0801	The HOMRCF feature could not be used.	Make sure the 9900 subsystem has the correct microcode level for HOMRCF, the SVP has HOMRCF installed and enabled, and the Remote Console PC has HOMRCF installed and enabled.
0810	The specified command cannot be accepted in this status. (The command was rejected.)	Check the pair status, and make sure the pair status is correct for the desired command.
0811	The specified command is treated as an NOP.	The specified command is treated as an NOP. (NOP means that the command can end without errors but executes nothing.)
0812	The new pair could not be created because a path group is set.	Disconnect from the host, or cancel the HORC path.

Table 5.2 HOMRCF Error Codes (continued)

Error Code	Description	Corrective Action
0813	The Split command was issued to a pair in the PSUS status.	The Split command cannot be issued because the pair is already in the PSUS status.
0814	The Paircreate command was issued to the pair in the PAIR status.	The Paircreate command cannot be issued because the pair is already in the PAIR status.
0817	A Reserve volume cannot be set because a path group is set.	Disconnect the volume to be reserved from the host, or delete the HORC path.
0818	The Pairresync or Pairsplit-E command cannot be issued because a path group is set.	Unmount the S-VOL (offline from the host), or delete the HORC path.
081F	Command Reject. P-VOL is used from HOST or by HORC.	Disconnect from the host, or cancel the HORC path.
0830	A pair cannot be created because the track format is different.	Make sure that the emulation type of the P-VOL and S-VOL is the same.
0831	A pair cannot be created because a number of slots is different.	Make sure that the capacity of the P-VOL and S-VOL is the same.
0834	The emulation type of the specified P-VOL is not supported by MRCF.	Make sure that the emulation type of the P-VOL is supported by the MRCF.
0835	The emulation type of the specified S-VOL is not supported by MRCF.	Make sure that the emulation type of the S-VOL is supported by MRCF.
0836	The pair cannot be created.	The emulation type of the P-VOL and S-VOL is not the same.
0840	Logical contradiction.	Call the Support Center for assistance.
0841	Logical contradiction.	Call the Support Center for assistance.
0842	Logical contradiction.	Call the Support Center for assistance.
0848	Logical contradiction.	Call the Support Center for assistance.
0849	Logical contradiction.	Call the Support Center for assistance.
084A	Logical contradiction.	Call the Support Center for assistance.
084B	Logical contradiction.	Call the Support Center for assistance.
0852	Command Reject. P-VOL and S-VOL are used from HOST or by HORC.	Disconnect from the host, or cancel the HORC path.
0880-08FF	Logical contradiction.	Call the Support Center for assistance.
0C70	A P-VOL is not installed.	Volumes which are not installed cannot be processed.
0C71	The P-VOL cannot be used.	Call the Support Center to make the P-VOL status normal.
0C72	The P-VOL is being formatted.	Wait until the formatting of the P-VOL completes.
0C80	The S-VOL is not installed.	Volumes which are not installed cannot be processed.
0C81	The S-VOL cannot be used.	Call the Support Center to make the P-VOL status normal.

Table 5.2 HOMRCF Error Codes (continued)

Error Code	Description	Corrective Action
0C82	The S-VOL is being formatted.	Wait until the formatting of the S-VOL completes.
0C90	The volume to be Reserved is not installed.	Volumes which are not installed cannot be processed.
0C91	The volume to be Reserved cannot be used.	Call the Support Center to make the volume status normal.
0C92	The volume to be Reserved is being formatted.	Wait until the formatting of the volume completes.
1001	Logical contradiction.	Call the Support Center for assistance.
1002	Logical contradiction.	Call the Support Center for assistance.
1003	Logical contradiction.	Call the Support Center for assistance.
1004	Logical contradiction.	Call the Support Center for assistance.
1005	Logical contradiction.	Call the Support Center for assistance.
1007	Logical contradiction.	Call the Support Center for assistance.
1009	The number of MRCF pairs exceeded the maximum.	Delete some of the pairs.
1010	Logical contradiction.	Call the Support Center for assistance.
1011	The number of the volume specified to be a Reserve volume has already been used for a Reserve volume.	Change the volume number for specifying a Reserve volume.
1012	The number of the volume specified to be a Reserve volume has already been used for a primary MRCF volume.	Change the volume number for specifying a Reserve volume.
1013	The number of the volume specified to be a Reserve volume has already been used for a hierarchical control primary volume.	Change the volume number for specifying a Reserve volume.
1014	The number of the volume specified to be a Reserve volume has already been used for a hierarchical control destination volume.	Change the volume number for specifying a Reserve volume.
1015	The volume specified to be a Reserve volume is not set as a Reserve volume.	Check the volume status.
1016	The volume can appropriately be allocated as an S-VOL does not exist among Reserve volumes.	Delete any Reserve volume which can be allocated as an S-VOL.
1017	A Reserve volume cannot be set because the max. number of Reserve volumes was exceeded.	Delete any of the Reserve volumes
101E	The Reserve volume itself does not exist in the system.	Set one or more Reserve volumes.
1026	It is impossible to make a pair any more because the volume which was specified as P-VOL is root volume already.	Delete some of the pairs of root volume.
1027	It is impossible to make a pair any more because the volume which was specified as P-VOL is node volume already.	Delete some of the pairs of node volume.

Table 5.2 HOMRCF Error Codes (continued)

Error Code	Description	Corrective Action
1028	It is impossible to make a pair because the volume which was specified as P-VOL is leaf volume already.	Confirm a pair condition.
1029	It is impossible to make a pair because the volume which was specified as S-VOL is leaf volume already.	Confirm a pair condition.
102E	P-VOL is used as source volume for HIHSM.	Confirm a matching condition.
102F	P-VOL is used as destination volume for HIHSM.	Confirm a matching condition.
1030	The specified P-VOL number does not exist.	Retry after refreshing the screen.
1031	The specified P-VOL has been set as a Reserve volume.	Check the pair status.
1032	No more pair can be created for the specified P-VOL.	Delete any of the pairs formed by the P-VOL.
1033	The specified P-VOL is not really a P-VOL.	Check the pair status.
1037	The specified P-VOL has been set as an MRCF S-VOL.	Check the pair status.
1038	The specified P-VOL has been set as a HODM P-VOL. (Displayed only if HODM is installed.)	Delete the HODM pair.
103A	The Pairresync command was issued to a device in the SMPL status.	Check the pair status.
103B	It is impossible to make a pair because volume which was specified as S-VOL is root volume already.	Confirm a pair condition.
103C	It is impossible to make a pair because volume which was specified as S-VOL is node volume already.	Confirm a pair condition.
103D	It is impossible for L2 pair to require a split because L1 pair is not in the split condition.	After making L1 pair a split condition, re-execute.
103E	A new pair was created with a P-VOL forming the HORC cooperation pattern.	Place the HOMRCF pair in the SMPL status, or place the HORC pair which uses the MRCF S-VOL as a P-VOL in the SMPL status.
103F	A pair status cannot be changed to form the HORC cooperation pattern.	Place the HORC pair which uses the MRCF S-VOL as a P-VOL in the PSUE or SMPL status.
1040	The specified S-VOL does not exist.	Set one or more Reserve volumes.
1042	S-VOL is used as destination volume for HIHSM.	Confirms a matching condition.
1043	The specified S-VOL number has already been used as that of an S-VOL.	Check the pair status.
1044	The specified S-VOL is not an MRCF S-VOL.	Check the pair status.
1046	The specified secondary volume is being used as a HORC P-VOL.	Delete the HORC pair.
1047	The specified secondary volume is being used as a HORC S-VOL.	Delete the HORC pair.
1048	The specified secondary volume is being used as a HODM P-VOL.	Delete the HODM pair.

Table 5.2 HOMRCF Error Codes (continued)

Error Code	Description	Corrective Action
104A	The specified secondary volume is being used as an MRCF P-VOL.	Check the pair status.
104B	S-VOL is used as source volume for HIHSM.	Confirm a matching condition.
104C	The volume specified as a Reserve volume is being used as a HODM P-VOL. (Displayed only if HODM is installed.)	Delete the HODM pair.
104D	The volume specified as a Reserve volume is being used as a HODM S-VOL. (Displayed only if HODM is installed.)	Delete the HODM pair.
104E	The volume specified as a Reserve volume is being used as a HORC P-VOL.	Delete the HORC pair.
104F	The volume specified as a Reserve volume is being used as a HORC S-VOL.	Delete the HORC pair.
1050	The specified P-VOL and S-VOL are not an HOMRCF pair.	Check the pair status.
1051	The volume numbers of the specified P-VOL and S-VOL are the same.	Retry after refreshing the screen.
1058	S-VOL is node volume whose L2 status is SP-Pend.	Confirm a matching condition.
1070	The status mode specification (status modec) in the Status Check command is incorrect.	Call the Support Center for assistance.
1071	The status classification (statusindc) in the Status Check command is incorrect.	Call the Support Center for assistance.
1072	The CU number specified by the Status Check command (volume status) does not exist.	Call the Support Center for assistance.
1084	Volume was used for reserve volume of HIHSM.	Check the volume, or cancel the reserve volume of HIHSM.
1085	P-VOL was used for reserve volume of HIHSM.	Check the P-VOL, or cancel the reserve volume of HIHSM.
1086	S-VOL was used for reserve volume of HIHSM.	Check the S-VOL, or cancel the reserve volume of HIHSM.
1087	P-VOL is used as source volume for HIHSM.	Confirm a matching condition.
1095	Request could not be accepted because status of pair who shared with P-VOL was Reverse-copy.	Confirm a matching condition.
1096	Request could not be accepted because L1 pair status was Reverse-copy.	Confirm a matching condition.
1097	Request could not be accepted because L2 pair status was Reverse-copy.	Confirm a matching condition.
1098	Reverse-Copy could not be accepted because pair status was not Split.	Confirm a matching condition.

Table 5.2 HOMRCF Error Codes (continued)

Error Code	Description	Corrective Action
1099	Reverse-copy to L2 pair could not be accepted because status of pair who shared with P-VOL was neither Split nor Suspend.	Confirm a matching condition.
109A	Reverse-copy could not be accepted because P-VOL was shared with HORC P-VOL whose status was not Suspend.	Confirm a matching condition.
109B	Reverse-copy could not be accepted because P-VOL was shared with HORC S-VOL whose status was not Suspend.	Confirm a matching condition.
109C	Reverse-copy could not be accepted because S-VOL was shared with HORC P-VOL.	Confirm a matching condition.

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 circumstances surrounding the error or failure and the exact content of any error codes and/or messages displayed on the Remote Console PC and/or logged at the host.

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

Appendix A Acronyms and Abbreviations

ACP	array control processor
CU	control unit (logical control unit)
CVS	Custom Volume Size (also called Virtual LUN)
DASD	direct-access storage device
DCR	Dynamic Cache Residency (also called FlashAccess)
DFW	DASD fast write
DKA	disk adapter
ESCON®	Enterprise System Connection (IBM trademark for optical channels)
GT	Hitachi GRAPH-Track™
HMBR	Hitachi Multiplatform Backup/Restore
HMRCF	Hitachi Multiple RAID Coupling Feature (also called ShadowImage)
HODM	Hitachi Online Data Migration
HOMRCF	Hitachi Open Multiple RAID Coupling Feature (also called Open ShadowImage)
HORC	Hitachi Open Remote Copy
HRC	Hitachi Remote Copy
LAN	local-area network
LDEV	logical device
LU	logical unit
LUN	logical unit number
MRCF	Multiple RAID Coupling Feature
NVS	nonvolatile storage
PC	personal computer
PDEV	physical device
P-VOL	primary volume
RAID	redundant array of independent disks
RMCMAIN	Remote Console Main
R-SIM	remote service information message
SIM	service information message
SM	shared memory
SMPL	simplex
S-VOL	secondary volume
SVP	service processor
TID	target ID

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