Hitachi Command Control Interface (CCI) User and Reference Guide

Hitachi Universal Storage Platform V/VM

Hitachi TagmaStore® Universal Storage Platform

Hitachi TagmaStore® Network Storage Controller

Hitachi Lightning 9900™ V Series

Hitachi Lightning 9900™

MK-90RD011-25

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Document Revision Level

Revision	Date	Description
MK-90RD011-00	July 2000	Initial Release
MK-90RD011-01 thru MK-90RD011-22	--	The release information for revisions 01-22 has been omitted. See MK-90RD011-23 for release information for these revisions.
MK-90RD011-23	September 2007	Revision 23, supersedes and replaces MK-90RD011-22
MK-90RD011-24	January 2008	Revision 24, supersedes and replaces MK-90RD011-23
MK-90RD011-25	May 2008	Revision 25, supersedes and replaces MK-90RD011-24

Source Documents for this Revision

- *RAID Manager Basic Specifications*, revision 64 (3/24/2008)

Changes in this Revision

- Added support for the following host platforms (section 3.1):
  - Microsoft Windows 2008
  - HP OpenVMS 8.3 support for IPv6
  - HP OpenVMS for Integrity Server
  - 64-bit RAID Manager for RH/IA64
- Added “SSB” to the output of the EX_CMDRJE error message (Table 5.3).
- Added support for Oracle10g H.A.R.D:
  - Added the “-vt rd10g” option for the raidvchkset command (section 4.12.1).
  - Added identification of “NON zero checking” to the output of the raidvchkdsp and raidvchkscan commands (sections 4.12.2, 4.12.3).
- Added “pathID” as HORCM_INSTP in horcm.conf (section 2.8.4).

Preface

This document describes and provides instructions for installing and using the Command Control Interface (CCI) software for Hitachi RAID storage systems. CCI enables the user to configure, perform, and manage operations for the following data management/business continuity features from the open-systems host:

TrueCopy
ShadowImage
Copy-on-Write Snapshot
Universal Replicator
Database Validator
Data Retention Utility/Open LDEV Guard

This document applies to the following Hitachi RAID storage systems:

Hitachi Universal Storage Platform V/VM (USP V/VM)
Hitachi TagmaStore® Universal Storage Platform (USP)
Hitachi TagmaStore Network Storage Controller (NSC)
Hitachi Lightning 9900™ V Series (9900V)
Hitachi Lightning 9900 (9900)

This document assumes the following:

- The user has a background in data processing and understands RAID storage systems and their basic functions.
- The user is familiar with the Hitachi RAID storage systems and has read and understands the *User and Reference Guide* for the storage system.
- The user is familiar with the host operating system.
- The user is familiar with the Hitachi business continuity features.

Notes:

- The term "Hitachi RAID storage system" refers to all supported Hitachi storage systems, unless otherwise noted.
- The terms used for the Hitachi RAID storage systems refer to all models of the storage system, unless otherwise noted. For example, "Universal Storage Platform V" refers to all models of the USP V, unless otherwise noted.

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

CCI Software Version

This document revision applies to CCI software version **01-22-03/02**.

Conventions for Storage Capacity Values

Storage capacity values for logical devices (LDEVs) on the Hitachi RAID storage systems are calculated based on the following values:

1 KB (kilobyte) = 1,024 bytes
1 MB (megabyte) = $1,024^2$ bytes
1 GB (gigabyte) = $1,024^3$ bytes
1 TB (terabyte) = $1,024^4$ bytes
1 PB (petabyte) = $1,024^5$ bytes
1 block = 512 bytes

Referenced Documents

Hitachi Universal Storage Platform V/VM documents:

- *Universal Storage Platform V/VM User and Reference Guide,* MK-96RD635
- *Storage Navigator User's Guide*, MK-96RD621
- *Hitachi ShadowImage User's Guide,* MK-96RD618
- *Hitachi TrueCopy User's Guide,* MK-96RD622
- *Data Retention Utility User's Guide*, MK-96RD612
- *Database Validator User's Guide*, MK-96RD611
- *Copy-on-Write Snapshot User's Guide*, MK-96RD607
- *Universal Replicator User's Guide*, MK-96RD624

Hitachi TagmaStore USP V/VM and NSC documents:

- *Universal Storage Platform User and Reference Guide,* MK-94RD231
- *Network Storage Controller User and Reference Guide,* MK-95RD279
- *Storage Navigator User's Guide*, MK-94RD206
- *Hitachi ShadowImage User Guide,* MK-94RD204
- *Hitachi TrueCopy User and Reference Guide,* MK-94RD215
- *Data Retention Utility User's Guide*, MK-94RD210
- *Database Validator User's Guide*, MK-94RD207
- *Copy-on-Write Snapshot User's Guide*, MK-95RD277
- *Universal Replicator User's Guide*, MK-94RD223

Hitachi Lightning 9900™ V Series documents:

- *User and Reference Guide*, MK-92RD100
- *Remote Console – Storage Navigator User's Guide*, MK-92RD101
- *Hitachi ShadowImage User's Guide*, MK-92RD110

- *Hitachi TrueCopy User and Reference Guide*, MK-92RD108
- *Open LDEV Guard User's Guide*, MK-93RD158
- *DB Validator Reference Guide*, MK-92RD140

Hitachi Lightning 9900™ documents:

- *User and Reference Guide*, MK-90RD008
- *Remote Console User's Guide*, MK-90RD003
- *Hitachi ShadowImage User's Guide*, MK-90RD031
- *Hitachi TrueCopy User and Reference Guide*, MK-91RD051

Comments

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- **E-mail:** doc.comments@hds.com
- **Fax:** 858-695-1186
- **Mail:**
  Technical Writing, M/S 35-10
  Hitachi Data Systems
  10277 Scripps Ranch Blvd.
  San Diego, CA 92131

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

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Chapter 1 Overview of CCI Functionality

1.1 Overview of Command Control Interface

The Hitachi Command Control Interface (CCI) software product enables you to configure and control Hitachi data replication and data protection operations by issuing commands from the open-systems host to the Hitachi RAID storage systems. This document covers CCI operations for the following Hitachi storage systems: Universal Storage Platform V/VM (USP V/VM), Universal Storage Platform (USP), Network Storage Controller (NSC), Lightning 9900V, and Lightning 9900.

The Hitachi data replication operations supported by CCI include (see section 1.2):

- TrueCopy (Synchronous and Asynchronous)
- ShadowImage
- Universal Replicator (USP V/VM, TagmaStore USP/NSC)
- Copy-on-Write Snapshot (USP V/VM, TagmaStore USP/NSC)

The Hitachi data protection operations supported by CCI include (see section 1.3):

- Database Validator
- Data Retention Utility (called “Open LDEV Guard” on Lightning 9900V/9900)

For remote copy operations, CCI interfaces with the system software and high-availability (HA) software on the host as well as the Hitachi software on the RAID storage system. CCI provides failover and operation commands that support mutual hot standby in conjunction with industry-standard failover products (e.g., MC/ServiceGuard, HACMP, FirstWatch®). CCI also supports a scripting function for defining multiple operations in a script (or text) file. Using CCI scripting, you can set up and execute a large number of commands in a short period of time while integrating host-based high-availability control over copy operations.

1.2 Overview of Hitachi Data Replication Functions

The Hitachi data replication features controlled by CCI include:

- TrueCopy (section 1.2.1)
- ShadowImage (section 1.2.2)
- Universal Replicator (section 1.2.3)
- Copy-on-Write Snapshot (section 1.2.4)

1.2.1 Hitachi TrueCopy

The Hitachi TrueCopy feature enables you to create and maintain remote copies of the data stored on the RAID storage systems for data backup and disaster recovery purposes. TrueCopy operations can be performed across distances of up to 43 km (26.7 miles) using standard ESCON® support, and up to 30 km (18.6 miles) using fibre-channel (FC) interface. Long-distance TrueCopy solutions are provided, based on user requirements and workload characteristics, using approved channel extenders and communication lines.

Hitachi TrueCopy operations can be performed using the Command Control Interface (CCI) software on the UNIX/PC server host, or the TrueCopy software on Storage Navigator. The CCI software on the UNIX/PC server displays Hitachi TrueCopy information and allows you to perform TrueCopy operations from the UNIX command line or via a script file. The CCI software interfaces with the RAID storage systems through a dedicated LU called a command device. The Hitachi TrueCopy software also displays TrueCopy information and allows you to perform TrueCopy operations via a Windows-based GUI.

Hitachi TrueCopy can be used in conjunction with ShadowImage to maintain multiple copies of critical data at your primary and/or secondary (remote) sites. This capability provides maximum flexibility in data backup and duplication activities.

For details on TrueCopy operations, please refer to the *TrueCopy User's Guide* for the storage system (e.g., *Hitachi TagmaStore® USP/NSC TrueCopy User's Guide*).

Note: The 7700E remote copy feature/software is called Hitachi Open Remote Copy (HORC).

1.2.2 Hitachi ShadowImage

The ShadowImage data duplication feature enables you to set up and maintain multiple copies of logical volumes within the same storage system. The RAID-protected ShadowImage duplicates are created and maintained at hardware speeds. ShadowImage operations for UNIX/PC server-based data can be performed using either the Command Control Interface (CCI) software on the UNIX/PC server host, or the ShadowImage software on Storage Navigator.

The Hitachi CCI software on the UNIX/PC server displays ShadowImage information and allows you to perform ShadowImage operations by issuing commands from the UNIX command line or by executing a script file. The CCI software interfaces with the storage system through a dedicated LU called a command device. The ShadowImage remote console software also displays ShadowImage information and allows you to perform ShadowImage operations using a Windows-based GUI. The ShadowImage software interfaces with the RAID storage system via its service processor (SVP).

ShadowImage can be used in conjunction with Hitachi TrueCopy to maintain multiple copies of critical data at your primary and/or secondary (remote) sites. This capability provides maximum flexibility in data backup and duplication activities.

For details on ShadowImage operations, please refer to the *ShadowImage User's Guide* for the storage system (e.g., *Hitachi TagmaStore® USP/NSC ShadowImage User's Guide*).

Note: The 7700E data duplication feature/software is called Hitachi Open Multi-RAID Coupling Feature (HOMRCF).

1.2.3 Hitachi Universal Replicator

Universal Replicator (UR) provides a RAID storage-based hardware solution for disaster recovery which enables fast and accurate recovery for large databases spanning multiple volumes. Universal Replicator provides update sequence consistency for user-defined journal group (i.e., large database) as well as protection for write-dependent applications in the event of a disaster. Universal Replicator enables you to configure and manage highly reliable data replication systems by using *journal volumes* to reduce chances of suspension of copy operations.

Universal Replicator can be used in conjunction with TrueCopy as part of a 3DC Cascading Configuration and/or a 3DC Multi-Target Configuration. Universal Replicator can also be used with ShadowImage to maintain multiple copies of critical data at primary and secondary (remote) sites. These capabilities provide maximum flexibility in data backup and duplication activities.

Note: Universal Replicator is available on USP V/VM and TagmaStore USP/NSC (not 9900V/9900).

For details on Universal Replicator operations, refer to the *Universal Replicator User's Guide* for the storage system, or contact your Hitachi Data Systems account team.

1.2.4 Hitachi Copy-on-Write Snapshot

Copy-on-Write (COW) Snapshot provides ShadowImage functionality using less capacity of the disk storage system and less time for processing than ShadowImage. COW Snapshot enables you to create copy pairs, just like ShadowImage, consisting of primary volumes (P-VOLs) and secondary volumes (S-VOLs). The COW Snapshot P-VOLs are logical volumes (OPEN-V LDEVs), but the COW Snapshot S-VOLs are virtual volumes (V-VOLs) with pool data stored in memory.

Copy-on-Write Snapshot is recommended for copying and managing data in a short time with reduced cost. However, since only some of the P-VOL data is copied by COW Snapshot, the data stored in the S-VOL is not guaranteed in certain cases (e.g., physical P-VOL failure). ShadowImage copies the entire P-VOL to the S-VOL, so even if a physical failure occurs, the P-VOL data can be recovered using the S-VOL. ShadowImage provides higher data integrity than COW Snapshot, so you should consider the use of ShadowImage when data integrity is more important than the copy speed or the capacity of the disk storage system.

Note: Copy-on-Write Snapshot is available on USP V/VM and TagmaStore USP/NSC (not 9900V/9900).

For details on Copy-on-Write Snapshot operations, see the *Copy-on-Write Snapshot User's Guide* for the storage system, or contact your Hitachi Data Systems account team.

1.3 Overview of Hitachi Data Protection Functions

The Hitachi data protection features controlled by CCI include:

- Database Validator (section 1.3.1)
- Data Retention Utility (section 1.3.2)

1.3.1 Hitachi Database Validator

The Database Validator feature is designed for the Oracle® database platform to prevent data corruption between the database and the storage system. Database Validator prevents corrupted data blocks generated in the database-to-storage system infrastructure from being written onto the storage disk. The combination of networked storage and database management software has a risk of data corruption while writing data on the storage. This data corruption rarely occurs; however, once corrupted data is written into storage, it can be difficult and time-consuming to detect the underlying cause, restore the system, and recover the database. Database Validator helps prevent corrupted data environments and minimizes risk and potential costs in backup, restore, and recovery operations. Database Validator combined with the Oracle9i Database product provides a resilient system that can operate for 24 hours a day, 365 days a year to provide the uptime required by enterprises today.

The Hitachi RAID storage systems support parameters for validation checking at the volume level, and these parameters are set through the command device using the Command Control Interface (CCI) software. CCI supports commands to set and verify these parameters for validation checking. Once validation checking is turned on, all write operations to the specified volume must have valid Oracle checksums. CCI reports a validation check error to the syslog file each time an error is detected.

Database Validator requires the CCI software product and a separate license key. Database Validator is not controlled via the Storage Navigator remote console software.

For details on Database Validator operations, please see the *Database Validator Reference Guide* for the storage system (e.g., *Hitachi TagmaStore® USP/NSC Database Validator User's Guide*), or contact your Hitachi Data Systems account team.

1.3.2 Hitachi Data Retention Utility (Open LDEV Guard)

Data Retention Utility (called Open LDEV Guard on 9900V/9900) enables you to prevent writing to specified volumes by the RAID storage system guarding the volumes. Data Retention Utility is similar to the Database Validator feature, setting a guarding attribute to the specified LU.

The RAID storage system supports parameters for guarding at the volume level. You can set and verify these parameters for guarding of open volumes using either the Storage Navigator software or the Command Control Interface (CCI) software on the host. Once guarding is enabled, the RAID storage system conceals the target volumes from SCSI commands (e.g., SCSI Inquiry, SCSI Read Capacity), prevents reading and writing to the volume, and protects the volume from being used as a copy volume (i.e., TrueCopy and ShadowImage paircreate operation fails).

For details on Data Retention Utility operations, please see the *Data Retention Utility* (or *Open LDEV Guard*) *User's Guide* for the storage system (e.g., *Hitachi TagmaStore® USP/NSC Data Retention Utility User's Guide*), or contact your Hitachi Data Systems account team.

Chapter 2 Overview of CCI Operations

This chapter provides a high-level description of the operations that you can perform with Hitachi Command Control Interface:

- Overview (section 2.1)
- Features of Paired Volumes (section 2.2)
- Overview of CCI ShadowImage Operations (section 2.3)
- Hitachi TrueCopy/ShadowImage Volumes (section 2.4)
- Applications of Hitachi TrueCopy/ShadowImage Commands (section 2.5)
- Overview of Copy-on-Write Snapshot operations (section 2.6)
- Overview of CCI Data Protection Operations (section 2.7)
- CCI Software Structure (section 2.8)
- Configuration Definition File (section 2.9)
- Error Monitoring and Configuration Confirmation (section 2.10)
- Recovery Procedures for HA Configurations (section 2.11)

2.1 Overview

CCI allows you to perform Hitachi TrueCopy and ShadowImage operations by issuing TrueCopy and ShadowImage commands from the UNIX/PC server host to the Hitachi RAID storage system. Hitachi TrueCopy and ShadowImage operations are nondisruptive and allow the primary volume of each volume pair to remain online to all hosts for both read and write operations. Once established, TrueCopy and ShadowImage operations continue unattended to provide continuous data backup.

This document covers the requirements for using Hitachi TrueCopy and ShadowImage in HA configurations. UNIX/PC servers in HA configurations normally support disk duplicating functions to enhance disk reliability (e.g., mirroring provided by the LVM or device driver, RAID5 or equivalent function provided by the LVM). UNIX/PC servers also feature hot standby and mutual hot standby functions in case of failures on the server side. However, mutual hot standby for disaster recovery has not yet been achieved, since it requires the remote mirroring function.

Hitachi TrueCopy supports the remote mirroring function, linkage function with the failover switch, and remote backup operation among servers, all of which are required by UNIX/PC servers in HA configurations for disaster recovery. For detailed information on TrueCopy operations, please refer to the *TrueCopy User and Reference Guide* for the storage system.

ShadowImage supports the mirroring function within a storage system. For detailed information on ShadowImage operations, please refer to the *ShadowImage User's Guide* for the storage system.

2.2 Features of Paired Volumes

The logical volumes, which have been handled independently by server machines, can be combined or separated in a pair being handled uniformly by the Hitachi TrueCopy and/or ShadowImage pairing function. Hitachi TrueCopy and ShadowImage regard those two volumes to be combined or separated as unique paired logical volume used by the servers. It is possible to handle paired volumes as groups by grouping them in units of server software or in units of database and its attribute.

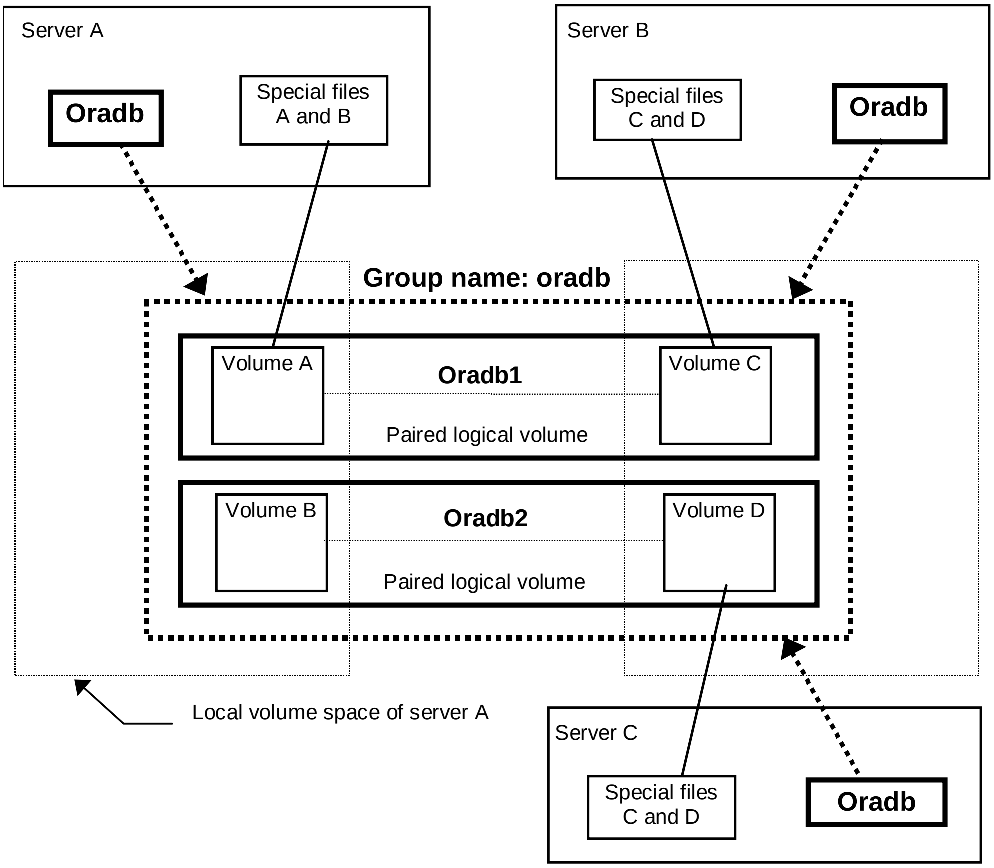


Figure 2.1 Concept of Paired Volumes

Addressing paired logical volumes: The correspondences between the paired logical volumes and physical volumes are defined by users by describing any intended paired logical volume names and group names in the configuration definition file of each server. It is possible to define a server for the paired logical volumes in units of group name. Each paired logical volume must belong to a group in order to determine the corresponding server.

Specification of volumes by commands: Volume names to be specified by the TrueCopy commands must be given using the paired logical volume names or the group names.

2.2.1 ShadowImage Duplicated Mirroring

Duplicated mirroring of a single primary volume is possible when the ShadowImage feature is used. The duplicated mirror volumes of the P-VOL are expressed as virtual volumes using the mirror descriptors (MU#0-2) in the configuration definition file as shown below.

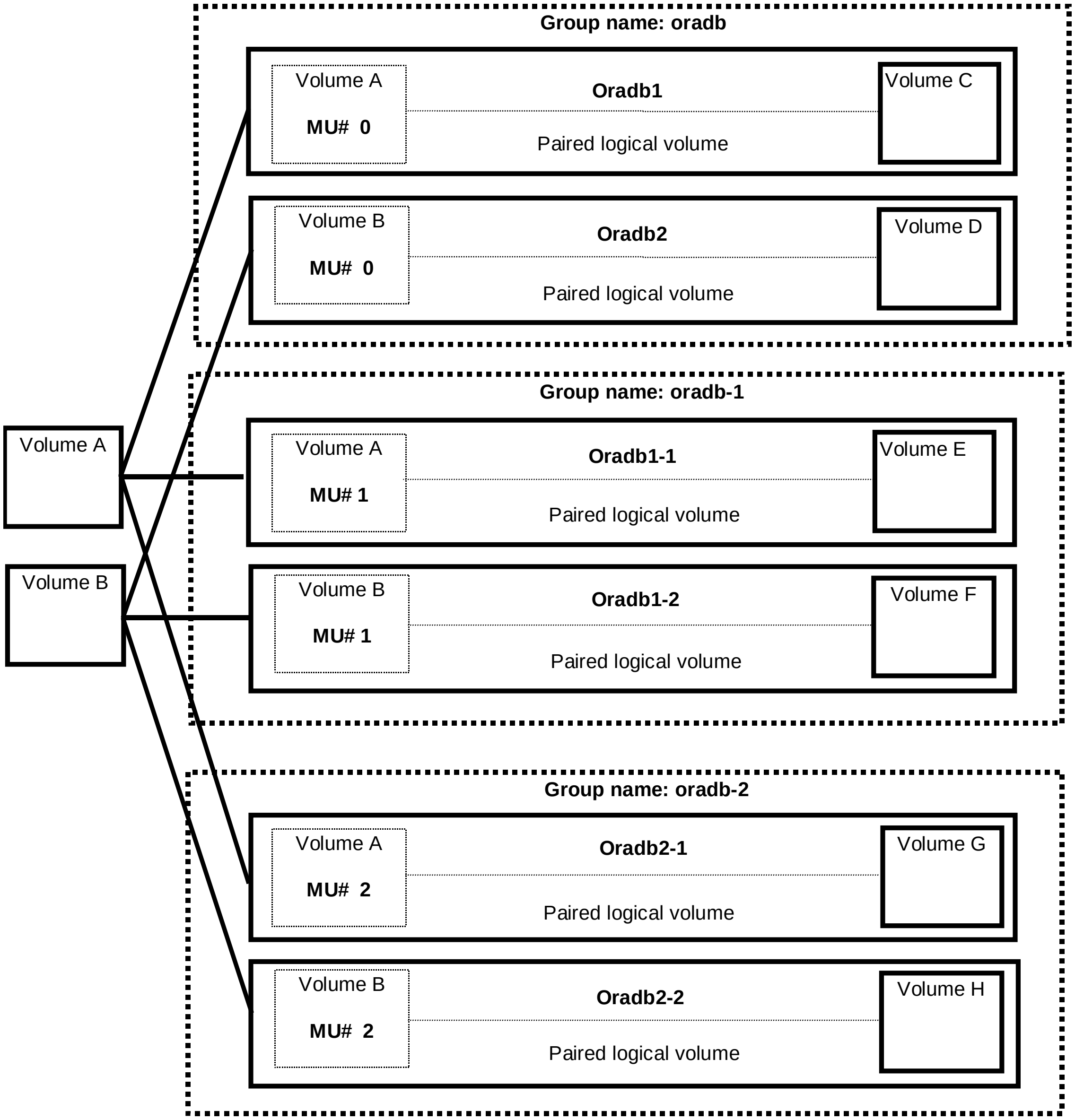


Figure 2.2 ShadowImage Duplicated Mirrors

2.2.2 ShadowImage Cascading Pairs

ShadowImage provides a cascading function for the ShadowImage S-VOL. The cascading mirrors of the S-VOL are expressed as virtual volumes using the mirror descriptors (MU#1-2) in the configuration definition file as shown below. The MU#0 of a mirror descriptor is used for connection of the S-VOL.

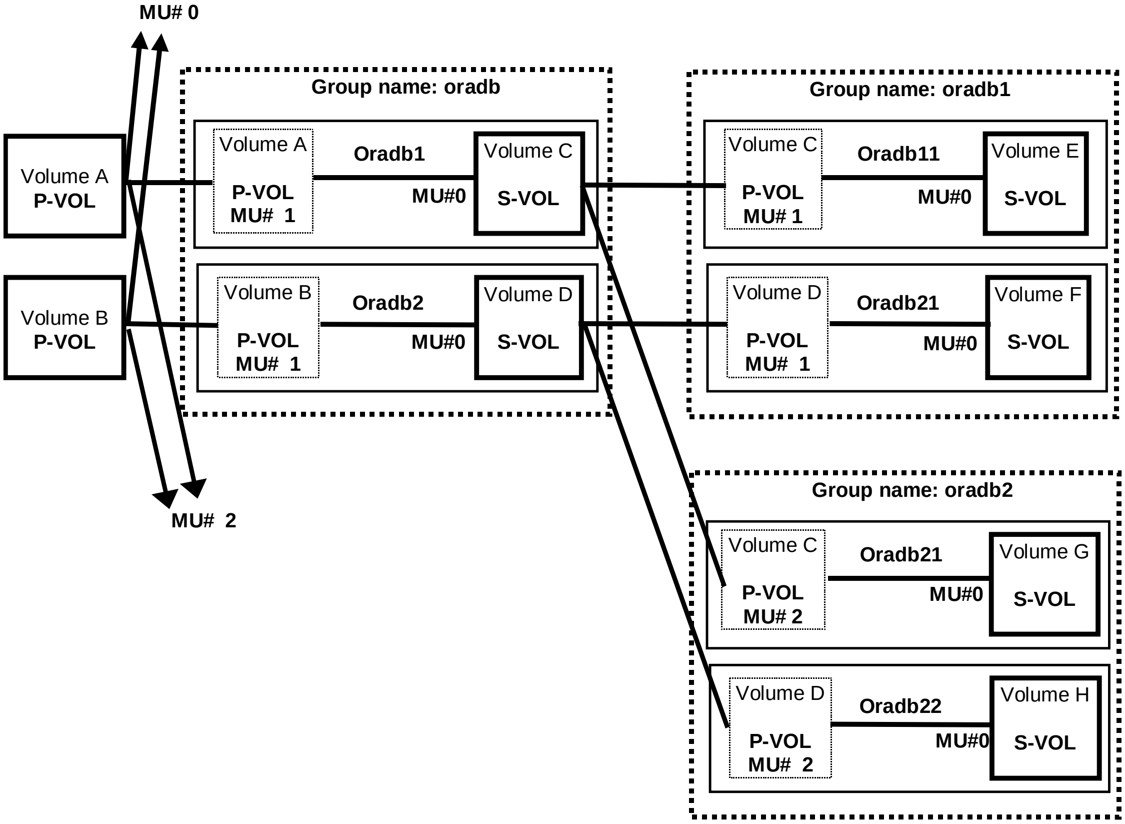
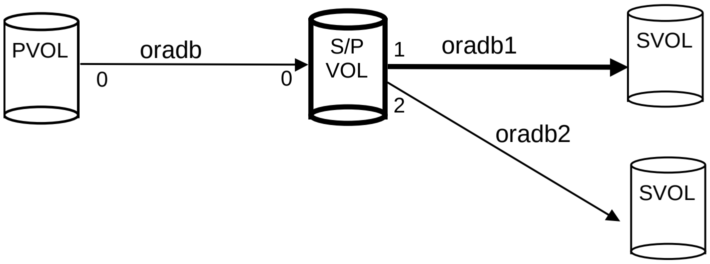


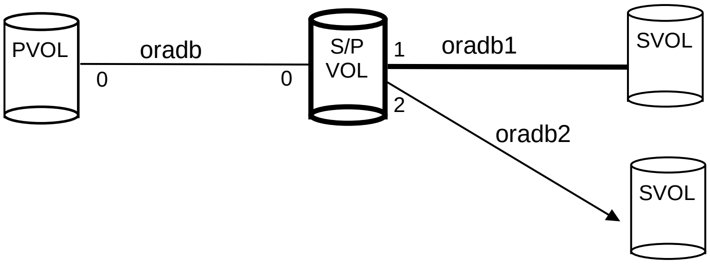
Figure 2.3 ShadowImage Cascade Volume Pairs

2.2.2.1 Restrictions for ShadowImage Cascading Volumes

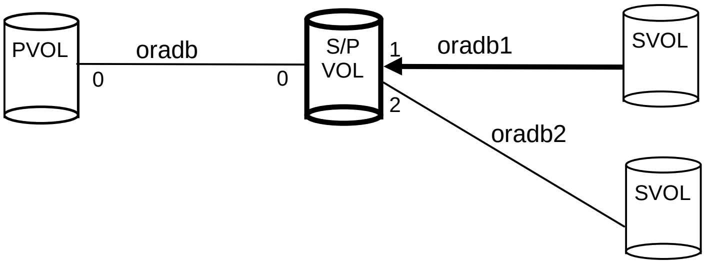
Pair Creation. Pair creation of SVOL (oradb1) can only be performed after the pair creation of S/PVOL (oradb). If pair creation of SVOL (oradb1) is performed at the SMPL or PSUS state of S/PVOL (oradb), paircreate will be rejected with EX_CMDRJE or EX_CMDIOE.



Pair Splitting. Pair splitting of SVOL (oradb1) can only be performed after the SMPL or PSUS state condition of S/PVOL (oradb), due to ShadowImage asynchronous copy. If the pair splitting of SVOL (oradb1) is performed at the COPY or PAIR state of S/PVOL (oradb), the pairsplit command will be rejected with EX_CMDRJE or EX_CMDIOE.

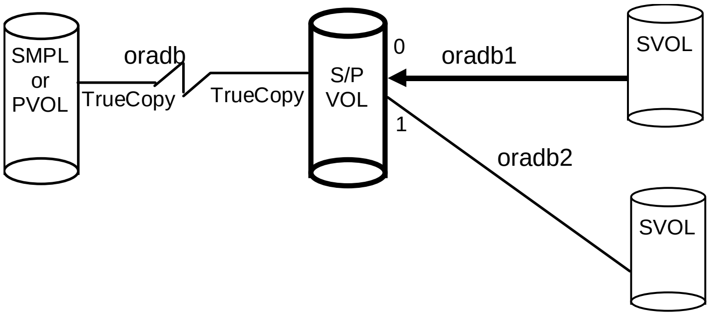


Pair Restore. Pair restore (resync from SVOL (oradb1) to S/PVOL) can only be performed when the state condition of SVOL (oradb) and another PVOL (oradb2) on the S/PVOL are SMPL. If the pair restore of SVOL (oradb1) is performed at the COPY or PAIR or PSUS state of S/PVOL (oradb or oradb2), the pairresync (-restore option) command will be rejected with EX_CMDRJE or EX_CMDIOE.



2.2.2.2 Restriction for TrueCopy/ShadowImage Cascading Volumes

Pair restore (resynchronization from SVOL (oradb1) to S/PVOL) can only be performed when the TrueCopy VOL (oradb) is SMPL or PSUS(SSUS), and another PVOL (oradb2) on the S/PVOL is SMPL or PSUS. If pairresync of S-VOL (oradb1) is performed when the S/PVOL (oradb or oradb2) is in any other state, the pairresync (-restore option) command will be rejected with EX_CMDRJE or EX_CMDIOE.



2.2.2.3 Overview of CCI TrueCopy Operations

CCI TrueCopy operates in conjunction with the software on the UNIX/PC servers and the Hitachi TrueCopy (HORC) functions of the RAID storage systems. The CCI software provides failover and other functions such as backup commands to allow mutual hot standby in cooperation with the failover product on the UNIX/PC server (e.g., MC/ServiceGuard, FirstWatch, HACMP). For the proper maintenance of Hitachi TrueCopy operations, it is important to find failures in paired volumes, recover the volumes from the failure as soon as possible, and continue operation in the original system.

Note: For information on the operational requirements for TrueCopy, please refer to the *Hitachi TrueCopy User and Reference Guide* for the storage system.

2.2.3 Hitachi TrueCopy Takeover Commands

Figure 2.4 illustrates the server failover system configuration. When a server software error or a node error is detected, the operation of the failover software causes the Cluster Manager (CM) to monitor server programs, and causes the CM of the standby node to automatically activate the HA control script of the corresponding server program. The HA control script usually contains the database recovery procedures, server program activation procedures, and other procedures. The takeover commands provided by Hitachi TrueCopy are activated by the control HA script and execute the control needed for failover of the server.

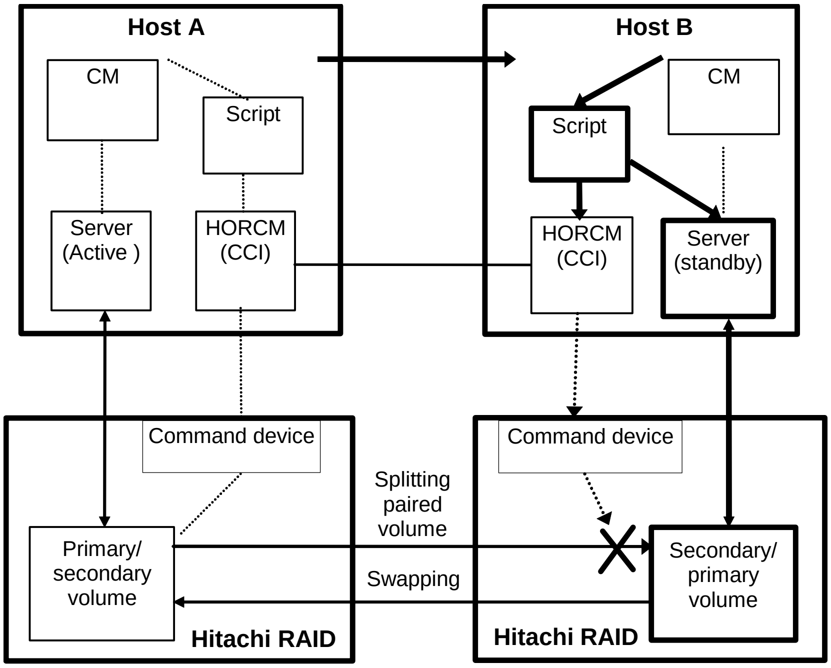


Figure 2.4 Server Failover System Configuration

In a high-availability (HA) environment, a package is a group of applications that are scripted to run on the secondary host in the event of a primary host failure. When using the HA software (e.g., MC/ServiceGuard), the package can be transferred to the standby node as an operation executed by the system administrator (see Figure 2.5). However, if the operation is performed in an environment in which Hitachi TrueCopy is used, the volume is switched from primary to secondary as if an error has occurred, even though data consistency is assured. When returning the package to the current node, it is necessary to copy the secondary volume data into the primary volume, and this operation can take as much time as the initial copy operation for the pair. In actual operation, no package can be transferred when TrueCopy is used. The secondary package is switched to the primary package, and vice versa, when the primary volume is switched to the secondary volume. Therefore, the primary and secondary TrueCopy volumes should be switched depending on the package state.

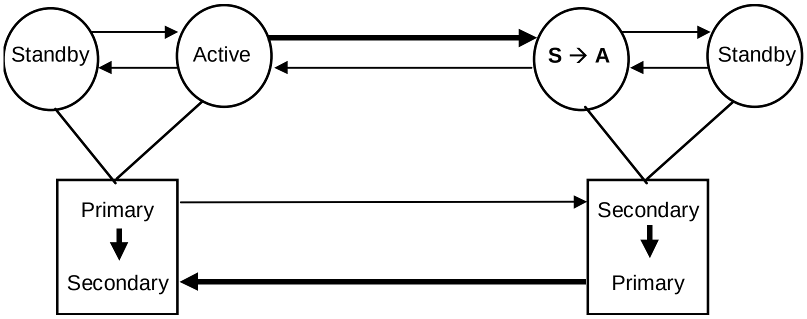


Figure 2.5 Package Transfer on High Availability (HA) Software

2.2.4 Hitachi TrueCopy Remote Commands

Figure 2.6 illustrates a Hitachi TrueCopy remote configuration. The Hitachi TrueCopy remote commands support a function which links the system operation for the purpose of volume backup among UNIX servers with the operation management of the server system. The Hitachi TrueCopy remote pair commands are also used to copy volumes in the failover configuration of the servers and to recover the volumes after the takeover.

- **Pair creation command:** Creates a new volume pair. Volume pairs can be created in units of volume or group.
- **Pair splitting command:** Splits a volume pair and allows read and write access to the secondary volume.
- **Pair resynchronization command:** Resynchronizes a split volume pair based on the primary volume. The primary volume remains accessible during resynchronization.
  - **Swaps(p) option (TrueCopy only).** Swaps volume from the SVOL(PVOL) to PVOL(SVOL) at suspending state on the SVOL(PVOL) side and resynchronizes the NEW_SVOL based on the NEW_PVOL. At the result of this operation, the volume attributes of own host (local host) become the attributes for the NEW_PVOL(SVOL).
- **Event waiting command:** Used to wait for completion of volume pair creation or resynchronization and to check the pair status.
- **Pair status display and configuration confirmation command:** Displays the pair status and configuration of the volume pairs, used for checking the completion of pair creation or pair resynchronization.

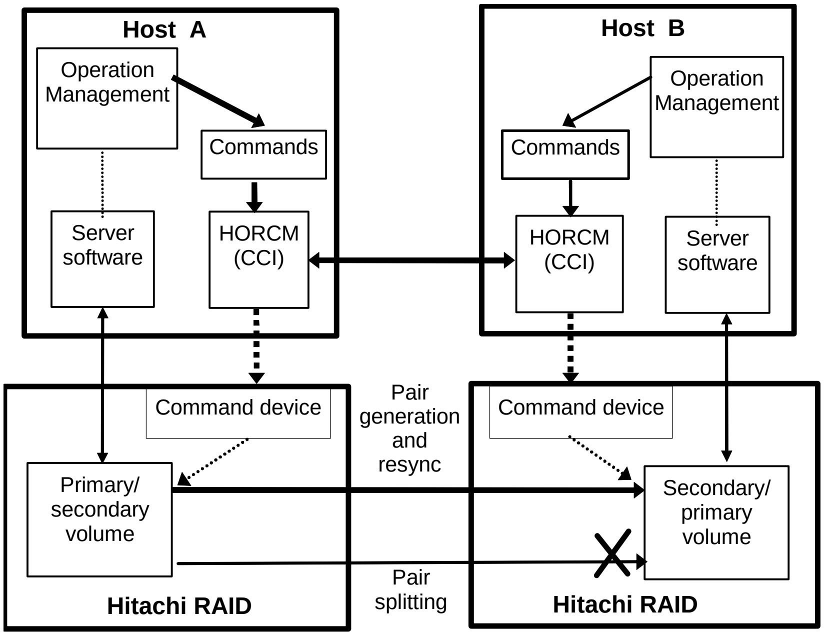


Figure 2.6 Hitachi TrueCopy Remote System Configuration

2.2.5 Hitachi TrueCopy Local Commands

Figure 2.7 illustrates a Hitachi TrueCopy local configuration. The TrueCopy local commands support a function which links the system operation for the purpose of volume backup among UNIX servers with the operation management of the server system. The TrueCopy local commands perform the same functions as the remote commands only within the same storage system instead of between two storage systems.

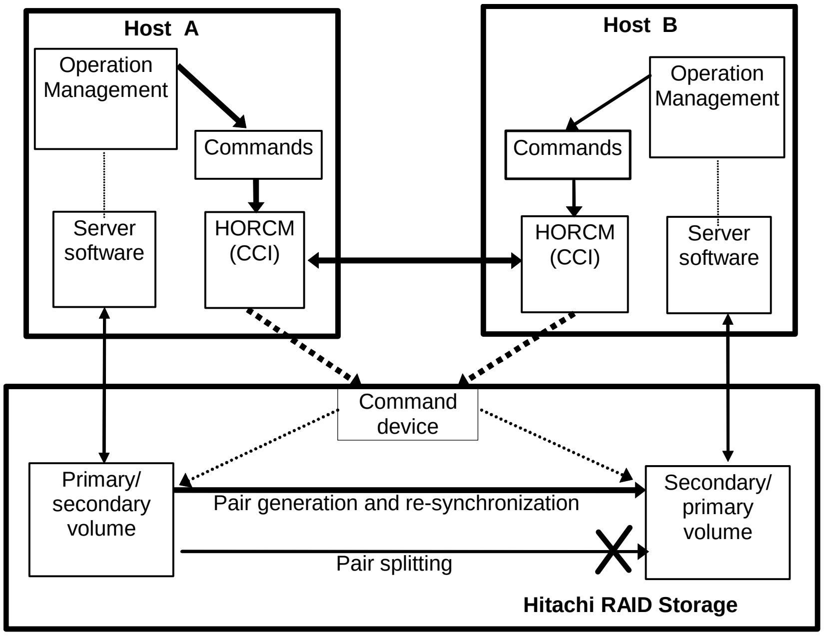


Figure 2.7 Hitachi TrueCopy Local System Configuration

2.3 Overview of CCI ShadowImage Operations

Figure 2.8 illustrates the ShadowImage configuration. The ShadowImage commands support a function which links the system operation for the purpose of volume backup among UNIX servers with the operation management of the server system. For detailed information on the operational requirements for ShadowImage, please refer to the *Hitachi ShadowImage User's Guide* for the storage system.

- **Pair creation command:** Creates a new volume pair. Volume pairs can be created in units of volume or group.
- **Pair splitting command:** Splits a volume pair and allows read and write access to the secondary volume.
- **Pair resynchronization command:** Resynchronizes a split volume pair based on the primary volume. The primary volume remains accessible during resynchronization.

  Restore option: Resynchronizes a split pair based on the secondary volume (reverse resync). The primary volume is not accessible during resync with restore option.
- **Event waiting command:** Used to wait for completion of volume pair creation or resynchronization and to check the pair status.
- **Pair status display and configuration confirmation command:** Displays the pair status and configuration of the volume pairs, used for checking the completion of pair creation or pair resynchronization.

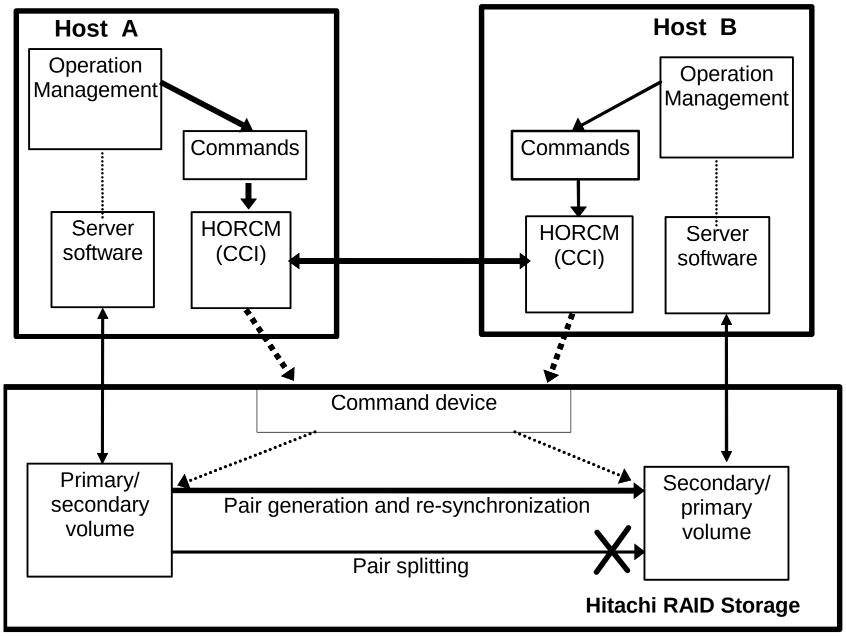


Figure 2.8 ShadowImage System Configuration

2.4 Hitachi TrueCopy/ShadowImage Volumes

Hitachi TrueCopy commands allow you to create volume pairs consisting of one primary volume (P-VOL) and one secondary volume (S-VOL). The TrueCopy P-VOL and S-VOL can be in different storage systems. Hitachi TrueCopy provides synchronous and asynchronous copy modes. TrueCopy Asynchronous can only be used between separate storage systems (not within one storage system). The maximum number of TrueCopy pairs in one storage system is 16,383 for TagmaStore USP/NSC, 8191 for 9900V, and 4095 for 9900, provided that one LUN is dedicated to the command device. For details on TrueCopy volumes and operations, please refer to the *Hitachi TrueCopy User and Reference Guide* for the storage system.

ShadowImage commands allow you to create volume pairs consisting of one P-VOL and up to nine S-VOLs using the ShadowImage cascade function. ShadowImage pairs are contained within the same storage system and are maintained using asynchronous update copy operations. The maximum number of ShadowImage pairs in one storage system is 8191 for TagmaStore USP/NSC, 4095 for 9900V, and 2047 for 9900. For details on ShadowImage volumes and operations, please refer to the *Hitachi ShadowImage User's Guide* for the storage system.

Each volume pair that you want to create must be registered in the CCI configuration file. ShadowImage volume pairs must include an MU (mirrored unit) number assigned to the S-VOL. The MU number indicates that the pair is a ShadowImage pair and not a Hitachi TrueCopy pair. Once the correspondence between the paired logical volumes has been defined in the HORCM_DEV section of the configuration file, you can use the configuration file to group the paired volumes into volume groups that can be managed by the host operating system's LVM (logical volume manager).

The host's LVM allows you to manage the Hitachi TrueCopy/ShadowImage volumes as individual volumes or by volume group. TrueCopy/ShadowImage commands can specify individual logical volumes or group names. For LUN Expansion (LUSE) volumes, you must enter commands for each volume (LDEV) within the expanded LU. If you define volume groups and you want to issue commands to those volume groups, you must register the volume groups in the configuration file. For further information on the LVM, refer to the user documentation for your operating system.

2.4.1 TrueCopy/ShadowImage/Universal Replicator Volume Status

Each TrueCopy pair consists of one P-VOL and one S-VOL, and each ShadowImage pair consists of one P-VOL and up to nine S-VOLs when the cascade function is used. Table 2.1 lists and describes the Hitachi TrueCopy and ShadowImage pair status terms. The P-VOL controls the pair status for the primary and secondary volumes. The major pair statuses are SMPL, PAIR, PSUS/PSUE, and COPY/RCPY. Read and write requests from the host are accepted or rejected depending on the pair status of the volume.

The pair status can change when a CCI command is executed. The validity of the specified operation is checked according to the status of the volume (primary volume).

- Table 2.2 shows the relationship between pair status and TrueCopy/Universal Replicator command acceptance.
- Table 2.3 shows the relationship between pair status and ShadowImage command acceptance.
- Table 2.4 shows the relationship between pair status and COW Snapshot command acceptance.

Table 2.1 Hitachi TrueCopy and ShadowImage Pair Status

Status	Hitachi TrueCopy Pair Status	ShadowImage Pair Status	Primary	Secondary
SMPL	Unpaired volume	Unpaired volume	R/W enabled	R/W enabled
PAIR	Paired volume. Initial copy is complete. Updates are processed synchronously or asynchronously.	Paired volume. Initial copy is complete. Updates are processed asynchronously.	R/W enabled	R enabled
COPY	In paired state, but initial copy, pairsplit, or resync operation is not complete. Includes COPY(PD), COPY(SP), and COPY(RS) status.	In paired state, but initial copy, pairsplit, or resync operation is not complete. Includes COPY(PD), COPY(SP), and COPY(RS) status.	R/W enabled	R enabled
RCPY	Not used for Hitachi TrueCopy	In paired state, but reverse resync operation is not complete. Includes COPY(RS-R) status.	R enabled	R enabled
PSUS (split)	In paired state, but updates to the S-VOL data are suspended due to user-requested pairsplit. The RAID storage system keeps track of P-VOL and S-VOL updates while the pair is split.	In paired state, but updates to the S-VOL data are suspended due to user-requested pairsplit. The RAID storage system keeps track of P-VOL and S-VOL updates while the pair is split.	R/W enabled	R/W enabled when using write enable pairsplit option
PSUE (error) or PFUS	In paired state, but updates to the S-VOL data are suspended due to an error condition. (PSUE is PSUS with reason of internal error. PFUS is PSUS with reason of sidefile full.)	In paired state, but updates to the S-VOL volume data are suspended due to an error condition. When a PSUE pair is resynched, the RAID storage system copies the entire P-VOL to the S-VOL (same as initial copy).	R/W enabled if no error occurs in the primary volume	R enabled
PDUB	Used for Hitachi TrueCopy LUSE pairs only. In paired state, but updates to one or more LDEVs within the LUSE pair are suspended due to error condition.	Not used for ShadowImage	R/W enabled if no error occurs in the primary volume	R enabled

LEGEND for Table 2.2, Table 2.3, and Table 2.4:

- Accepted = Accepted and executed. When operation terminates normally, the status changes to the indicated number.
- Acceptable = Accepted but no operation is executed.
- Rejected = Rejected and operation terminates abnormally.

Table 2.2 Pair Status versus TrueCopy and Universal Replicator Commands

		Hitachi TrueCopy Command					
		Paircreate		Pairsplit			Pairresync
#	Status	Copy	Nocopy	-r or -rw option	-P option	-S option	Resync
①	SMPL	Accepted ②	Accepted ③	Rejected	Rejected	Acceptable	Rejected
②	COPY	Acceptable	Acceptable	Accepted ④	Rejected.	Accepted ①	Acceptable
③	PAIR	Acceptable	Acceptable	Accepted ④	Accepted ④	Accepted ①	Acceptable
④	PSUS	Rejected	Rejected	Acceptable	Acceptable	Accepted ①	Accepted ② (see *Note*)
⑤	PSUE	Rejected	Rejected	Rejected	Rejected	Accepted ①	Accepted ② (see *Note*)
⑥	PDUB	Rejected	Rejected	Rejected	Rejected	Accepted ①	Accepted ② (see *Note*)

Pairsplit of a Hitachi TrueCopy Asynchronous volume will be returned after verification of state transition that waits until delta data is synchronized from P-VOL to S-VOL.

Note: In case of the **SSWS** state after **SVOL-SSUS-takeover**, pairresync command (from PVOL to SVOL) is rejected because the delta data for SVOL becomes dominant, and its state expect to be using -swaps(p) option of pairresync. If the pairresync command (from PVOL to SVOL) is rejected, confirm this special state using the -fc option of the pairdisplay command.

Table 2.3 Pair Status versus ShadowImage Commands

	ShadowImage Command					
	Paircreate		Pairsplit			Pairresync
Pair Status	No -split	-split	-E option	-C option	-S option	Resync
① SMPL	Accepted ②	Accepted [2] ②→④	Rejected	Rejected	Acceptable	Rejected
② COPY RCPY	Acceptable	Accepted [1] ②→④	Accepted ⑤	Accepted [1] ②→④	Accepted ①	Acceptable
③ PAIR	Acceptable	Accepted [2] ②→④	Accepted ⑤	Accepted [2] ②→④	Accepted ①	Acceptable
④ PSUS	Rejected	Acceptable	Accepted ⑤	Acceptable	Accepted ①	Accepted ②
⑤ PSUE	Rejected	Rejected	Acceptable	Rejected	Accepted ①	Accepted ②

Note: If the PVOL does not have Write in the PAIR state, then data identical with an SVOL is guaranteed. Therefore, in case of using the SVOL with the SMPL state, after stopping Write to the PVOL, generate a paired volume, and then split the paired volume after confirming that the paired volume has the PAIR status. In the PSUE state, ShadowImage does not manage differential data at the PVOL or SVOL. Therefore, pairresync issued to a pair in the PSUE state is all copy performance, but the copy progress rate returned by the **-fc** option of the pairdisplay command indicates "0%".

Note 1: The state change (②→④) is effective COPY state only that is changed without specification of -split for paircreate command.

Note 2: The (②→④) state change is displayed as PVOL_PSUS & SVOL_COPY (see display example below), and reading and writing are enabled for SVOL in SVOL_COPY state.

```
# pairsplit -g oradb
# pairdisplay -g oradb -fc
Group   PairVol(L/R) (Port#,TID,LU-M), Seq#, LDEV#.P/S, Status, %,  P-LDEV# M
oradb   oradev3(L)   (CL2-N , 3,  4-0) 8071   28..P-VOL PSUS,  100     29   W
oradb   oradev3(R)   (CL2-N , 3,  5-0) 8071   29..S-VOL COPY,   97     28   -
```

PVOL_PSUS & SVOL_COPY is the non-reflected PSUS state that data is still being copied from the P-VOL to the S-VOL, and this state has the following specific behavior.

- If you will attempt to read non-reflected data on SVOL in PVOL_PSUS & SVOL_COPY state, then HOMRCF copies non-reflected data from PVOL to SVOL, and will be returned the correct data after copied. This will brings the performance degradation (1/6 to 1/15 with IOPS) to read on the SVOL.
- If you will attempt to write non-reflected data on SVOL in PVOL_PSUS & SVOL_COPY state, then HOMRCF copies non-reflected data from PVOL to SVOL, and writing data is managed as delta data for SVOL after copied. This will brings the performance degradation (1/6 to 1/8 with IOPS) to write on the SVOL.
- If you will attempt to write to the data on PVOL that does not still reflected the data to SVOL, then HOMRCF copies non-reflected data from PVOL to SVOL, and writing data is managed as delta data for PVOL. This will brings the performance degradation (1/6 to 1/8 with IOPS) to write on the PVOL.

- The state changes for pairsplit are (WD = Write Disable, WE = Write Enable):

  If PVOL has non-reflected data in PAIR state:

Behavior of OLD pairsplit at T0	Behavior of First pairsplit at T0
T0 PVOL_PAIR ←→ SVOL_PAIR(WD)	PVOL_PAIR ←→ SVOL_PAIR(WD)
T1: PVOL_COPY ←→ SVOL_COPY(WD)	PVOL_PSUS ←→ SVOL_COPY(WE)
T2: PVOL_PSUS ←→ SVOL_SSUS(WE)	PVOL_PSUS ←→ SVOL_SSUS(WE)

  If PVOL has been reflected all data to SVOL in PAIR state:

Behavior of OLD pairsplit at T0	Behavior of First pairsplit at T0
T0: PVOL_PAIR ←→ SVOL_PAIR(WD)	PVOL_PAIR ←→ SVOL_PAIR(WD)
T1: PVOL_PSUS ←→ SVOL_SSUS(WE)	PVOL_PSUS ←→ SVOL_SSUS(WE)

- The state changes for paircreate -split are:

Behavior of OLD paircreate -split at T0	Behavior of First paircreate -split at T0
T0: SMPL ←→ SMPL	SMPL ←→ SMPL
T1: PVOL_COPY ←→ SVOL_COPY(WD)	PVOL_PSUS ←→ SVOL_COPY(WE)
T2: PVOL_PSUS ←→ SVOL_SSUS(WE)	PVOL_PSUS ←→ SVOL_SSUS(WE)

- If you will attempt the “pairevtwait -s psus” in PVOL_PSUS & SVOL_COPY state, then pairevtwait will return immediately even if the S-VOL is still in SVOL_COPY state because PVOL is already in PVOL_PSUS state. If you want to wait the “SVOL_SSUS” state, and then you must check the status of the SVol becomes “SVOL_PSUS” via the return code used “pairvolchk -ss” command on SVOL side or “pairvolchk -ss -c” command on PVOL side.
  OR you can use “pairevtwait -ss ssus” on both PVOL and SVOL, “pairevtwait -ss ssus -l” on SVOL locally.

- If you will attempt the “pairresync -restore” or “pairsplit -S” in PVOL_PSUS & SVOL_COPY state, then HOMRCF will reject this command due to unable to perform. In this case, you need to wait until the SVol state becomes “SVOL_SSUS”.

Table 2.4 Pair Status versus SnapShot Commands

	Copy-on-Write Snapshot Command					
	Paircreate		Pairsplit			Pairresync
Pair Status	No -split	-split	-E option	-C option	-S option	Resync
① SMPL	Accepted ②	Rejected	Rejected	Rejected	Acceptable	Rejected
② COPY RCPY	Acceptable	Rejected	Rejected	Rejected	Rejected	Acceptable
③ PAIR	Acceptable	Accepted* ④	Rejected	Accepted ④	Accepted ①	Acceptable
④ PSUS (PFUS)	Rejected	Acceptable	Rejected	Acceptable	Accepted ①	Accepted* ②
⑤ PSUE	Rejected	Rejected	Acceptable	Rejected	Accepted ①	Accepted* ②

Accepted*: Accepted*: A command is accepted and issued; whether this command is executed or not depends on the microcode version of the RAID storage system.

Notes:

- Pairsplit (“simplex -S”) of SnapShot volume will be returned without verification of state transition that waits until SMPL state. **In SMPL state, the volume which was SVOL becomes R/W disable and data is discarded.**
- In the “PSUE” state, SnapShot does not manage for differential data between the primary volume and secondary volume.

2.4.2 TrueCopy Async, TrueCopy Sync CTG, and Universal Replicator Volumes

Hitachi TrueCopy Asynchronous/Universal Replicator provides paired volumes which utilize asynchronous transfer to ensure the sequence of writing data between the primary volume and secondary volume. The sequence of writing data between the primary and secondary volumes is guaranteed within each consistency (CT) group (see Figure 2.9).

Restrictions:

- **Group definition of TrueCopy Async/Universal Replicator/TrueCopy Sync CTG volume:** All volumes in a group must be contained within the same storage system. If two or more groups of CCI include the same CT group (CTGID), then pair operation of the group specification is handled in CT group entirety.
- **Registration of CTGID number and limitations:** CCI registers CTGID to RAID disk array automatically when paired volumes are created by paircreate command, and groups of configuration definition files are mapped to CTGID. The maximum number of CT groups is 256 for USP V/VM and USP/NSC (CTGID0 to CTGID255), 128 for 9900V (CTGID0 to CTGID127), and 64 for 9900 (CTGID0-CTGID63) (16 for 7700E). TrueCopy Async/Universal Replicator pair command will be terminated with EX_ENOCTG when the maximum number of CT groups is exceeded.
- **Relationships between CTGID and Journal group ID:** CT group numbers 0-127 are used for TrueCopy Asynchronous, TrueCopy Sync CTG, and Universal Replicator. The rest of the CT group numbers 128-255 are used only for Universal Replicator, and are mapped to the journal groups.

Table 2.5 Assignment of CT Groups

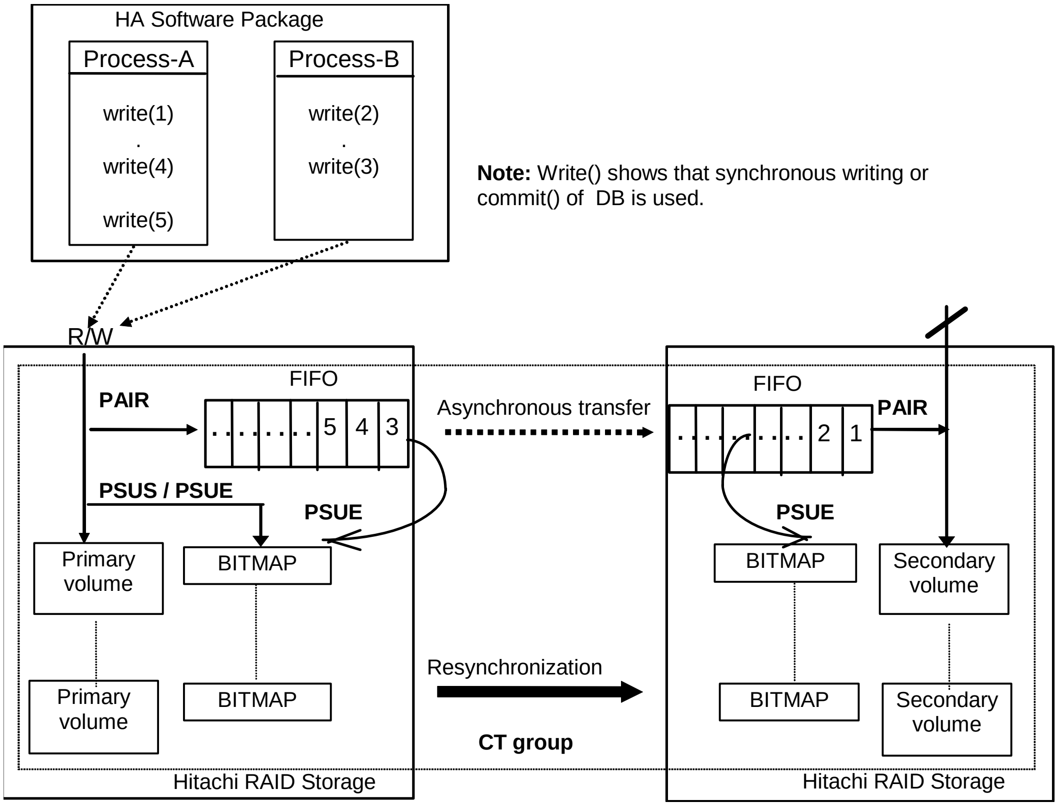
CTG	Assignment	
0 -127	TrueCopy Async TrueCopy Sync CTG	CTG 0-127
	Universal Replicator	JNG 0-127
128 - 255	Universal Replicator	JNG 128-255

- **At-time Split for TrueCopy Sync CTG:** The operation for making data consistency is only supported by the following option:
  - `pairsplit –g <group>  ... [-r]`
  - `pairsplit –g <group>  ... -rw`

TrueCopy Asynchronous/Universal Replicator volumes have the following characteristics:

- **PAIR state**: A Hitachi TrueCopy Async pair changes to the PAIR status as soon as all pending recordsets have been placed in the queue at the primary volume, without waiting for the updates to complete at the secondary volume.
- **Pair splitting**: When a TrueCopy Async pair is split or deleted, all pending recordsets at the primary volume are sent to the secondary volume, then the pair status changes to PSUS or SMPL. For pairsplit only, updates for the primary volume which occur during and after the pairsplit operation are marked on the bitmap of the primary volume.

- **Pair resynchronization**: The pairresync command resynchronizes the secondary volume based on the primary volume. This resynchronization does not guarantee the sequenced data transfer.
- **Error suspending**: Pending recordsets which have not yet been sent to the secondary volume are marked on the bitmap of the primary volume and then deleted from the queue, and then the pair status changes to PSUE.
- **Group operations**: HORCM registers CTGID to the storage system automatically when paired volumes are created by the paircreate command, and groups of configuration file are mapped to CTGID. If more than one group defined in the configuration definition file is assigned to the same CT group ID, then pair operations of the group specification apply to the entire CT group.



Note: Write() shows that synchronous writing or commit() of DB is used.

Figure 2.9 Hitachi TrueCopy Asynchronous Consistency Groups

2.4.2.1 Sidefile Cache for Hitachi TrueCopy Asynchronous

The first-in-first-out (FIFO) queue of each CT group is placed in an area of cache called the sidefile. The sidefile is used for transferring Hitachi TrueCopy Async recordsets to the RCU. The sidefile is not a fixed area in cache but has variable capacity for write I/Os for the primary volume. If the host write I/O rate is high and the MCU cannot transfer the Hitachi TrueCopy Async recordsets to the RCU fast enough, then the sidefile capacity expands gradually. The sidefile has a threshold to control the quantity of data transfer of host side write I/O. Host side write I/Os are controlled by delaying response when the sidefile exceeds the constant quantity limit on cache in the storage system (see Figure 2.10).

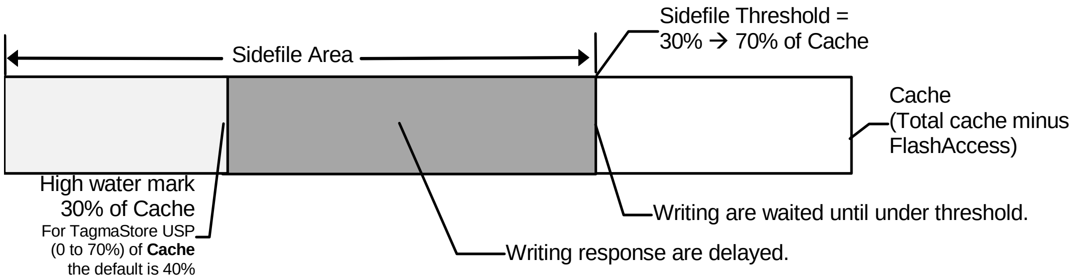


Figure 2.10 Sidefile Quantity Limit

Sidefile area: Sidefile area = 30% to 70% of cache as set on Storage Navigator (or SVP) (default sidefile = 40% for TagmaStore USP/NSC, 50% for 9900V/9900).

Write I/O control at high-water mark (HWM): When the quantity of data in sidefile reaches 30% of cache, the Hitachi TrueCopy Async pair status is HWM of PAIR state, and the host write I/Os receive delayed response in the range of 0.5 seconds to 4 seconds. Following is an arithmetic expression of the HWM at 100% of a sidefile space:

HWM(%) = High water mark(%) / Sidefile threshold (30 to 70) * 100

Write I/O control at sidefile threshold: When the quantity of data in sidefile reaches the defined sidefile area, host write I/Os are delayed until there is enough sidefile space to store the next new write data. The copy pending timeout group option is between 1 second and 255 seconds (600 for seconds for Universal Replicator). The timeout value is defined on Storage Navigator (or SVP) and specifies the maximum delay between the M-VOL update and the corresponding R-VOL update. The default timeout value is 90 seconds, 60 seconds for Universal Replicator. If the timeout occurs during this waiting state, the pair status changes from PAIR to PSUS (sidefile full), and host write I/Os continue with updates being managed by the cylinder bitmap. *Important:* The copy pending timeout value should be less than the I/O timeout value of the host system.

2.4.2.2 Hitachi TrueCopy Asynchronous Transition States

Hitachi TrueCopy Async volumes have special states for sidefile control during status transitions. Table 2.6 shows the transition states for Hitachi TrueCopy Synchronous and Hitachi TrueCopy Asynchronous volumes.

The **suspending** and **deleting** states are temporary internal states within the RAID storage system. CCI cannot detect these transition states, because these states are reported on the previous state from the storage system. These states are therefore concealed inside the pairsplit command. After the pairsplit command is accepted, host write I/Os for the P-VOL are managed by the cylinder bitmap (normal), non-transmitted data remaining in the P-VOL's FIFO queue is transferred to the S-VOL's FIFO queue, and the pair status is then set to PSUS [SMPL] state when all data in the P-VOL's FIFO queue has been transmitted.

PFUL. If the quantity of data in sidefile cache exceeds 30% of cache storage, the internal status of the RAID storage system is PFUL, and host write I/Os receive delayed response in the range of 0.5 seconds to 4 seconds.

PFUS. If the quantity of data in sidefile cache exceeds the user-defined sidefile area (30%-70%), then host write I/Os are waited for enough sidefile space to store the next new write data. If the copy pending timeout occurs during this waiting state, then the pair status changes from PAIR to PFUS, host write I/Os are accepted, and write data is managed by bitmap.

The CCI software can detect and report the PFUL and PFUS states as follows:

- As a return code of the **pairvolchk** command
- As the status code displayed to code item by the **pairmon** command
- As the paired status displayed to status item using **-fc** option of **pairdisplay** command

Table 2.6 State Table for Hitachi TrueCopy Sync vs. TrueCopy Async

CCI State	Storage System Internal State	Description			Writing Control on TC Async Vol		Transfer data via ESCON
		TC Sync	TC Async		Writing data	Response	
SMPL	SMPL	SMPL	Same		Normal	Usual	None
COPY	COPY	COPY	Same		Via Sidefile	Usual [Note 1]	Sidefile & bitmap
	Deleting	N/A	SMPL from COPY by using [pairsplit -S]		Normal	Usual	Sidefile
	Suspending	N/A	PSUS from COPY by using [pairsplit]		Via Bitmap	Usual	Sidefile
PAIR	PAIR	Synchronized	Asynchronized sidefile in use	Less than HWM	Via Sidefile	Usual	Sidefile
	PFUL	N/A		HWM to Threshold	Via Sidefile	Delayed	Sidefile
				Over Threshold	Via Sidefile	Wait until under threshold	Sidefile
	Deleting	N/A	SMPL from PAIR by using [pairsplit -S]		Normal	Usual	Sidefile
	Suspending	N/A	PSUS from PAIR	Using [pairsplit]	Via Bitmap	Usual	Sidefile
				Timeout of over threshold			
PSUS	PSUS	PSUS	Same		Via Bitmap	Usual	None
	PFUS	None	Timeout Over Threshold		Via Bitmap	Usual	None
PSUE	PSUE	PSUE	Same (Link down etc)		Via Bitmap	Usual	None
PDUB	PDUB	PDUB	Same		Via Bitmap	Usual	None

Note 1: If the host has more Write I/Os in COPY state, then host Write I/Os will be delayed until there is enough space in the sidefile.

Explanation of terms in Table 2.6:

- **Bitmap:** Host writes noted (without ordering) in a delta data bit map.
- **Normal:** Host side writing data is not managed by BITMAP or sidefile.
- **Usual:** Host side writing response is not delayed.
- **HWM (High Water Mark):** Sidefile quantity is over 30% of total cache storage (minus Cache Residency Manager usage).

(1) Suspending, [Deleting] status. These are temporary states internal to the storage system, and CCI cannot detect these states definitely because they are reported on the previous state from the storage system. Therefore these states are concealed inside of pairsplit command. After a pairsplit command has been accepted, host side write I/O for primary volume will be managed by the BITMAP[NORMAL]: non-transmitted data which remains in the FIFO queue of the primary volume is transferred to FIFO queue of the secondary volume, and pair status will be set to “PSUS” [“SMPL”] state when data transfer is complete.

(2) PFUL status. If sidefile quantity is over 30% of cache storage, then internal status of the storage system is “PFUL”, and host side write I/O is being with delayed response of range from 0.5 seconds (minimum) to 4 seconds (maximum).

2.4.2.3 TrueCopy Async/Universal Replicator ERROR State

In the case of an ESCON or fibre-channel (FC) failure, the S-VOL FIFO queue is missing a data block that was transferred from the P-VOL FIFO queue. The RCU waits to store the next sequenced data block in the S-VOL FIFO queue until the TrueCopy Async copy pending timeout occurs (defined using Hitachi TrueCopy remote console software). If the timeout occurs during this waiting state, the pair status is changed from PAIR to PSUE, and non-sequenced data blocks are managed by the S-VOL bitmap. The missing data block can be recovered using the pairresync command, which merges the S-VOL bitmap with the P-VOL bitmap, shows its situation on the secondary side.

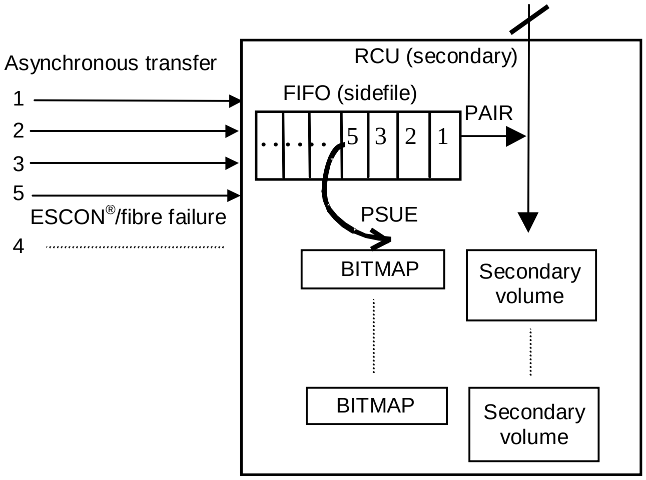
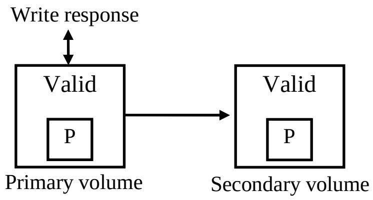
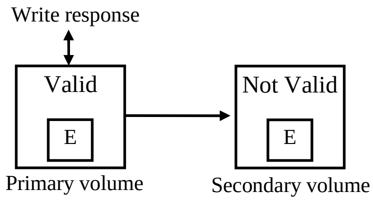
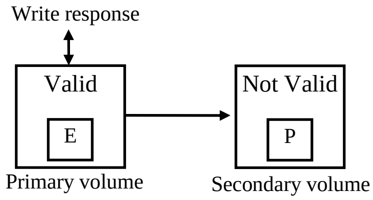


Figure 2.11 Hitachi TrueCopy Async Suspension Condition

2.4.3 TrueCopy Sync/Async and Universal Replicator Fence-Level Settings

Hitachi TrueCopy volume pairs are assigned a fence level for write I/Os to ensure the mirroring consistency of critical volumes. Accordingly, when the secondary volume takes over from the primary volume, the takeover action is determined according to the pair status and fence level of the corresponding secondary volume. Table 2.7 shows the relationship between Hitachi TrueCopy pair status and fence level.

Table 2.7 Relationship between Hitachi TrueCopy Pair Status and Fence Level

	Fence Level and Write Response			
Hitachi TrueCopy Pair Status of Volume	Data [1]	Status [2]	Never [3]	Async [4]
	OK	OK	OK	OK
	Mirroring consistency assured	Mirroring consistency assured	Mirroring consistency assured	Data consistency assured
	ERROR	OK	OK	OK
	Mirroring consistency assured	Mirroring consistency not assured	Mirroring consistency not assured	Data consistency assured
	ERROR	ERROR	OK	OK
	Mirroring consistency assured	Mirroring consistency assured	Mirroring consistency not assured	Data consistency assured

Mirror consistency = Identity of data and sequence of data are assured via error notification as an I/O completion.
Data consistency = Sequence of data is assured in I/O order based on host.

[1] When fence level is **data**: Mirroring consistency is assured, since a write error is returned if mirror consistency with the remote SVOL is lost. The secondary volume can continue operation, regardless of the status. *Note:* A PVOL write that discovers a link down situation will, in addition to returning an error to the host, likely be recorded on [only] the PVOL side.

[2] When fence level is **status**: If there is a mirror consistency problem (i.e., PSUE) and it is possible to set the SVOL to PSUE, the PVOL write completes OK. If the SVOL cannot be set to PSUE for any reason, the PVOL write completes with an error. The mirror consistency of the SVOL depends on its status:

- **PSUE:** The secondary volume is dubious.
- **PAIR:** The secondary volume can continue operation.

[3] When fence level is **never**: Writing to the PVOL is still enabled in the state where mirror consistency to the SVOL is lost, regardless of whether the secondary volume status is updated or not. Thus, the secondary could have these states:

- **PSUE:** The secondary volume is dubious.
- **PAIR:** The secondary volume is substantially dubious, since it can continue operation and is also dubious. The P-VOL status must be checked to confirm the mirroring consistency.

[4] When fence level is **async**: TrueCopy Async/Universal Replicator uses asynchronous transfers to ensure the sequence of write data between the PVOL and SVOL. Writing to the PVOL is enabled, regardless of whether the SVOL status is updated or not. Thus the mirror consistency of the secondary volume is dubious (similar to “Never” fence):

- **PSUE:** The SVOL mirroring consistency is not assured, but the PSUE suspended state ensures the sequence of data for the CT group, thus data consistency is also assured during PSUE state. At PSUE state, PVOL writes still complete and are also noted in a bitmap for future transfer. Due to use of bitmap in suspend state, data consistency is not assured during a copy state resync.
- **PAIR:** If the PVOL and SVOL are both PAIR state, mirror consistency is not assured (may be behind) but data consistency is assured (what has reached the SVOL is in the proper order).

2.4.3.1 How to Set the Fence Level

Figure 2.12 shows the relations between redo log files (journal) and data files. If the S-VOL takes over from the P-VOL in the status shown in Figure 2.12 (where two errors have occurred), the secondary host leaves data (V) unprocessed in the roll-back processing and cannot be recovered completely. Therefore, the fence level of a redo log file must be defined as data. Once the fence level is set to data, the P-VOL returns an error if data may possibly be inconsistent when a write request is issued by the host. Since the writing into the data file has not been executed due to a write error of the redo log file, the log file stays consistent with the data file. However, when the fence level is set to data, a write I/O error occurs even in the case where operation is suspended due to an error in the S-VOL. Accordingly, the duplication becomes meaningless when the S-VOL takes over. Thus, applications using paired volumes with the data fence level should be able to handle write I/O errors properly. For example, the Oracle application creates multiple redo log files by itself (three by default). The fence level can be set to data in this case in which disk errors are permissible by creating multiple file.

Since most UNIX file systems (excluding JFS and VxFS) have no journal files, the fence level should be defined as Never. When a takeover by the S-VOL occurs, fsck is executed on the volume and the file system is cleaned up, even if the S-VOL is undefined at the secondary host. The data that will be lost depends on how much differential data is contained in the P-VOL when the S-VOL is suspended. During operation, error recovery should be performed when the suspended status (PSUE or PDUB) is detected (when one error occurs).

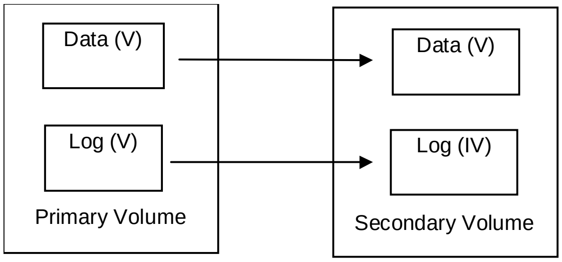


Figure 2.12 Relation between Logs and Data in Paired Status

2.5 Applications of Hitachi TrueCopy/ShadowImage Commands

This section provides examples of tasks which can be performed using Hitachi TrueCopy and/or ShadowImage commands (see Figure 2.12 - Figure 2.17):

- Back up secondary volume in paired status (TrueCopy or ShadowImage)
- Restore secondary volume to primary volume in split status (TrueCopy or ShadowImage)
- Swapping paired volume for duplex operation (TrueCopy only)
- Restoring secondary volume for duplex operation (TrueCopy only)

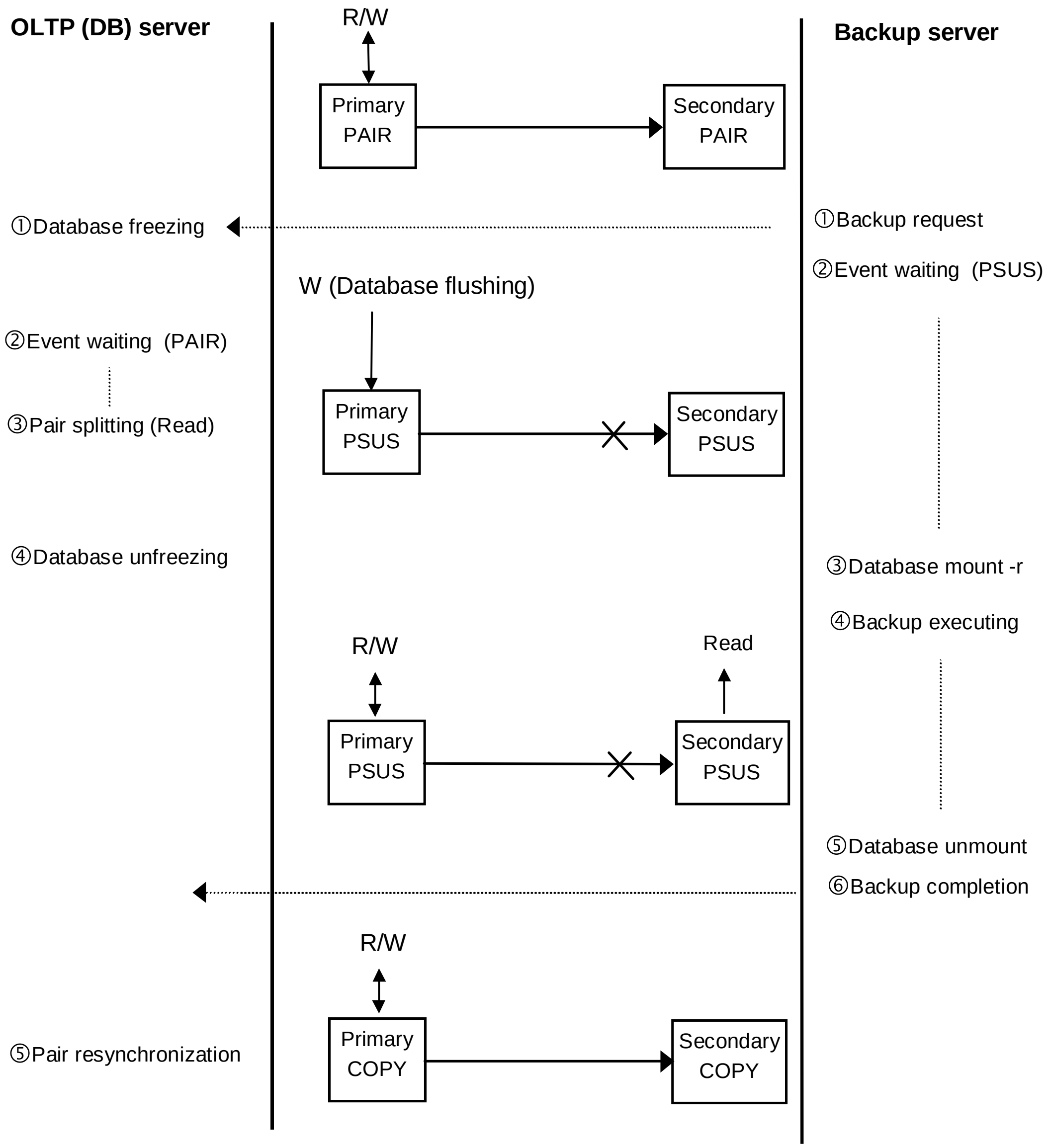


Figure 2.13 Backing Up S-VOL in Paired Status Using Hitachi TrueCopy

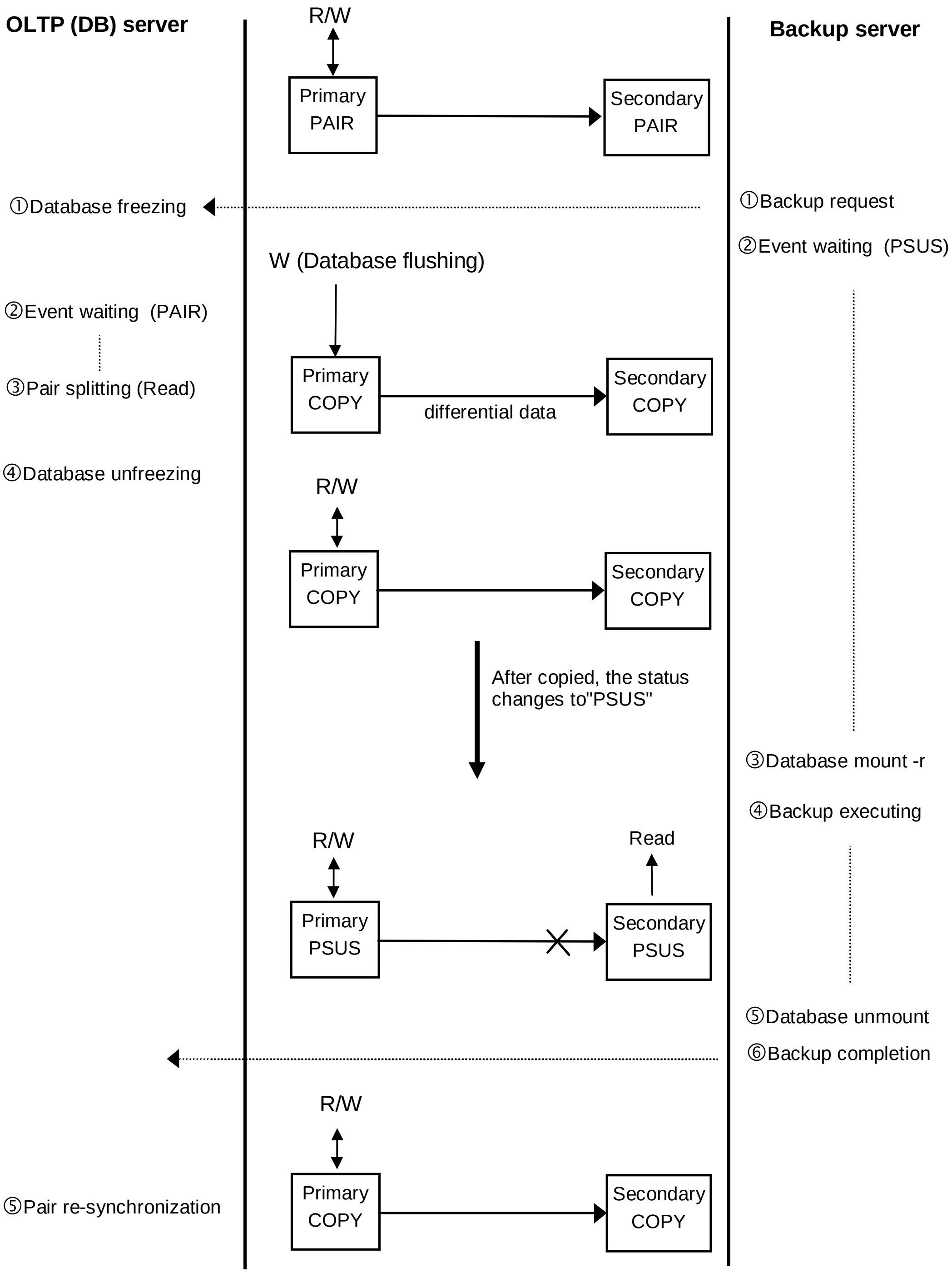


Figure 2.14 Backing Up S-VOL in Paired Status Using ShadowImage

Note: When you issue the pairsplit command to a ShadowImage paired volume, the pair status changes to COPY, and the differential data due to asynchronous copy is copied to the secondary volume. When this copy is finished, the pair status changes to PSUS. The primary volume remains write-enabled throughout the pairsplit operation (COPY and PSUS status).

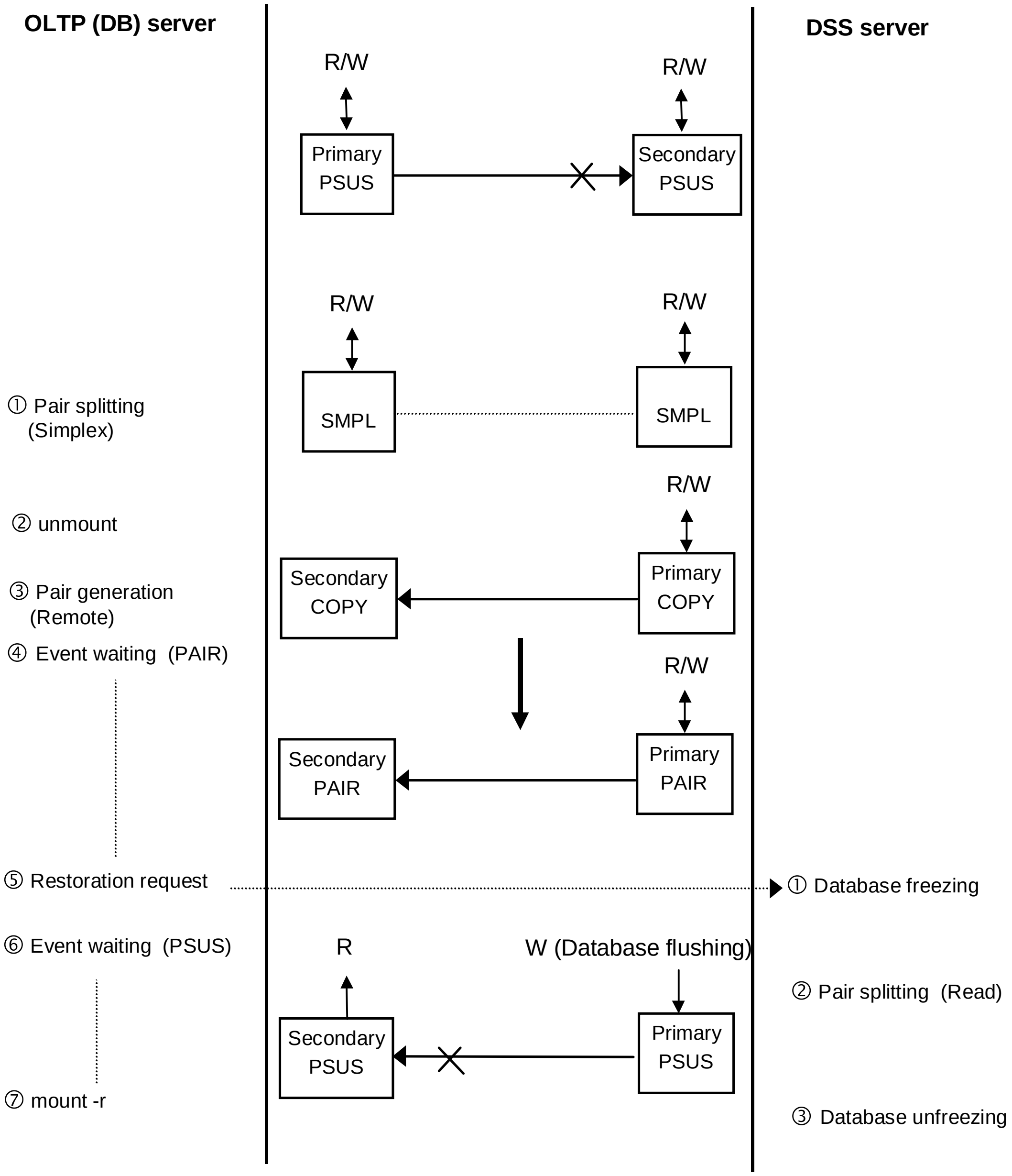


Figure 2.15 Restoring S-VOL to P-VOL in Split Status Using Hitachi TrueCopy

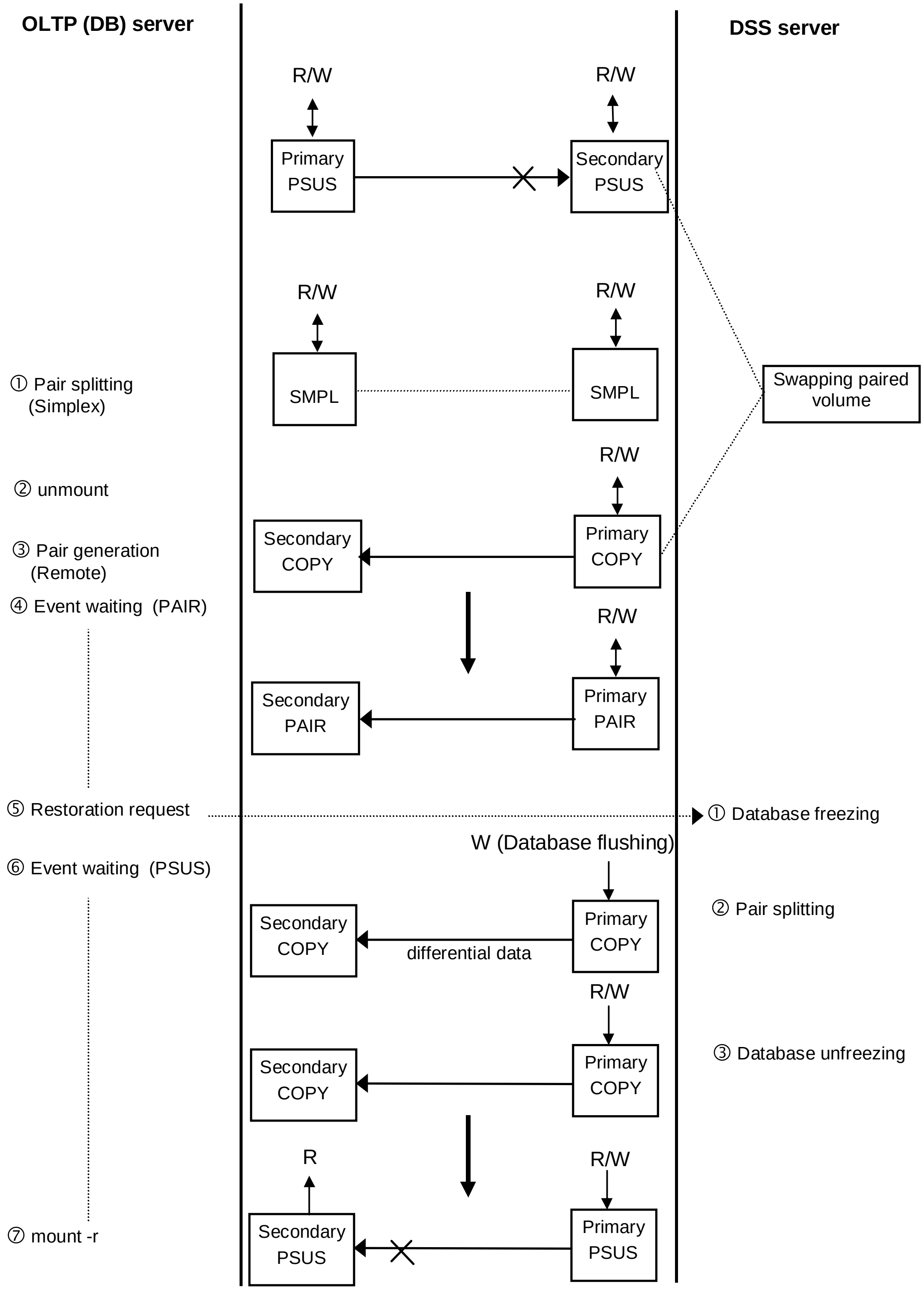


Figure 2.16 Restoring S-VOL to P-VOL in Split Status Using ShadowImage

Note: When a swap of the primary/secondary is performed, only one paired volume is possible.

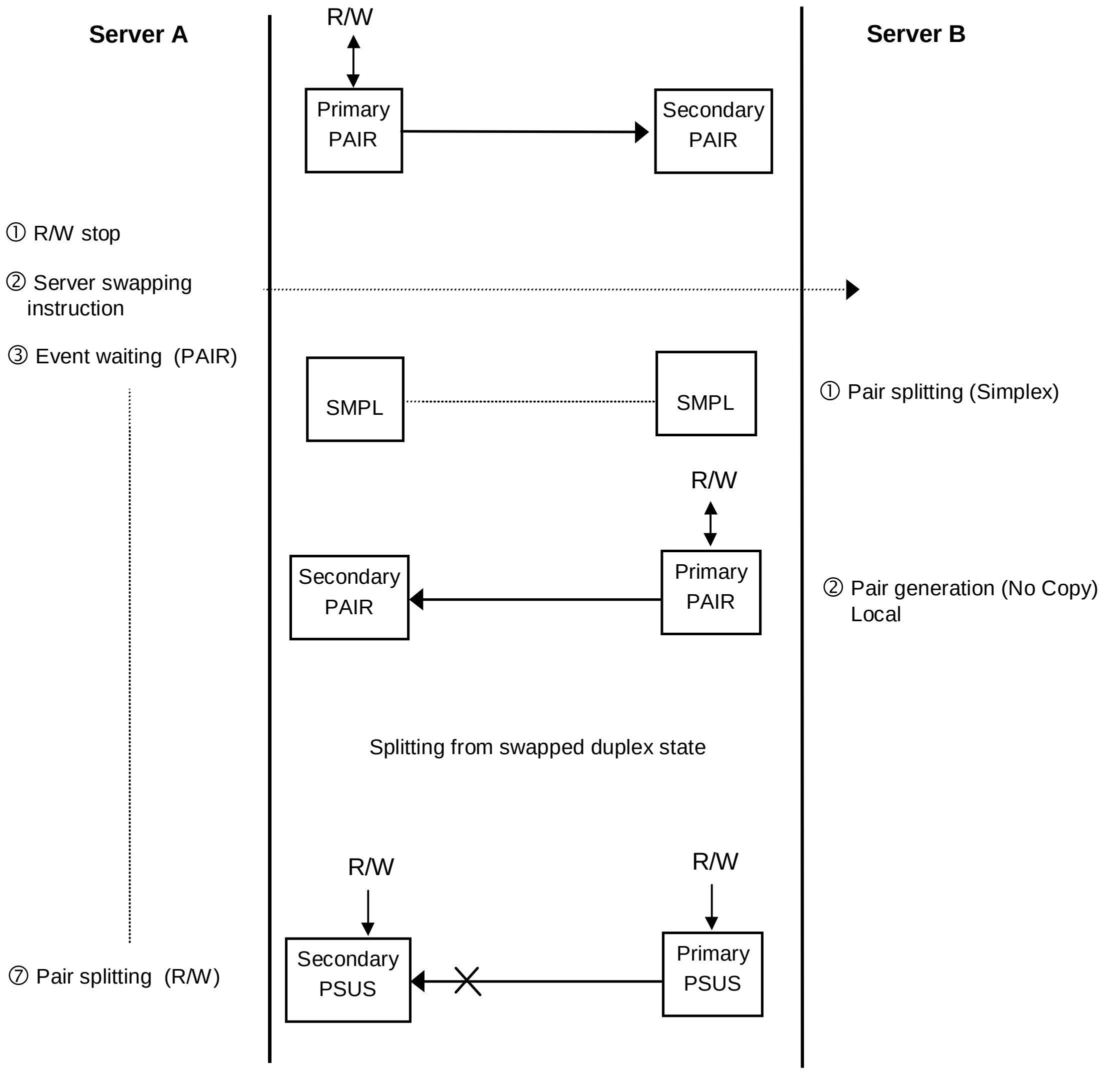


Figure 2.17 Swapping Paired Volume for Duplex Operation — Hitachi TrueCopy Only

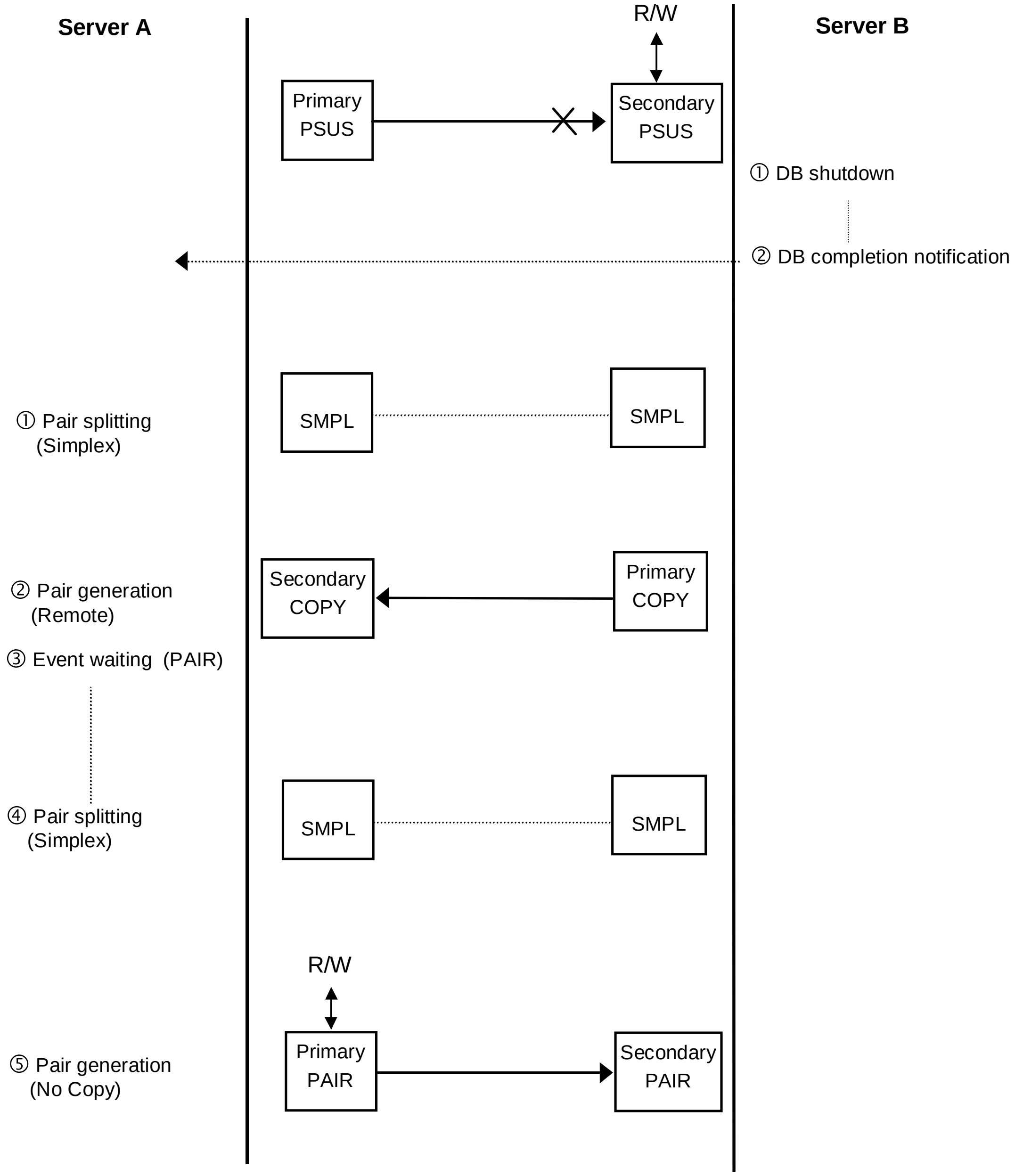


Figure 2.18 Restoring S-VOL for Duplex Operation (Hitachi TrueCopy Only)

2.6 Overview of Copy-on-Write Snapshot Operations

Copy-on-Write Snapshot normally creates virtual volumes for copying on write without specifying LUNs as S-VOLs. However, to use a SnapShot volume via the host, it is necessary to map the SnapShot S-VOL to a LUN. Therefore, CCI provides a combined command to enable the user or APP to use the same CCI command in order to maintain the compatibility of ShadowImage.

SnapShot uses two techniques called V-VOL mapping and SnapShot using copy on write. Also SnapShot volumes are put into pooling volumes called SnapShot pool, and the SnapShot pool are specified as pool ID when a SnapShot is made. The SnapShot and volume mapping is illustrated in Figure 2.19.

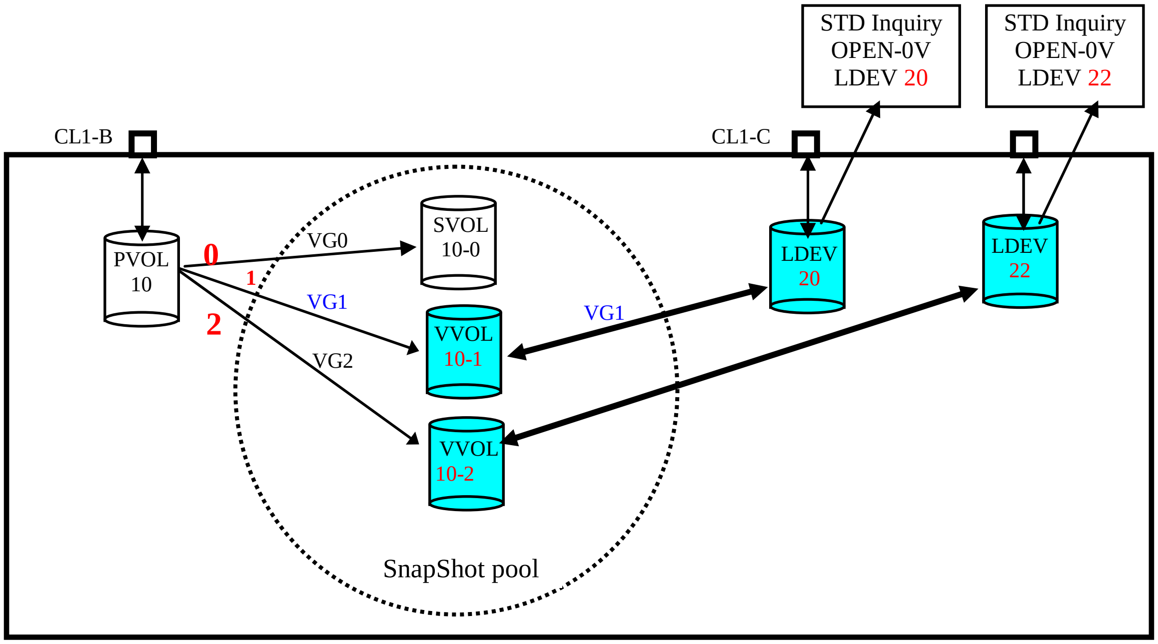


Figure 2.19 Copy-on-Write Snapshot and Volume Mapping

2.6.1 Creating SnapShot

The CCI command for creating a COW SnapShot pair is the same as for ShadowImage. The RAID storage system determines whether the pair is a ShadowImage or SnapShot pair by the LDEV attribute of the S-VOL. A SnapShot pair is generated in the following two cases.

- When V-VOL unmapped to the S-VOL of SnapShot called OPEN-0V is specified as S-VOL.
- When S-VOL is not specified.

The V-VOL has the following characteristic.

- It is displayed as "OPEN-0V" to identify V-VOL easily via SCSI Inquiry or CCI.
- V-VOL unmapped to the S-VOL of SnapShot will reply to SCSI Inquiry, but Reading and/or Writing will not be allowed. LDEV will reply the capacity setting as an LU to SCSI Read Capacity.
- V-VOL became the S-VOL of SnapShot will reply to SCSI Inquiry, and Reading and/or Writing will be allowed.

2.6.2 SnapShot Volume Specifications

- Allowable type of paired volume: The supported volume type is OPEN-V only for P-VOL, and OPEN-0V for S-VOL.
- Number of volumes (SnapShot) can be paired: This depends on P-VOL capacity, SnapShot pool capacity, and shared memory capacity on the RAID storage system.
- Duplicated writing mode: Copying on write.
- Number of mirror volumes: Up to 64 secondary volumes can be defined for each P-VOL.

2.6.3 SnapShot Volume Characteristics

Each paired volume consists of a primary volume (P-VOL) and a secondary volume (S-VOL). Each volume has the status for controlling the state concerning the pairing.

The P-VOL controls the pairing state which is reflected on the status of the S-VOL. The major pairing statuses are "SMPL", "PAIR", "PSUS", "COPY", and "RCPY". The status is changed when the CCI command is issued. A read or write request from the host is allowed or rejected according to the status.

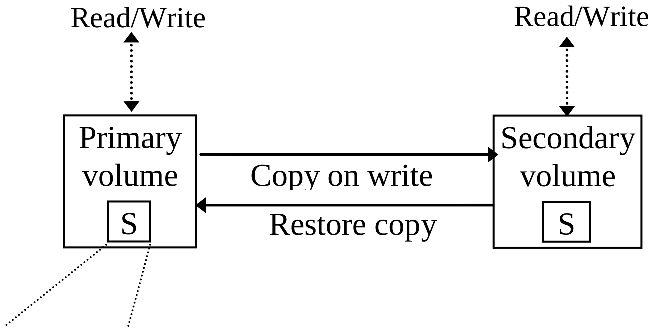


Table 2.8 SnapShot Pairing Status

Status	Pairing Status	Primary	Secondary
SMPL	Unpaired (SnapShot) volume	R/W enabled	R/W disable (*Note 1*)
PAIR (PFUL)	The snapshot available state allocated the resource.	R/W enabled	R/W disable
COPY	The preparing state allocates the resource for the snapshot.	R/W enabled	R/W disable
RCPY	The copying state from snapshot to the primary volume by using restore option.	R/W disable	R/W disable
PSUS (PFUS)	The differences of the updated data of the primary and secondary volume are controlled with copying on write.	R/W enabled	R/W enabled
PSUE (Error)	"PSUS" status owing to an internal failure. The differences of the updated data for the snapshot volume are not controlled.	R/W enabled (*Note 2*)	R/W disable

Note 1: V-VOL unmapped to the SVOL of SnapShot will reply to SCSI Inquiry, but Reading and/or Writing will not be allowed.

Note 2: Reading and writing are enabled, as long as no failure occurs in the primary volume.

2.7 Overview of CCI Data Protection Operations

User data files are normally placed to a disk through some software layer such as file system, LVM, diskdriver, SCSI protocol driver, bus adapter, and SAN switching fabric. Data corruption can happen on above software bugs and human error as follows. The purpose of Data Protection is to prevent writing to volumes by RAID storage system guarding the volume.

The CCI Data Protection functions include:

- Database Validator (sections 2.7.1, 2.7.2). For further information on Database Validator, please refer to the *Database Validator Reference Guide* for the storage system.
- Data Retention Utility (DRU) (called “Open LDEV Guard” on 9900V/9900) (sections 2.7.3 and 2.7.4). For further information on Data Retention Utility, please refer to the *Data Retention Utility User’s Guide* for USP V/VM and USP/NSC (*Open LDEV Guard User’s Guide* for Lightning 9900V and 9900).

2.7.1 Database Validator

The purpose of Database Validator (9900V and later) is to prevent data corruption by checking Oracle data validation before ORACLE data block is written on a disk.

- **Data Block corruption**: Oracle data is corrupted by some intervening software layer and hardware components. The RAID storage system can check the validity of the data block before the Oracle DataBlock is written to disk.
- **Data Block address corruption**: The OS (file system, LVM, Diskdriver) may write blocks to the wrong location. The RAID storage system can check the validity of the data block address to verify that the Oracle DataBlock is written to the correct location on disk.
- **Protection of Oracle volume**: Oracle datafiles might be overwritten by a non-Oracle application or by human operation using a command. The RAID storage system can protect volumes storing Oracle files to prevent the volumes from being modified by another application or by human error.

Note: For information on error monitoring for Database Validator, see section 2.10.2.

2.7.2 Restrictions on Database Validator

- **Oracle Tablespace Location**
  - File system-based Oracle files are not supported by DB Validator. All Oracle tablespace files must be placed on raw volumes (including LVM raw volumes) directly.
  - If host-based striping is used on the raw volumes, then the stripe size must be an exact multiple of the Oracle block size.
  - Oracle redo log files (including archive logs) must be on separate volumes with respect to the data files (including control files) to different LU. In other words, Oracle redo log files and the data files must not be mixed on the same LU.
- **Restoring of Oracle Files**
  - Before restoring Oracle data files from a backup, the data validation may need to be temporarily turned off for those data files that were backed up prior to the Oracle checksum being enabled.

    Old blocks may exist on disk without checksum information in them if the database was running without checksum enabled in the past.
- **Oracle on LVM (VxVM)**
  - LVM block size must be a multiple of the Oracle block size. The Oracle block size must be less than or equal to the minimum of the LVM stripe size and the largest block size that LVM will not fracture (known as “Logical Track Group” in LVM), which is 256 KB in LVM.
  - When adding new physical volumes (PVs) to a logical volume (LV) to be used as an Oracle datafile, controlfile, or online log, in order to have HARD checking take effect on those new PVs, the data validation should be re-enabled.

    Similarly, in order to have HARD checking no longer performed on PVs that have been removed from an LV that had previously been used by Oracle, HARD checking should be explicitly disabled on the device corresponding to the PV.
  - If host-based mirroring is used such as LVM mirroring, all component PV mirrors must be HARD-enabled, otherwise the entire logical volume (LV) is exposed. That is, if a user takes an unmirrored HARD-enabled LV, then makes it mirrored on the fly without HARD-enabling all sides of the mirror, that entire LV is exposed to data corruption.
  - LVM bad block relocation will not be allowed on PVs that are HARD-enabled.
- **Oracle and LVM (VxVM) on HA Cluster Server**
  - If HA Cluster software will be writing to LVM metadata at regular intervals in order to confirm whether its disks are available or not, then its LVM’s area must be out of checking for Database Validator by using “-vs <bsize> SLBA ELBA” option.

2.7.3 Data Retention Utility/Open LDEV Guard

The purpose of Data Retention Utility (DRU) (Open LDEV Guard on 9900V) is to prevent writing to volumes by RAID storage system guarding the volume. DRU is similar to the command that supports Database Validator, setting a protection attribute to the specified LU.

- **Hiding from Inquiry command.** The RAID storage system conceals the target volumes from SCSI Inquiry command by responding “unpopulated volume” (0x7F) to the device type.
- **SIZE 0 volume.** The RAID storage system replies with “SIZE 0” to the target volumes through SCSI Read capacity command.
- **Protection of reading.** The RAID storage system protects from reading the target volumes by responding the check condition of “Illegal function” (SenseKey = 0x05, SenseCode = 0x2200).
- **Protection of writing.** The RAID storage system replies with “Write Protect” in Mode sense header, and protects from writing the target volumes by responding the check condition of “Write Protect” (SenseKey=0x07, SenseCode=0x2700).
- **SVOL Disabling.** The RAID storage system protects from becoming the SVOL through pair-creation.

2.7.4 Restrictions on Data Retention Utility Volumes

- **File systems using Data Retention Utility (Open LDEV Guard)**
  - When using the UNIX file system volumes as the DRU/Open LDEV Guard, the volumes must be mounted with Read Only option by setting the DRU/Open LDEV Guard after the volumes are unmounted.
  - In case of Windows 2003/2008 file system, you have to use "-x mount" and "-x umount" option of CCI commands with above procedures.
  - DRU/Open LDEV Guard volumes set to Write Protect Mode (Read ONLY) cannot be used for the file system (NTFS, FAT) on Windows OS.
- **LVM (VxVM) on Data Retention Utility (Open LDEV Guard)**
  - When operating the LVM volumes to be used by DRU/Open LDEV guard, LVM commands may be writing the volumes, and then DRU/Open LDEV Guard should be re-enabled.
- **Data Retention Utility (Open LDEV Guard) in HA Cluster Server**
  - If HA Cluster software will be writing to the metadata at regular intervals in order to confirm whether its disks are available or not, then DRU/Open LDEV Guard should not be used in HA environments.
- **Dynamic disk on Windows systems**
  - DRU/Open LDEV Guard volumes cannot be used to the dynamic disk, because the dynamic disk does not handle the volumes set to Write Protect Mode (Read ONLY). DRU/Open LDEV Guard volumes must be used for the Basic disk only.
- **LUN#0**
  - Some operating systems cannot recognize LUNs over LUN#1, if LUN#0 is set to the "inv" as the attribute of DRU/OpenLDEV Guard. This is because some HBA drivers do not scan all LUNs on a port, if LUN#0 is invisible.

2.7.5 Operations

The Hitachi storage systems (9900V and later) have parameters for the protection checking to each LU, and these parameters are set through the command device by CCI. CCI supports the following commands in order to set and verify the parameters for the protection checking to each LU:

- **raidvchkset** (see section 4.12.1)

  This command sets the parameter for the protection checking to the specified volumes.

- **raidvchkdsp** (see section 4.12.2)

  This command shows the parameter for the protection checking on the specified volumes based on CCI configuration definition file.

- **raidvchkscan** (see section 4.12.3)

  This command shows the parameter for the protection checking on the specified volumes based on the **raidscan** command.

- **raidvchkscan** (for the journal status of Universal Replicator) (see section 4.12.4)

  This command is used to discover the journal volume list setting via SVP within the storage system. It also displays any information for the journal volume.

2.8 CCI Software Structure

Figure 2.20 illustrates the CCI software structure: the CCI components on the RAID storage system, and the CCI instance on the UNIX/PC server. The CCI components on the storage system include the command device(s) and the Hitachi TrueCopy and/or ShadowImage volumes. Each CCI instance on a UNIX/PC server includes:

- HORC Manager (HORCM):
  - Log and trace files
  - A command server
  - Error monitoring and event reporting files
  - A configuration management feature
- Configuration definition file (defined by the user)
- The Hitachi TrueCopy and/or ShadowImage user execution environments, which contain the TrueCopy/ShadowImage commands, a command log, and a monitoring function.

2.8.1 HORCM Operational Environment

The HORCM operates as a daemon process on the host server and is activated automatically when the server machine starts up or manually by the start-up script. HORCM refers to the definitions in the configuration file when it is activated. The environmental variable HORCM_CONF is used to define the configuration file to be referenced.

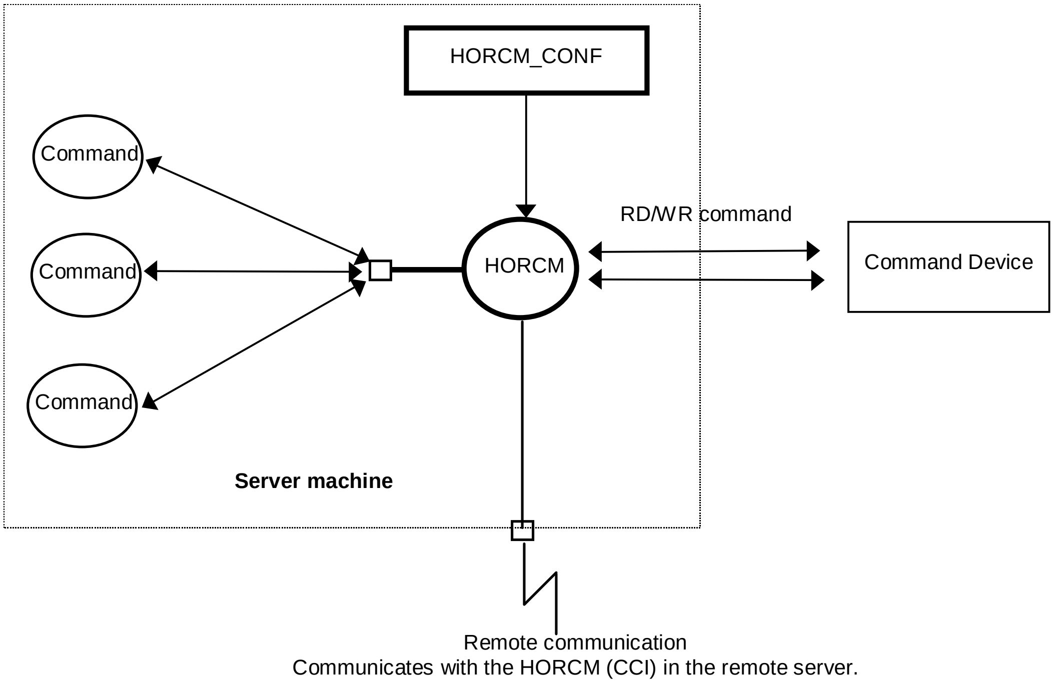


Figure 2.20 HORCM Operational Environment

2.8.2 CCI Instance Configurations

The basic unit of the CCI software structure is the CCI instance. Each copy of CCI on a server is a CCI instance. Each instance uses a defined configuration file to manage volume relationships while maintaining awareness of the other CCI instances. Each CCI instance normally resides on one server (one node). If two or more nodes are run on a single server (e.g., for test operations), it is possible to activate two or more instances using instance numbers. The CCI command, Hitachi TrueCopy or ShadowImage, is selected by the environment variable (HORCC_MRCF). The default command execution environment for CCI is Hitachi TrueCopy.

The CCI instance shown in Figure 2.21 has a remote execution link and a connection to the RAID storage system. The remote execution link is a network connection to another PC to allow you to execute CCI functions remotely. The connection between the CCI instance and the storage system illustrates the connection between the CCI software on the host and the command device. The command device accepts TrueCopy and ShadowImage CCI commands and communicates read and write I/Os between the host and the volumes on the storage system. The host does not communicate Hitachi TrueCopy or ShadowImage commands directly to the volumes on the storage system. The CCI commands always go through the command device.

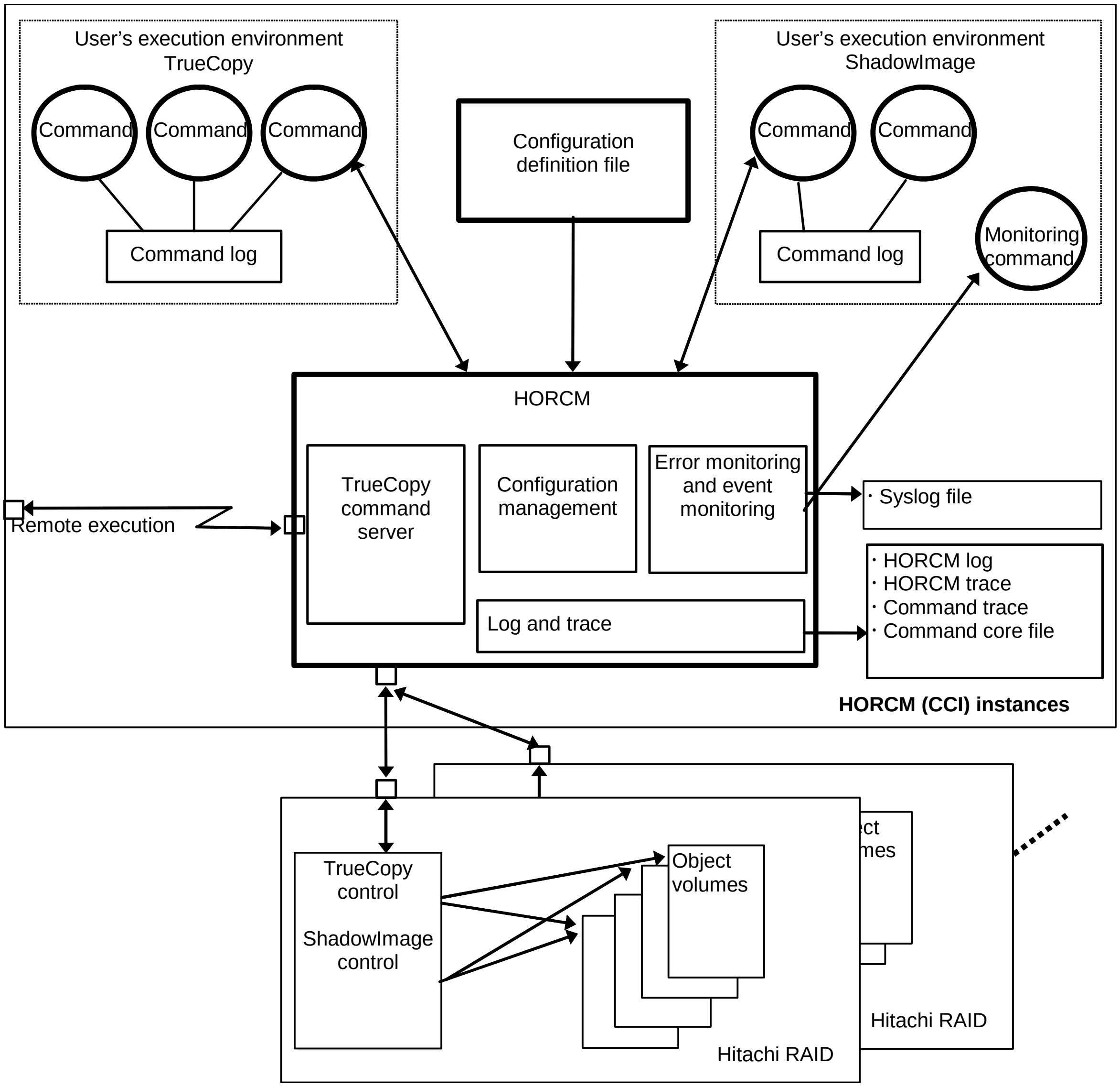


Figure 2.21 CCI Software Structure

Connecting the host to one storage system allows you to maintain multiple copies of your data for testing purposes or offline backup. Connecting the host to two storage systems enables you to migrate data or implement disaster recovery by maintaining duplicate sets of data in two different storage systems. You can implement disaster recovery solutions by placing the storage systems in different geographic areas. Having two attached hosts, one for the primary volume and one for the secondary volume, allows you to maintain and administer the primary volumes while the secondary volumes can be taken offline for testing. Two hosts connected to two storage systems also allows the most flexible disaster recovery plan, because both sets of data are administered by different hosts, which guards against storage system as well as host failure.

The four possible CCI instance configurations are:

- **One host connected to one storage system**. Each CCI instance has its own operation manager, server software, and scripts and commands, and each CCI instance communicates independently with the command device. The RAID storage system contains the command device which communicates with the CCI instances as well as the primary and secondary volumes of both CCI instances.
- **One host connected to two storage systems**. Each CCI instance has its own operation manager, server software, and scripts and commands, and each CCI instance communicates independently with the command device. Each RAID storage system has a command device which communicates with each CCI instance independently. Each storage system contains the primary volumes of its connected CCI instance and the secondary volumes of the other CCI instance (located on the same host in this case).
- **Two hosts connected to one storage system**. The CCI instances are connected via the LAN so that they can maintain awareness of each other. The RAID storage system contains the command device which communicates with both CCI instances and the primary and secondary volumes of both CCI instances
- **Two hosts connected to two storage systems**. The CCI instances are connected via the LAN so that they can maintain awareness of each other. Each RAID storage system has a command device which communicates with each CCI instance independently. Each storage system contains the primary volumes of its connected CCI instance and the secondary volumes of the other CCI instance (located on a different host in this case).

2.8.3 Host Machines that Can be Paired

Host machines are combined when a paired logical volume is defined, provided the host machines run on the operating system (OS) of the same architecture. This is because the host machine may be incapable of recognizing the paired volume of another host, although the HORC management of them runs properly.

As a particular application uses HORC, users sometimes use HORC volume as the retention volume for the data backup of the server. In this case, RAID Manager requires that the RAID Manager instance corresponds to each OS platform that is located on the secondary site for the pair operation of data backup on the primary servers of each OS platform.

However, it is possible to prepare only one server at a secondary site by supporting RAID Manager communications among different OSs (including the converter for “little-endian” vs “big-endian”).

Figure 2.22 represents RAID Manager’s communication among different OSs, and Table 2.9 shows the supported communication (32-bit, 64-bit, MPE/iX) among different OSs. Please note the following terms that are used in the example:

- **RM-H**: RAID Manager instance setting HORCMFCTBL environment variable for HP-UX on Windows
- **RM-S**: RAID Manager instance setting HORCMFCTBL environment variable for Solaris on Windows

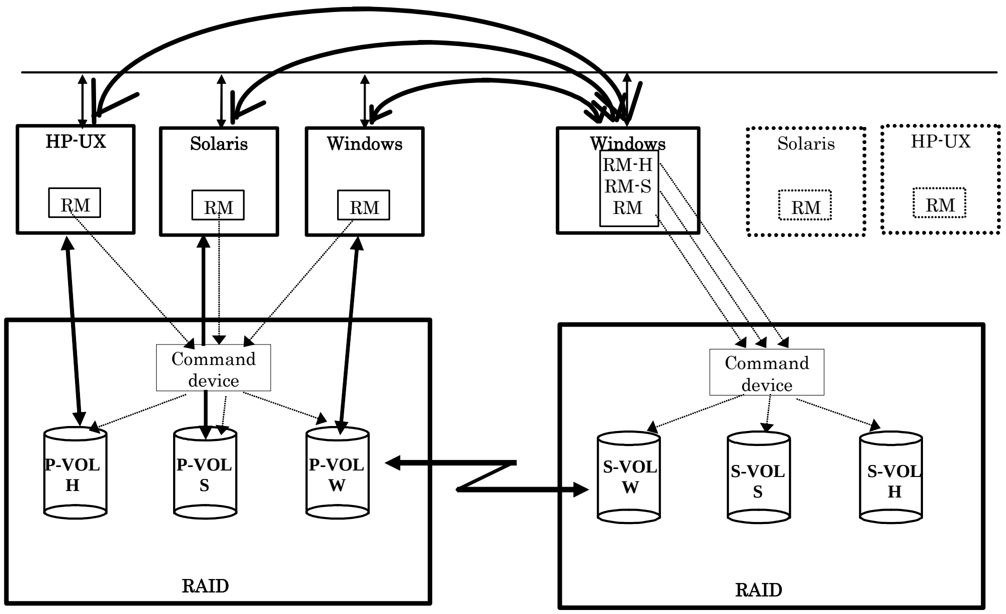


Figure 2.22 RAID Manager Communication Among Different Operating Systems

Table 2.9 Supported HORCM Communication

		HORCM				
		32 bit		64 bit		MPE/iX
HORCM		little	big	little	big	big
32 bit	little	AV	AV	AV		AV
	big	AV	AV	AV		AV
64 bit	little	AV	AV	AV		NA
	big					
MPE/iX	big	AV	AV	NA		AV

Restriction: RAID Manager for MPE/iX cannot communicate with 64bit HORCM.

Restriction: RAID Manager's communications among different operating systems is supported on HP-UX, Solaris, AIX®, Linux®, and Windows (except for Tru64™ UNIX (Digital UNIX)). Also, RAID Manager does not require that the HORCMFCTBL environment variable is set—except for RM-H and RM-S instances (to ensure that the behavior of the operating system platform is the same across different operating systems).

2.8.4 Configuration Definition File

The CCI configuration definition file is the text file which defines connected hosts and the volumes and groups known to the CCI instance. Physical volumes (special files) used independently by the servers are combined when paired logical volume names and group names are given to them. The configuration definition file describes the correspondence between the physical volumes used by the servers and the paired logical volumes and the names of the remote servers connected to the volumes. See section 2.9 for sample CCI configurations and their configuration definition file(s). See section 3.4 for instructions on creating the CCI configuration file.

Figure 2.23 illustrates the configuration definition of paired volumes. Figure 2.24 shows a sample configuration file for a UNIX-based operating system. Figure 2.25 shows a sample configuration file for a Windows operating system.

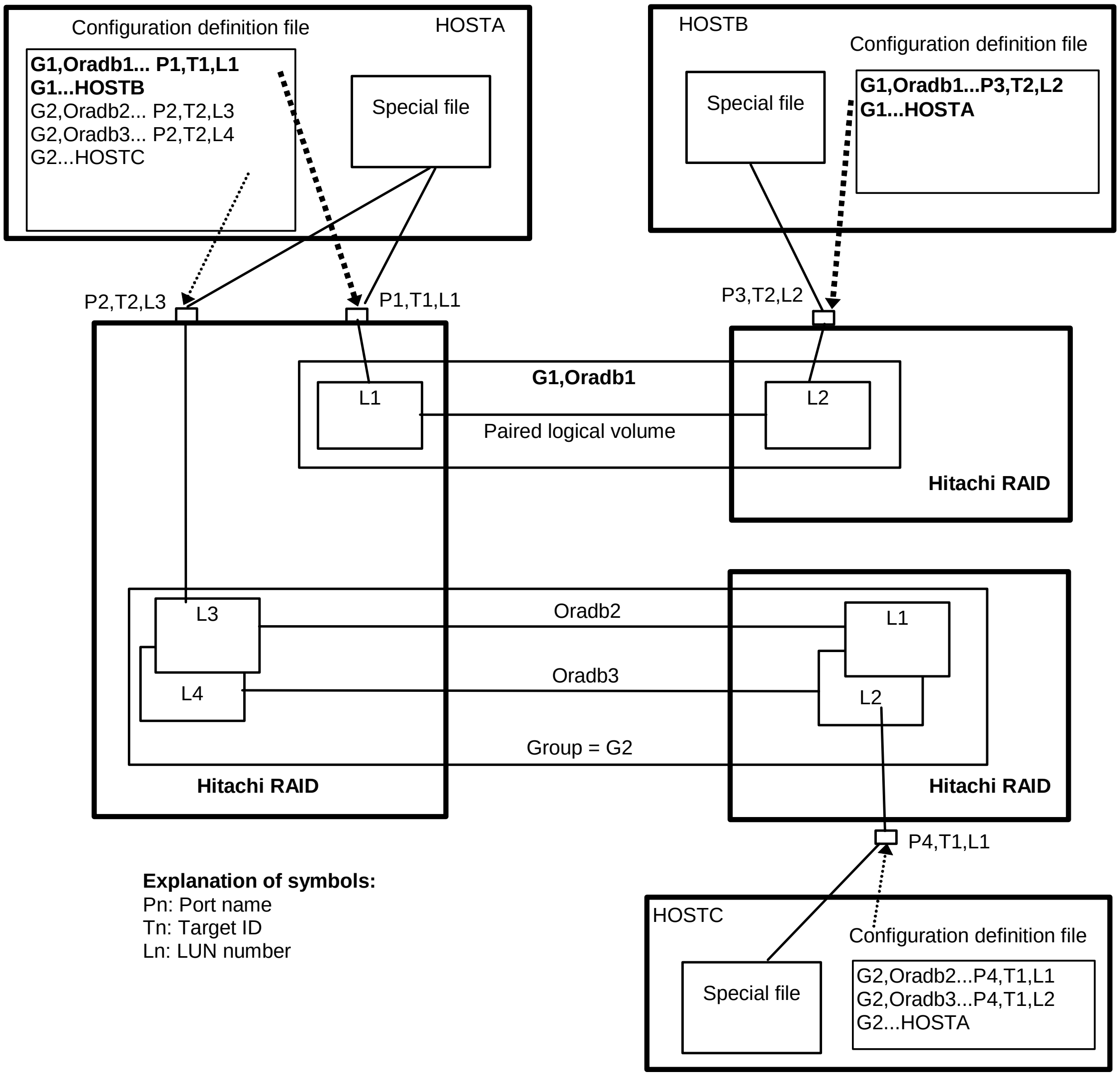
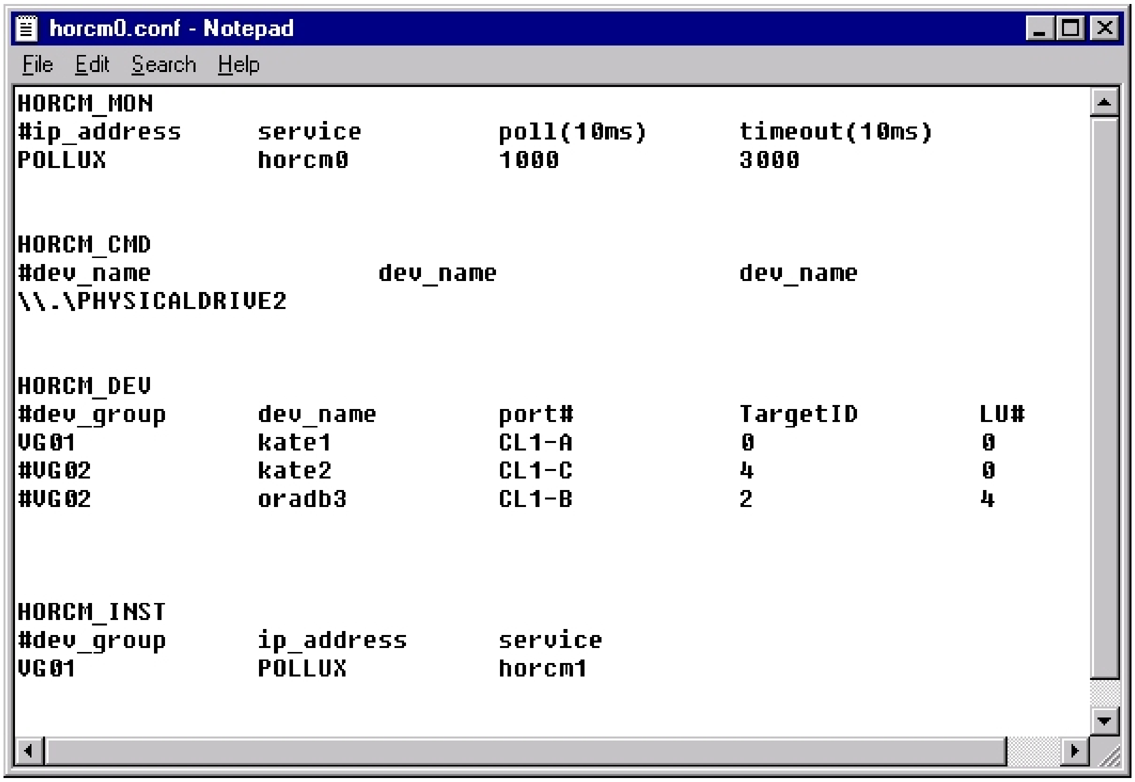


Figure 2.23 Configuration Definition of Paired Volumes

```
HORCM_MON
#ip_address  service         poll(10ms)     timeout(10ms)
HST1         horcm           1000           3000

HORCM_CMD
#unitID 0... (seq#30014)
#dev_name     dev_name       dev_name
/dev/rdsk/c0t0d0
#unitID 1... (seq#30015)
#dev_name     dev_name       dev_name
/dev/rdsk/c1t0d0

HORCM_DEV
#dev_group   dev_name        port#          TargetID       LU#     MU#
oradb        oradb1          CL1-A          3              1       0
oradb        oradb2          CL1-A          3              1       1
oralog       oralog1         CL1-A          5              0
oralog       oralog2         CL1-A1         5              0
oralog       oralog3         CL1-A1         5              1
oralog       oralog4         CL1-A1         5              1       h1
HORCM_INST
#dev_group   ip_address      service
oradb        HST2            horcm
oradb        HST3            horcm
oralog       HST3            horcm
```

Figure 2.24   Configuration File Example — UNIX-Based Servers



```
HORCM_MON
#ip_address     service         poll(10ms)      timeout(10ms)
POLLUX          horcm0          1000            3000


HORCM_CMD
#dev_name               dev_name                dev_name
\\.\PHYSICALDRIVE2


HORCM_DEV
#dev_group      dev_name        port#           TargetID        LU#
VG01            kate1           CL1-A           0               0
#VG02           kate2           CL1-C           4               0
#VG02           oradb3          CL1-B           2               4



HORCM_INST
#dev_group      ip_address      service
VG01            POLLUX          horcm1
```

Figure 2.25   Configuration File Example — Windows Servers

HORCM_MON. The monitor parameter (HORCM_MON) defines the following values:

- **Ip_address:** The network address (IPv4 or IPv6) of the local host. When HORCM has two or more network addresses on different subnets or MPE/iX, enter **NONE** for IPv4 or **NONE6** for IPv6 here.
- **Service:** Specifies the UDP port name assigned to the HORCM communication path, which is registered in "/etc/services" ("\WINNT\system32\drivers\etc\services" in Windows, "SYS$SYSROOT:[000000.TCPIP$ETC]SERVICES.DAT" in OpenVMS). If a port number is specified instead of a port name, the port number will be used.
- **Poll:** The interval for monitoring paired volumes. To reduce the HORCM daemon load, make this interval longer. If set to -1, the paired volumes are not monitored. The value of -1 is specified when two or more CCI instances run on a single machine.
- **Timeout:** The time-out period of communication with the remote server.

HORCM_CMD. The command parameter (HORCM_CMD) defines the UNIX device path or Windows physical device number of the command device. The command device must be mapped to the SCSI/fibre using the LUN Manager remote console software (or SVP). You can define more than one command device to provide failover in case the original command device becomes unavailable (see section 2.8.6).

Note: To enable dual pathing of the command device under Solaris systems, make sure to include all paths to the command device **on a single line** in the HORCM_CMD section of the config file. Putting the path information on separate lines may cause parsing issues, and failover may not occur unless the HORCM startup script is restarted on the Solaris system.

When a server is connected to two or more storage systems, the HORCM identifies each storage system using the unitID (see Figure 2.26). The unitID is assigned sequentially in the order described in this section of the configuration definition file. The server must be able to verify that unit ID is the same Serial# (Seq#) with among server when the storage system is shared by two or more servers. This can be verified using the **raidqry** command.

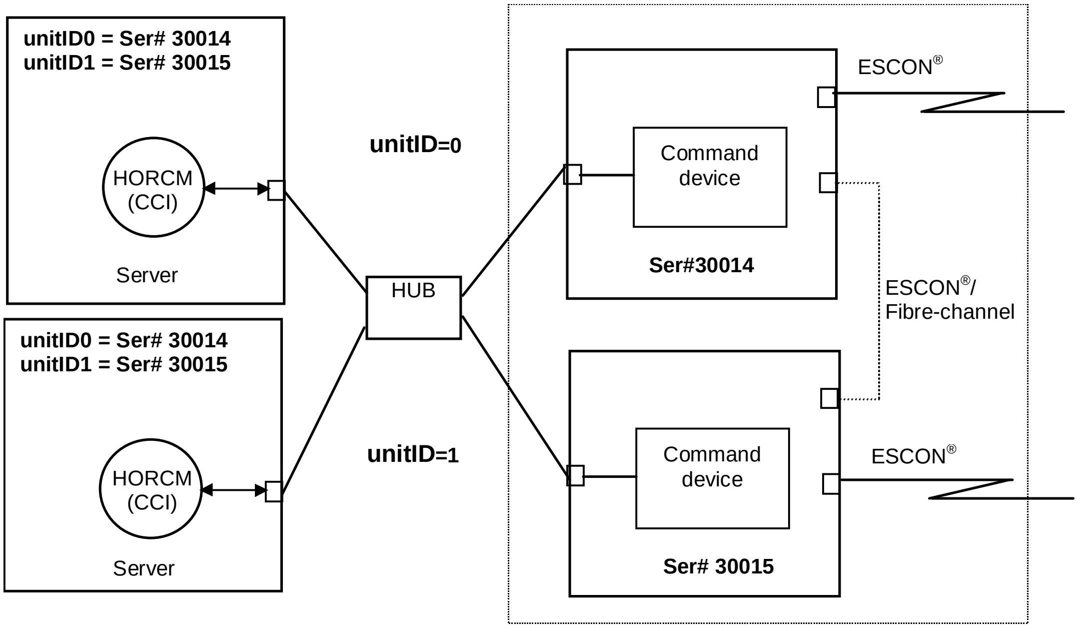


Figure 2.26 Configuration and Unit IDs for Multiple Storage Systems

dev_name for Windows

In Windows SAN environment," Volume{guid}" is changed on every re-boot under MSCS/Windows 2003/2008, if Windows finds the same signature on the command device connected with Multi-Path. Therefore, the user must find NEW "Volume{guid}" and change "Volume{guid}" described in the CCI configuration file. CCI supports the following naming format specifying Serial#/LDEV#/Port# as notation of the command device for only Windows.

`\\.\CMD-Ser#-ldev#-Port#`

```
HORCM_CMD
#dev_name                    dev_name              dev_name
     \\.\CMD-30095-250-CL1-A
```

To allow more flexibility, CCI allows the following format.

- For minimum specification. Specifies to use any command device for Serial#30095
  `\\.\CMD-30095`
  If Windows has two different array models that share the same serial number, fully define the serial number, ldev#, port and host group for the CMDDEV.
- For under Multi Path Driver. Specifies to use any port as the command device for Serial#30095, LDEV#250
  `\\.\CMD-30095-250`
- For full specification. Specifies the command device for Serial#30095, LDEV#250 connected to Port CL1-A, Host group#1
  `\\.\CMD-30095-250-CL1-A-1`
- Other examples

  \\.\CMD-30095-250-CL1-A
  \\.\CMD-30095-250-CL1

dev_name for UNIX

In UNIX SAN environment, there are situations when the device file name will be changed, a failover operation in UNIX SAN environment or every reboot under Linux when the SAN is reconfigured. The CCI user needs to find NEW "Device Special File" and change HORCM_CMD described in the CCI configuration file. Thus, CCI supports the following naming format specifying Serial#/LDEV#/Port#:**HINT** as notation of the command device **for UNIX**:

```
\\.\CMD-Ser#-ldev#-Port#:HINT
```

```
HORCM_CMD
#dev_name                              dev_name         dev_name
\\.\CMD-30095-250-CL1-A-1:/dev/rdsk/
```

If these names are specified, HORCM finds "\\.\CMD-Serial#-Ldev#-Port#" from the device files specified by **HINT** at HORCM start-up. HINT must be specified "directory terminated with '/' on the device file name" or "directory including device file name pattern" as below, for example:

/dev/rdsk/ → this finds a specified CMD from /dev/rdsk/*
/dev/rdsk/c10 → this finds a specified CMD from /dev/rdsk/c10*
/dev/rhdisk → this finds a specified CMD from /dev/rhdisk*

The device files discovered during HINT are filtered with the following pattern:

HP-UX: /dev/rdsk/* or /dev/rdisk/disk*
Solaris: /dev/rdsk/*s2, AIX: /dev/rhdisk*
Linux : /dev/sd...., zLinux : /dev/sd....
MPE/iX: /dev/...
Tru64: /dev/rrz*c or /dev/rdisk/dsk*c or /dev/cport/scp*
DYNIX: /dev/rdsk/sd*
IRIX64: /dev/rdsk/*vol or /dev/rdsk/node_wwn/*vol/*

If a HINT is already specified, "**:HINT**" can be omitted for next command devices, and then a command device will be found from the cached Inquiry information of HORCM for saving unnecessary device scanning.

```
HORCM_CMD
#dev_name                         dev_name              dev_name
\\.\CMD-30095-250-CL1:/dev/rdsk/  \\.\CMD-30095-250-CL2
```

Example for minimum specification. Specifies to use any command device for Serial#30095:

```
\\.\CMD-30095:/dev/rdsk/
```

Example for under Multi Path Driver. Specifies to use any port as the command device for Serial#30095, LDEV#250:

```
\\.\CMD-30095-250:/dev/rdsk/
```

Example for full specification. Specifies the command device for Serial#30095, LDEV#250 connected to Port CL1-A, Host group#1:

```
\\.\CMD-30095-250-CL1-A-1:/dev/rdsk/
```

Other examples:

```
\\.\CMD-30095-250-CL1:/dev/rdsk/      \\.\CMD-30095-250-CL2
\\.\CMD-30095:/dev/rdsk/c1            \\.\CMD-30095:/dev/rdsk/c2
```

HORCM_DEV. The device parameter (HORCM_DEV) defines the RAID storage system device addresses for the paired logical volume names. When the server is connected to two or more storage systems, the unit ID is expressed by port# extension. Each group name is a unique name discriminated by a server which uses the volumes, the attributes of the volumes (such as database data, redo log file, UNIX file), recovery level, etc. The group and paired logical volume names described in this item must reside in the remote server. The hardware SCSI/fibre bus, target ID, and LUN as hardware components need not be the same.

The following values are defined in the HORCM_DEV parameter:

- **dev_group**: Names a group of paired logical volumes. A command is executed for all corresponding volumes according to this group name.
- **dev_name**: Names the paired logical volume within a group (i.e., name of the special file or unique logical volume). The name of paired logical volume must be different than the “dev name” on another group.
- **Port#**: Defines the RAID storage system port number of the volume that corresponds with the dev_name volume. The following “n” shows unit ID when the server is connected to two or more storage systems (e.g., CL1-A1 = CL1-A in unit ID 1). If the “n” option is omitted, the unit ID is 0. The port is not case sensitive (e.g., CL1-A= cl1-a= CL1-a= cl1-A).

	Basic				Option				Option				Option			
CL1	An	Bn	Cn	Dn	En	Fn	Gn	Hn	Jn	Kn	Ln	Mn	Nn	Pn	Qn	Rn
CL2	An	Bn	Cn	Dn	En	Fn	Gn	Hn	Jn	Kn	Ln	Mn	Nn	Pn	Qn	Rn

The following ports can only be specified for the 9900V:

	Basic				Option				Option				Option			
CL3	an	bn	cn	dn	en	fn	gn	hn	jn	kn	ln	mn	nn	pn	qn	rn
CL4	an	bn	cn	dn	en	fn	gn	hn	jn	kn	ln	mn	nn	pn	qn	rn

For 9900V, CCI supports four types of port names for host groups:

- Specifying the port name without a host group:
  CL1-A
  CL1-A**n** where **n** unit ID for multiple RAID
- Specifying the Port name without a host group
  CL1-A-**g** where **g** : host group
  CL1-A**n**-**g** where **n**-**g** : host group=**g** on CL1-A in unit ID=**n**

The following ports can only be specified for USP/NSC and USP V/VM:

	Basic				Option				Option				Option			
CL5	an	bn	cn	dn	en	fn	gn	hn	jn	kn	ln	mn	nn	pn	qn	rn
CL6	an	bn	cn	dn	en	fn	gn	hn	jn	kn	ln	mn	nn	pn	qn	rn
CL7	an	bn	cn	dn	en	fn	gn	hn	jn	kn	ln	mn	nn	pn	qn	rn
CL8	an	bn	cn	dn	en	fn	gn	hn	jn	kn	ln	mn	nn	pn	qn	rn
CL9	an	bn	cn	dn	en	fn	gn	hn	jn	kn	ln	mn	nn	pn	qn	rn
CLA	an	bn	cn	dn	en	fn	gn	hn	jn	kn	ln	mn	nn	pn	qn	rn
CLB	an	bn	cn	dn	en	fn	gn	hn	jn	kn	ln	mn	nn	pn	qn	rn
CLC	an	bn	cn	dn	en	fn	gn	hn	jn	kn	ln	mn	nn	pn	qn	rn
CLD	an	bn	cn	dn	en	fn	gn	hn	jn	kn	ln	mn	nn	pn	qn	rn
CLE	an	bn	cn	dn	en	fn	gn	hn	jn	kn	ln	mn	nn	pn	qn	rn
CLF	an	bn	cn	dn	en	fn	gn	hn	jn	kn	ln	mn	nn	pn	qn	rn
CLG	an	bn	cn	dn	en	fn	gn	hn	jn	kn	ln	mn	nn	pn	qn	rn

- **Target ID**: Defines the SCSI/fibre target ID number of the physical volume on the specified port. See Appendix C for further information on fibre address conversion.
- **LU#**: Defines the SCSI/fibre logical unit number (LU#) of the physical volume on the specified target ID and port.

  Note: In case of fibre channel, if the TID and LU# displayed on the system are different than the TID on the fibre address conversion table, then you must use the TID and LU# indicated by the **raidscan** command in the CCI configuration file.
- **MU# for HOMRCF**: Defines the mirror unit number (0 - 2) for the identical LU on the HOMRCF. If this number is omitted it is assumed to be zero (0). The cascaded mirroring of the S-VOL is expressed as virtual volumes using the mirror descriptors (MU#1-2) in the configuration definition file. The MU#0 of a mirror descriptor is used for connection of the S-VOL. SnapShot will have 64 mirror descriptions in HOMRCF and SnapShot feature.

	SMPL		P-VOL		S-VOL	
Feature	MU#0-2	MU#3 – 63	MU#0-2	MU#3 – 63	MU#0	MU#1 – 63
HOMRCF	valid	Invalid	valid	Invalid	valid	Invalid
SnapShot	valid	valid	valid	valid	valid	Invalid

- **MU# for HORC/Universal Replicator**: Defines the mirror unit number (0 - 3) of one of four possible HORC/UR bitmap associations for an LDEV. If this number is omitted, it is assumed to be zero (0). The Universal Replicator mirror description is described in the MU# column by adding "h" in order to identify identical LUs as the mirror descriptor for UR. The MU# for HORC must be specified "blank" as "0". The mirror description for HORC is only one, but UR will have four mirrors, as shown below.

State/ Feature	SMPL		P-VOL		S-VOL	
	MU#0	MU#h1 - h3	MU#0	MU#h1 - h3	MU#0	MU#h1 - h3
TrueCopy	Valid	Not Valid	Valid	Not Valid	Valid	Not Valid
Universal Replicator	Valid	Valid	Valid	Valid	Valid	Valid

HORCM_INST. The instance parameter (HORCM_INST) defines the network address (IP address) of the remote server (active or standby). It is used to refer to or change the status of the paired volume in the remote server (active or standby). When the primary volume is shared by two or more servers, there are two or more remote servers using the secondary volume. Thus, it is necessary to describe the addresses of all of these servers.

The following values are defined in the HORCM_INST parameter:

- **dev_group**: The server name described in dev_group of HORC_DEV.
- **ip_address**: The network address of the specified remote server.
- **service**: The port name assigned to the HORCM communication path (registered in the /etc/services file). If a port number is specified instead of a port name, the port number will be used.

When HORCM has two or more network addresses on different subnets for communication, the ip_address of HORCM_MON must be NONE. This configuration for multiple networks can be found using **raidqry -r <group>** command option on each host. The current network address of HORCM can be changed using **horcctl -NC <group>** on each host.

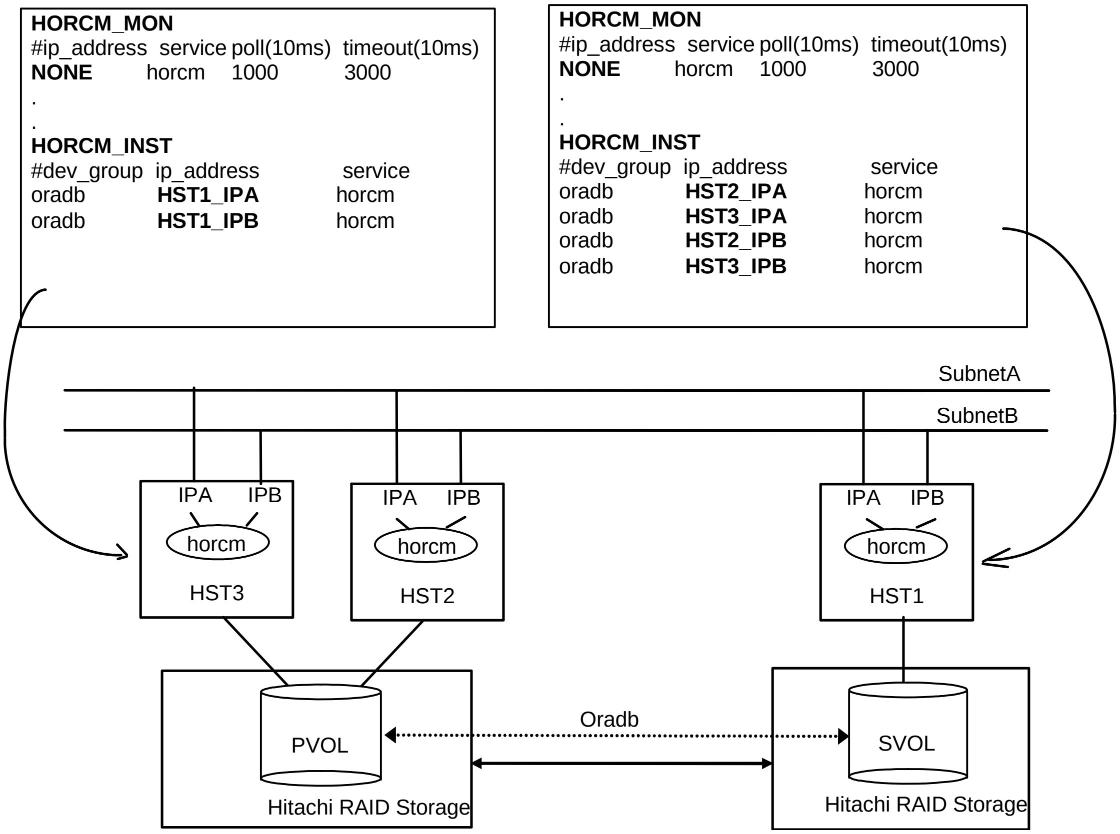


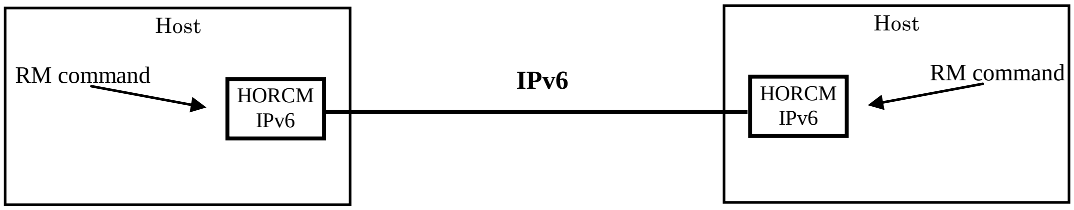
Figure 2.27 Configuration for Multiple Networks

For example:

```
# horcctl -ND -g IP46G
Current network address = 158.214.135.106,services = 50060
```

```
# horcctl -NC -g IP46G
Changed network address(158.214.135.106,50060 -> fe80::39e7:7667:9897:2142,50060)
```

In case of IPv6 only, the configuration must be defined as HORCM/IPv6.

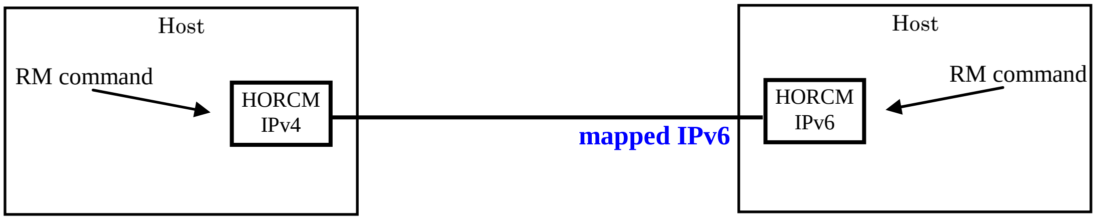


```
HORCM_MON
#ip_address service poll(10ms) timeout(10ms)
NONE6       horcm0       1000    3000
#fe80::209:6bff:febe:3c17   horcm0   1000
3000

#/********** For HORCM_CMD ****************/
HORCM_CMD
#dev_name
#UnitID 0 (Serial# 63502)
/dev/rdsk/c1t0d0s2

#/********** For HORCM_LDEV ****************/
HORCM_LDEV
#dev_group   dev_name    Serial#   LDEV#  MU#
IPV6G        dev1        63502     577

#/********** For HORCM_INST ****************/
HORCM_INST
#dev_group  ip_address                service
IPV6G       fe80::202:a5ff:fe55:c1d2  horcm0
```

```
HORCM_MON
#ip_address service poll(10ms) timeout(10ms)
NONE6       horcm0       1000    3000
#fe80::202:a5ff:fe55:c1d2  horcm0   1000
3000

#/********** For HORCM_CMD ****************/
HORCM_CMD
#dev_name
#UnitID 0 (Serial# 63502)
/dev/rdsk/c1t0d0s2

#/********** For HORCM_LDEV ****************/
HORCM_LDEV
#dev_group   dev_name    Serial#   LDEV#  MU#
IPV6G        dev1        63502     677

#/********** For HORCM_INST ****************/
HORCM_INST
#dev_group  ip_address                service
IPV6G       fe80::209:6bff:febe:3c17   horcm0
```

Figure 2.28   Network Configuration for IPv6

In case of IPv4 mapped IPv6, it is possible to communicate between HORCM/IPv4 and HORCM/IPv6 using IPv4 mapped IPv6.



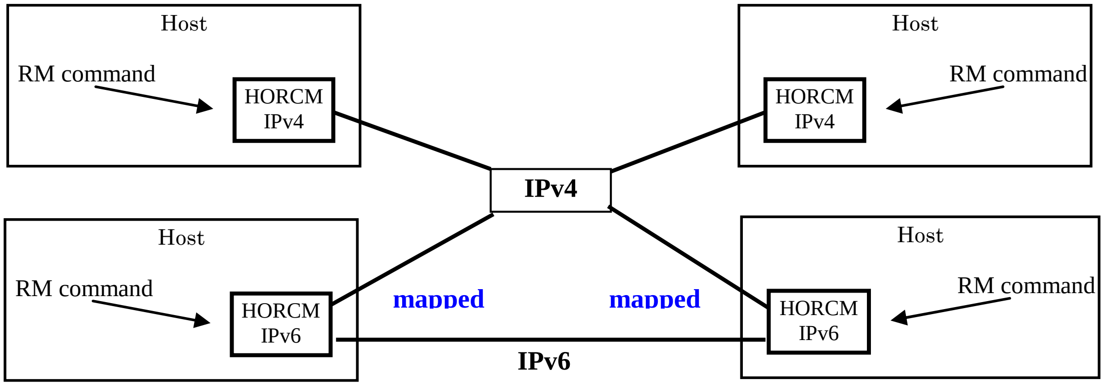
```
HORCM_MON
#ip_address service poll(10ms) timeout(10ms)
NONE        horcm4       1000    3000
#158.214.127.64   horcm4       1000    3000

#/********** For HORCM_CMD ****************/
HORCM_CMD
#dev_name
#UnitID 0 (Serial# 63502)
/dev/rdsk/c1t0d0s2

#/********** For HORCM_LDEV ****************/
HORCM_LDEV
#dev_group   dev_name    Serial#   LDEV#  MU#
IPM4G         dev1        63502     577

#/********** For HORCM_INST ****************/
HORCM_INST
#dev_group   ip_address              service
IPM4G        158.214.135.105         horcm6
```

```
HORCM_MON
#ip_address service poll(10ms) timeout(10ms)
NONE6        horcm6       1000    3000
#::ffff:158.214.135.105   horcm6       1000
3000

#/********** For HORCM_CMD ****************/
HORCM_CMD
#dev_name
#UnitID 0 (Serial# 63502)
/dev/rdsk/c1t0d0s2

#/********** For HORCM_LDEV ****************/
HORCM_LDEV
#dev_group   dev_name    Serial#   LDEV#  MU#
IPM4G         dev1        63502     677

#/********** For HORCM_INST ****************/
HORCM_INST
#dev_group   ip_address              service
IPM4G        ::ffff:158.214.127.64   horcm4
IPM4G        158.214.127.64          horcm4
```

"`::ffff:158.214.127.64`" shows IPv4 mapped IPv6.
If IP_address will be specified with IPV4 format, then
HORCM converts to IPV4 mapped IPV6 .

Figure 2.29 Network Configuration for IPv4 Mapped IPv6

In case of mixed IPv4 and IPv6, it is possible to communicate between HORCM/IPv4 and HORCM/IPv6 and HORCM/IPv6 using IPv4 mapped IPv6 and native IPv6.



```
HORCM_MON
#ip_address service poll(10ms) timeout(10ms)
NONE        horcm4       1000    3000
#158.214.127.64    horcm4       1000    3000
#/********** For HORCM_CMD ****************/
HORCM_CMD
#dev_name
#UnitID 0 (Serial# 63502)
/dev/rdsk/c1t0d0s2
#/********** For HORCM_LDEV ****************/
HORCM_LDEV
#dev_group   dev_name    Serial#   LDEV#  MU#
IP46G         dev1         63502     577
#/********** For HORCM_INST ****************/
HORCM_INST
#dev_group   ip_address                service
IP46G        158.214.135.105           horcm4
IP46G        158.214.135.106           horcm6
```

```
HORCM_MON
#ip_address service poll(10ms) timeout(10ms)
NONE        horcm4       1000    3000
#158.214.135.105    horcm4       1000    3000
#/********** For HORCM_CMD ****************/
HORCM_CMD
#dev_name
#UnitID 0 (Serial# 63502)
/dev/rdsk/c1t0d0s2
#/********** For HORCM_LDEV ****************/
HORCM_LDEV
#dev_group   dev_name    Serial#   LDEV#  MU#
IP46G         dev1         63502     677
#/********** For HORCM_INST ****************/
HORCM_INST
#dev_group   ip_address                service
IP46G        158.214.127.64            horcm4
IP46G        158.214.127.65            horcm6
```

```
HORCM_MON
#ip_address service poll(10ms) timeout(10ms)
NONE6       horcm6       1000    3000
#/********** For HORCM_CMD ****************/
HORCM_CMD
#dev_name
#UnitID 0 (Serial# 63502)
/dev/rdsk/c1t0d0s2
#/********** For HORCM_LDEV ****************/
HORCM_LDEV
#dev_group   dev_name    Serial#   LDEV#  MU#
IP46G         dev1         63502     577
#/********** For HORCM_INST ****************/
HORCM_INST
#dev_group   ip_address                service
IP46G        158.214.135.105             horcm4
IP46G       fe80::202:a5ff:fe55:c1d2     horcm6
```

```
HORCM_MON
#ip_address service poll(10ms) timeout(10ms)
NONE6       horcm6       1000    3000
#/********** For HORCM_CMD ****************/
HORCM_CMD
#dev_name
#UnitID 0 (Serial# 63502)
/dev/rdsk/c1t0d0s2
#/********** For HORCM_LDEV ****************/
HORCM_LDEV
#dev_group   dev_name    Serial#   LDEV#  MU#
IP46G         dev1         63502     677
#/********** For HORCM_INST ****************/
HORCM_INST
#dev_group   ip_address                service
IP46G        158.214.127.64              horcm4
IP46G       fe80::209:6bff:febe:3c17     horcm6
```

Figure 2.30 Network Configuration for Mixed IPv4 and IPv6

HORCM_LDEV. The HORCM_LDEV parameter is used for specifying stable LDEV# and Serial# as the physical volumes corresponding to the paired logical volume names. Each group name is unique and typically has a name fitting its use (e.g., database data, Redo log file, UNIX file). The group and paired logical volume names described in this item must also be known to the remote server.

(a) dev_group: This parameter is the same as HORCM_DEV parameter.

(b) dev_name: This parameter is the same as HORCM_DEV parameter.

(c) MU#: This parameter is the same as HORCM_DEV parameter.

(d) Serial#: This parameter is used to describe the Serial number of RAID box.

(e) CU:LDEV(LDEV#): This parameter is used to describe the LDEV number in the RAID storage system and supports three types format as LDEV#.

```
HORCM_LDEV
#dev_group   dev_name    Serial#      CU:LDEV(LDEV#)   MU#
   oradb     dev1        30095        02:40              0
   oradb     dev2        30095        02:41              0
```

- Specifying “CU:LDEV” in hex used by SVP or Web console
  Example for LDEV# 260
  01: 04
- Specifying “LDEV” in decimal used by inqraid command of RAID Manager
  Example for LDEV# 260
  260
- Specifying “LDEV” in hex used by inqraid command of RAID Manager
  Example for LDEV# 260
  0x104

Note: HORCM_LDEV format can be used for Lightning 9900V and later. LDEV# will be converted to “Port#, Targ#, Lun#” mapping to this LDEV internally, because the RAID storage system needs to specify “Port#, Targ#, Lun#” for the target device. This feature is TagmaStore USP/NSC and 9900V microcode dependent; if HORCM fails to start, use HORCM_DEV.

HORCM_INSTP. This parameter is used to specify “pathID” for TrueCopy link as well as “HORCM_INST”.

```
HORCM_INSTP
dev_group        ip_address      service   pathID
VG01             HSTA            horcm     1
VG02             HSTA            horcm     2
```

Note: PathID can be specified for TrueCopy on USP V/VM and USP/NSC. UR cannot be specified. PathID is used for the paircreate command and pairresync -swapp[s], so it must be specified at the PVOL and SVOL sites. If PathID is not specified, it will be used as CU free.

2.8.5 Command Device

The Hitachi TrueCopy/ShadowImage commands are issued by the HORC Manager (HORCM) to the RAID storage system command device. The command device is a user-selected, dedicated logical volume on the storage system which functions as the interface to the CCI software on the UNIX/PC host. The command device is dedicated to CCI communications and cannot be used by any other applications. The command device accepts TrueCopy and ShadowImage read and write commands that are executed by the storage system. The command device also returns read requests to the UNIX/PC host. The volume designated as the command device is used only by the storage system and is blocked from the user. The command device uses 16 MB, and the remaining volume space is reserved for CCI and its utilities. The command device can be any OPEN-*x* device (e.g., OPEN-3, OPEN-8) that is accessible by the host. A LUSE volume cannot be used as a command device. A Virtual LVI/LUN volume as small as 36 MB (e.g., OPEN-3-CVS) can be used as a command device.

WARNING: Make sure the volume to be selected as the command device does not contain any user data. The command device will be inaccessible to the UNIX/PC server host.

The CCI software on the host issues read and write commands to the command device. When CCI receives an error notification in reply to a read or write request to the RAID storage system, the CCI software will switch to an alternate command device, if one is defined. If a command device is blocked (e.g., online maintenance), you can switch to an alternate command device manually. If no alternate command device is defined or available, all Hitachi TrueCopy and ShadowImage commands will terminate abnormally, and the host will not be able to issue commands to the storage system. The user must set one or more alternate command devices (see section 2.8.6) to avoid data loss and storage system downtime.

Each command device must be set using the LUN Manager remote console software. If the remote LUN Manager feature is not installed, please ask your Hitachi Data Systems representative about LUN Manager configuration services. Each command device must also be defined in the HORCM_CMD section of the configuration file for the CCI instance on the attached host. If an alternate command device is not defined in the configuration file, the CCI software may not be able to use the device. See section 2.9 for instructions on setting and defining command devices.

The CCI Protection Facility (see section 4.16) uses an enhanced command device which has an attribute to indicate protection ON or OFF.

Notes:

- For Solaris operations, the command device must be labeled.
- To enable dual pathing of the command device under Solaris systems, make sure to include all paths to the command device **on a single line** in the HORCM_CMD section of the configuration file. Figure 2.31 shows an example with two controller paths (c1 and c2) to the command device. Putting the path information on separate lines may cause parsing issues, and failover may not occur unless the HORCM startup script is restarted on the Solaris system.

```
HORCM_CMD
#dev_name dev_name dev_name
/dev/rdsk/c1t66d36s2 /dev/rdsk/c2t66d36s2
```

Figure 2.31 Example of Alternate Path for Command Device for Solaris Systems

2.8.6 Alternate Command Device Function

The CCI software issues commands to the command device via the UNIX/PC raw I/O interface. If the command device fails in any way, all Hitachi TrueCopy/ShadowImage commands are terminated abnormally, and the user cannot use any commands. Because the use of alternate I/O pathing depends on the platform, restrictions are placed upon it. For example, on HP-UX systems only devices subject to the LVM can use the alternate path PV-LINK. To avoid command device failure, CCI supports an alternate command device function.

- **Definition of alternate command devices**. To use an alternate command device, you must define two or more command devices for the HORCM_CMD item in the configuration definition file (see sections 2.8.3 and 2.9). When two or more devices are defined, they are recognized as alternate command devices.
- **Timing of alternate command devices**. When the HORCM receives an error notification in reply from the operating system via the raw I/O interface, the command device is alternated. It is possible to alternate the command device forcibly by issuing an alternating command provided by Hitachi TrueCopy (**horcctl -C**).
- **Operation of alternating command**. If the command device will be blocked due to online maintenance (e.g., microcode replacement), the alternating command should be issued in advance. When the alternating command is issued again after completion of the online maintenance, the previous command device is activated again.
- **Multiple command devices on HORCM startup**. If at least one command device is available during one or more the command devices which was described to the configuration definition file, then HORCM will be able to start with warning message to startup log by using available command device. The user needs to confirm that all command devices can be changed by using **horcctl -C** command option, or HORCM has been started without warning message to the HORCM start up log.

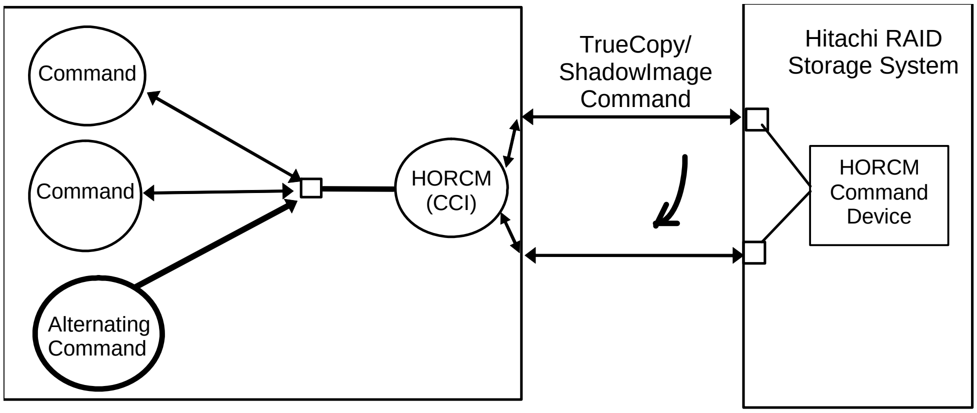


Figure 2.32 Alternate Command Device Function

2.8.7 Command Interface with Hitachi TrueCopy/ShadowImage

When the CCI commands are converted into SCSI commands of a special format, a SCSI through driver which can send such special SCSI commands to the RAID storage system is needed. As a result, it is quite possible that support by CCI depends on the OS supplier. Accordingly, it is necessary to use read/write command that can easily be issued by many UNIX/PC server platforms. Ioctl() can be used for the following platforms: HP-UX, Linux, Solaris, Windows, IRIX®64, OpenVMS, and zLinux®.

Format of SCSI commands used. Use the RD/WR command. They should be RD/WR command valid for special LDEV, since they should be discriminated from the normal RD/WR command.

Recognition of control command area (LBA#). The host issues control commands through a special file for raw I/O of a special LDEV. Since the specific LU (command device) receiving these commands is a normal disk viewed from the SCSI interface, the operating system may access the control area of its local. The RAID storage system must distinguish such accesses from the control command accesses. Normally, several megabytes of the OS control area is used from the initial LAB#. To avoid using this area, a specific LBA# area is decided and control commands are issued within this area. The command LAB# recognized by the storage system is shown below, provided the maximum OS control area is 16 MB.

32768 <= LBA# <= 32768 * 2 (In units of block; 512 bytes per block)
The host seeks 32768 * 512 bytes and issues a command.

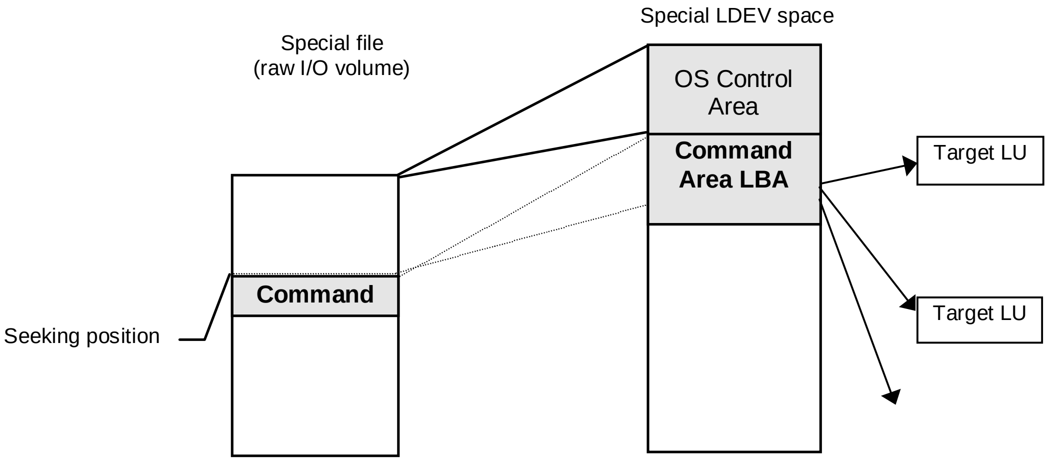


Figure 2.33 Relation between Special File and Special LDEV

Acceptance of commands. A command is issued in the LBA area of the special LDEV explained above. The RD/WR command meeting this requirement should be received especially as the CCI command. A command is issued in the form of WR or WR-RD. When a command is issued in the form of RD, it is regarded as an inquiry (equivalent to a SCSI inquiry), and a CCI recognition character string is returned.

2.8.7.1 Command Competition

The CCI commands are asynchronous commands issued via the SCSI interface. Accordingly, if several processes issue these commands to a single LDEV, the storage system cannot take the proper action. To avoid such a problem, two or more WR commands should not be issued to a single LDEV. The command initiators should not issue two or more WR commands to a single LDEV unless the storage system can receive commands with independent initiator number * LDEV number simultaneously.

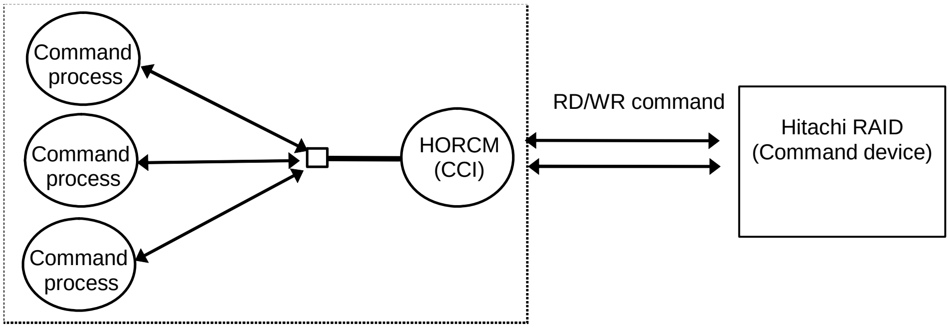


Figure 2.34 HORCM and Command Issue Process

2.8.7.2 Flow of Commands

Figure 2.35 shows the flow of RD/WR command control in a specified LBA#.

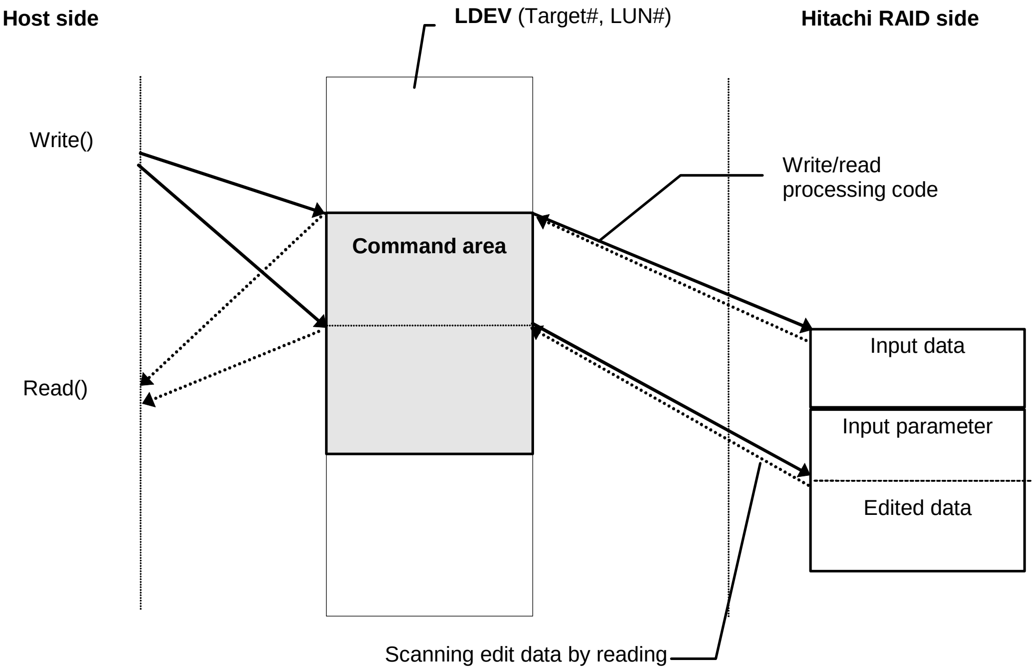


Figure 2.35 Flow of Command Issue

2.8.7.3 Issuing Commands for LDEV(s) within a LUSE Device

A LUSE device is a group of LDEVs regarded as a single logical unit. Since it is necessary to know about the configuration of the LDEVs when issuing a command, a new command is used. This command specifies a target LU and acquires LDEV configuration data (see Figure 2.36).

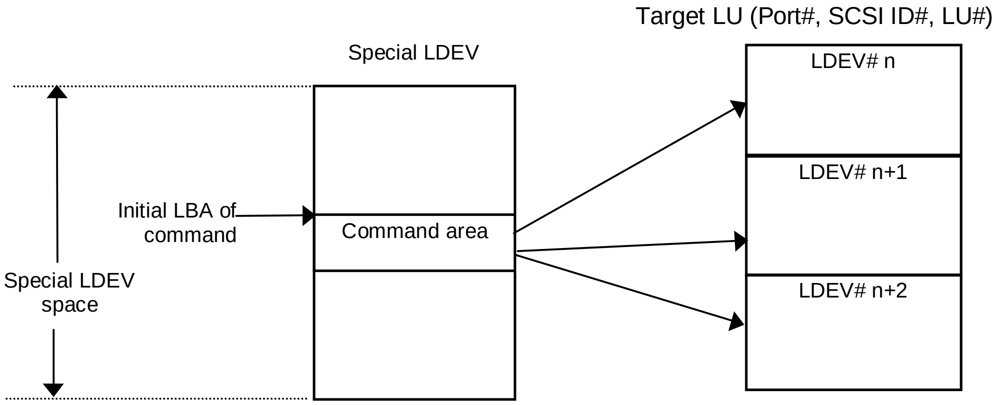


Figure 2.36 LUSE Device and Command Issue

2.8.8 Logical DKC per 64K LDEVs

The Universal Storage Platform V/VM controller manages internal LDEV numbers as a four-byte data type in order to support over 64K LDEVs. Because the LDEV number for the host interface is defined as two-byte data type, the USP V/VM implements the concept of the logical DKC (LDKC) in order to maintain the compatibility of this host interface and to make operation possible for over 64K LDEVs without changing the host interface.

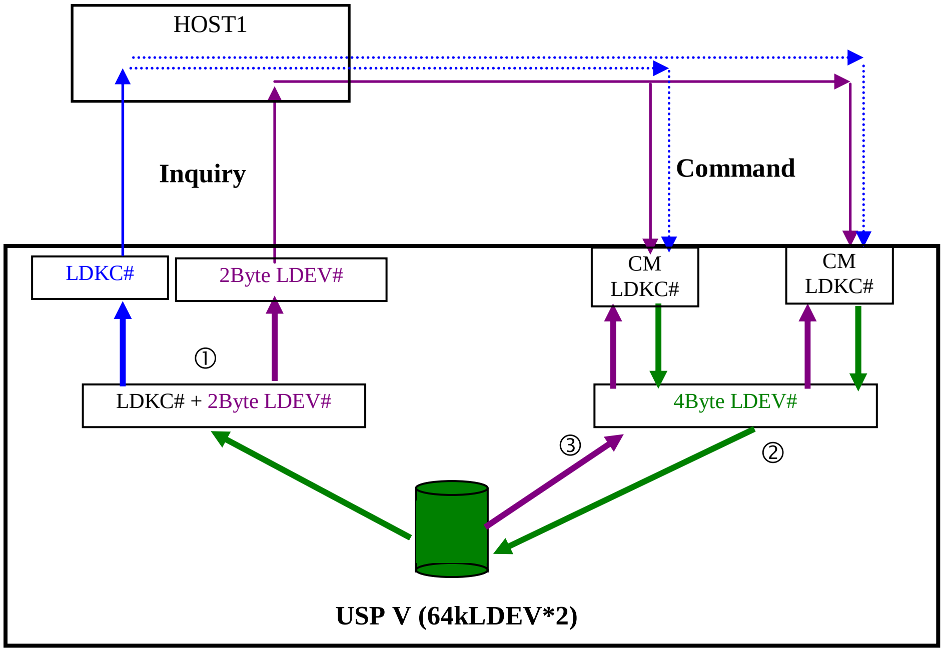


Figure 2.37 Relation between LDEVs and Command Device on LDKC

① Converting to LDKC# and 2-byte LDEV: returns the LDEV number to the host by converting from 4-byte LDEV# to LDKC# and 2-byte LDEV#.

LDKC# (0 or 1 for 128K LDEVs) = internal DKC LDEV# / 64K
LDEV# for the Host = internal DKC LDEV# % 64K

② Converting to 4-byte LDEV: converts as internal LDEV# from LDKC# and 2-byte LDEV# to 4-byte LDEV#.

internal DKC LDEV# = 64K * LDKC# (0 or 1 for 128K LDEVs) + LDEV# from the host

③ Filtering to 2-byte LDEV: returns 2-byte LDEV# to the host by filtering 4-byte LDEV# via the command device.

LDEV# for the host = internal DKC LDEV# - 64K * LDKC# (0 or 1 for 128K LDEVs)

If "0 ≤ LDEV# for the host < 64k", then returns LDEV# for the host, else returns NO LDEV.

Restrictions:

- For TrueCopy Async, you cannot create a CT group across LDKC.
- For ShadowImage and COW Snapshot, you cannot create a paired-volume across LDKC.
- You must configure LUSE/POOL/JNL using multiple LDEVs within the same LDKC.

2.8.9 Command Device Guarding

In the customer environment, a command device may be attacked by the maintenance program of the Solaris Server, after that usable instance will be exhausted. As a result, CCI instance could not start up on all servers (except attacked server). This may happen on wrong operation of the maintenance personnel for the UNIX Server. In that case, the command device needs some protection assumed a human error, as long as it can be seen as the device file from the maintenance personnel.

Thus, RAID F/W (for the command device) and CCI support this protection in order to guard from the similar access.

2.8.9.1 Guarding Method

Currently, assignment of the instance via the command device is ONE phase. Therefore, if the command device will be read a special allocation area of the instance through the maintenance tool and so on, then it causes a fault of full space of the instance, because the command device interprets as assignment of the instance from RAID Manager.

The RAID Manager has TWO phases that it reads to acquire usable LBA, and writes with the acquired LBA in attaching sequence to the command device, so the command device will be able to confirm whether it was required as the assignment for RAID Manager or not, by detecting and adding two status bits to the instance assignment table.

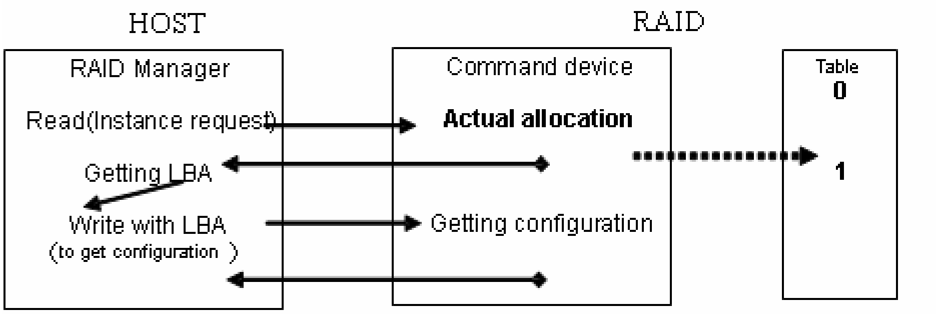


Figure 2.38 Current Assignment Sequence

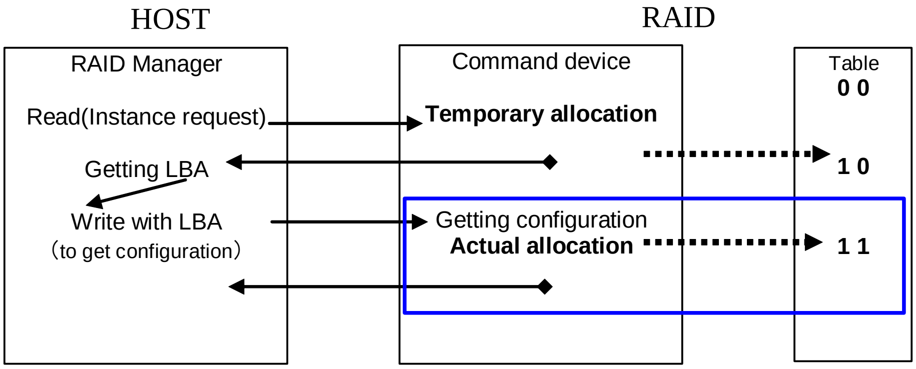


Figure 2.39 Improved Assignment Sequence

The command device performs the assignment of an instance through TWO phase that has “temporary allocation (1 0)” and “actual allocation (1 1)” to the instance assignment table.

If the command device will be attacked, the instance assignment table will be filled with “temporary allocation (1 0)” status, after that the command device will detects a fault of full space as the instance assignment, and then will clear up all “temporary allocation (1 0)”, and re-assigns the required instance automatically.

This does not require a service personnel to do “OFF/ON” of the command device for clear up the instance table.

2.8.9.2 Verifying the RM Instance Number

RAID Manager provides a way to verify number of “temporary allocation (1 0)” and “actual allocation (1 1)” on the instance table so that a user can confirm own validity of the RM instance number they are using. The `horcctl -DI` command shows the number of RM instances as follows of when HORCM has being started.

```
Example without command device security:
# horcctl -DI
Current control device = /dev/rdsk/c0t0d0  AI = 14 TI = 0 CI = 1

Example with command device security:
# horcctl -DI
Current control device = /dev/rdsk/c0t0d0*  AI = 14 TI = 0 CI = 1
```

AI : NUM of Actual instances in use
TI : NUM of temporary instances in RAID
CI : NUM of instances using current (own) instance

2.8.10 CCI Software Files

The CCI software product consists of files supplied to the user, log files created internally, and files created by the user. These files are stored on the local disk in the server machine. Table 2.10 lists the CCI files which are provided for UNIX®-based systems. Table 2.11 lists the CCI files which are provided for Windows-based systems. Table 2.12 lists the CCI files which are provided for OpenVMS®-based systems.

Table 2.10 CCI Files for UNIX-based Systems

No.	Title	File name	Command name	Mode	User*	Group
01	HORCM	/etc/horcmgr	horcmd	0544	root	sys
02	HORCM_CONF	/HORCM/etc/horcm.conf	–	0444	root	sys
03	Takeover	/usr/bin/horctakeover	horctakeover	0544	root	sys
04	Accessibility check	/usr/bin/paircurchk	paircurchk	0544	root	sys
05	Pair generation	/usr/bin/paircreate	paircreate	0544	root	sys
06	Pair splitting	/usr/bin/pairsplit	pairsplit	0544	root	sys
07	Pair resynchronization	/usr/bin/pairresync	pairresync	0544	root	sys
08	Event waiting	/usr/bin/pairevtwait	pairevtwait	0544	root	sys
09	Error notification	/usr/bin/pairmon	pairmon	0544	root	sys
10	Volume check	/usr/bin/pairvolchk	pairvolchk	0544	root	sys
11	Pair configuration confirmation	/usr/bin/pairdisplay	pairdisplay	0544	root	sys
12	RAID scanning	/usr/bin/raidscan	raidscan	0544	root	sys
13	RAID activity reporting	/usr/bin/raidar	raidar	0544	root	sys
14	Connection confirming	/usr/bin/raidqry	raidqry	0544	root	sys
15	Trace control	/usr/bin/horcctl	horcctl	0544	root	sys
16	HORCM activation script	/usr/bin/horcmstart.sh	horcmstart.sh	0544	root	sys
17	HORCM shutdown script	/usr/bin/horcmshutdown.sh	horcmshutdown.sh	0544	root	sys
18	Connection confirming	/HORCM/usr/bin/inqraid	--	0544	root	sys
19	Synchronous waiting	/usr/bin/pairsyncwait	pairsyncwait	0544	root	sys
20	Configuration file making	/HORCM/usr/bin/mkconf.sh	--	0544	root	sys
21	Database Validator setting	/usr/bin/raidvchkset	raidvchkset	0544	root	sys
22	Database Validator confirmation	/usr/bin/raidvchkdsp	raidvchkdsp	0544	root	sys
23	Database Validator confirmation	/usr/bin/raidvchkscan	raidvchkscan	0544	root	sys

**Note:* For information and instructions on changing the UNIX user for the CCI software, please see section 3.3.4.

Table 2.11 CCI Files for Windows-based Systems

No.	Title	File name	Command name
001	HORCM	\HORCM\etc\horcmgr.exe	horcmd
002	HORCM_CONF	\HORCM\etc\horcm.conf	—
003	Takeover	\HORCM\etc\horctakeover.exe	horctakeover
004	Accessibility check	\HORCM\etc\paircurchk.exe	paircurchk
005	Pair generation	\HORCM\etc\paircreate.exe	paircreate
006	Pair split	\HORCM\etc\pairsplit.exe	pairsplit
007	Pair re-synchronization	\HORCM\etc\pairresync.exe	pairresync
008	Event waiting	\HORCM\etc\pairevtwait.exe	pairevtwait
009	Error notification	\HORCM\etc\pairmon.exe	pairmon
010	Volume checking	\HORCM\etc\pairvolchk.exe	pairvolchk
011	Pair configuration confirmation	\HORCM\etc\pairdisplay.exe	pairdisplay
012	RAID scanning	\HORCM\etc\raidscan.exe	raidscan
013	RAID activity reporting	\HORCM\etc\raidar.exe	raidar
014	Connection confirmation	\HORCM\etc\raidqry.exe	raidqry
015	Trace control	\HORCM\etc\horcctl.exe	horcctl
016	HORCM activation script	\HORCM\etc\horcmstart.exe	horcmstart
017	HORCM shutdown script	\HORCM\etc\horcmshutdown.exe	horcmshutdown
018	Synchronous waiting	\HORCM\etc\pairsyncwait.exe	pairsyncwait
019	Connection confirmation	\HORCM\etc\inqraid.exe	inqraid
020	Configuration file making	\HORCM\Tool\mkconf.exe	mkconf
021	Oracle Validation setting	\HORCM\etc\raidvchkset	raidvchkset
022	Oracle Validation confirmation	\HORCM\etc\raidvchkdsp	raidvchkdsp
023	Oracle Validation confirmation	\HORCM\etc\raidvchkscan	raidvchkscan
024	Tool	\HORCM\Tool\chgacl.exe	chgacl
025	Tool	\HORCM\Tool\svcexe.exe	svcexe
026	Sample script for svcexe	\HORCM\Tool\HORCM0_run.txt	—
027	Tool	\HORCM\Tool\TRCLOG.bat	TRCLOG.bat
028	Takeover	\HORCM\usr\bin\horctakeover.exe	horctakeover
029	Accessibility check	\HORCM\usr\bin\paircurchk.exe	paircurchk
030	Pair generation	\HORCM\usr\bin\paircreate.exe	paircreate
031	Pair split	\HORCM\usr\bin\pairsplit.exe	pairsplit
032	Pair re-synchronization	\HORCM\usr\bin\pairresync.exe	pairresync
033	Event waiting	\HORCM\usr\bin\pairevtwait.exe	pairevtwait

No.	Title	File name	Command name
034	Volume check	\HORCM\usr\bin\pairvolchk.exe	pairvolchk
035	Synchronous waiting	\HORCM\usr\bin\pairsyncwait.exe	pairsyncwait
036	Pair configuration confirmation	\HORCM\usr\bin\pairdisplay.exe	pairdisplay
037	RAID scanning	\HORCM\usr\bin\raidscan.exe	raidscan
038	Connection confirmation	\HORCM\usr\bin\raidqry.exe	raidqry
039	Oracle Validation setting	\HORCM\usr\bin\raidvchkset	raidvchkset
040	Oracle Validation confirmation	\HORCM\usr\bin\raidvchkdsp	raidvchkdsp
041	Oracle Validation confirmation	\HORCM\usr\bin\raidvchkscan	raidvchkscan

Notes:

- The \HORCM\etc\ commands are used from the console window. If these commands are executed without an argument, the interactive mode will start up.
- The \HORCM\usr\bin commands have no console window, and can therefore be used from the application.
- The \HORCM\usr\bin commands do not support the directory mounted volumes in subcommands.

Table 2.12 CCI Files for OpenVMS®-based Systems

No.	Title	File name	Command name	User
001	HORCM	$ROOT:[HORCM.etc]horcmgr.exe	horcmd	sys
002	HORCM_CONF	$ROOT:[HORCM.etc]horcm.conf	–	sys
003	Takeover	$ROOT:[HORCM.usr.bin]horctakeover.exe	horctakeover	sys
004	Volume Accessibility check	$ROOT:[HORCM.usr.bin]paircurchk.exe	paircurchk	sys
005	Pair generation	$ROOT:[HORCM.usr.bin]paircreate.exe	paircreate	sys
006	Pair splitting	$ROOT:[HORCM.usr.bin]pairsplit.exe	pairsplit	sys
007	Pair re-synchronization	$ROOT:[HORCM.usr.bin]pairresync.exe	pairresync	sys
008	Event waiting	$ROOT:[HORCM.usr.bin]pairevtwait.exe	pairevtwait	sys
009	Error notification	$ROOT:[HORCM.usr.bin]pairmon.exe	pairmon	sys
010	Volume checking	$ROOT:[HORCM.usr.bin]pairvolchk.exe	pairvolchk	sys
011	Pair configuration confirmation	$ROOT:[HORCM.usr.bin]pairdisplay.exe	pairdisplay	sys
012	RAID scan	$ROOT:[HORCM.usr.bin]raidscan.exe	raidscan	sys
013	RAID activity report	$ROOT:[HORCM.usr.bin]raidar.exe	raidar	sys
014	Connection confirmation	$ROOT:[HORCM.usr.bin]raidqry.exe	raidqry	sys
015	Trace control	$ROOT:[HORCM.usr.bin]horcctl.exe	horcctl	sys
016	HORCM activation script	$ROOT:[HORCM.usr.bin]horcmstart.exe	horcmstart.sh	sys
017	HORCM shutdown script	$ROOT:[HORCM.usr.bin]horcmshutdown.exe	horcmshutdown.sh	sys
018	Connection confirmation	$ROOT:[HORCM.usr.bin]inqraid.exe	—	sys
019	Synchronous waiting	$ROOT:[HORCM.usr.bin]pairsyncwait.exe	pairsyncwait	sys
020	Configuration file making	$ROOT:[HORCM.usr.bin]mkconf.exe	—	sys
021	Database Validator setting	$ROOT:[HORCM.usr.bin]raidvchkset.exe	raidvchkset	sys
022	Database Validator confirmation	$ROOT:[HORCM.usr.bin]raidvchkdsp.exe	raidvchkdsp	sys
023	Database Validator confirmation	$ROOT:[HORCM.usr.bin]raidvchkscan.exe	raidvchkscan	sys
024	Sample file for horcmstart	$ROOT:[HORCM]loginhorcm*.com	—	sys
025	Sample file for horcmstart	$ROOT:[HORCM]runhorcm*.com	—	sys

Notes:

- $ROOT is defined as SYS$POSIX_ROOT. $POSIX_ROOT is necessary when using C RTL.
- The User-name for OpenVMS is “System”.

2.8.11 Log and Trace Files

The CCI software (HORCM) and Hitachi TrueCopy and ShadowImage commands maintain start-up log files, execution log files, and trace files which can be used to identify the causes of errors and keep records of the status transition history of the paired volumes. Please refer to Appendix A for a complete description of the CCI log and trace files.

2.8.12 User-Created Files

Script Files. CCI supports scripting to provide automated and unattended copy operations. A CCI script contains a list of CCI commands which describes a series of TrueCopy and/or ShadowImage operations. The scripted commands for UNIX-based platforms are defined in a shell script file. The scripted commands for Windows-based platforms are defined in a text file. The host reads the script file and sends the commands to the command device to execute the TrueCopy/ShadowImage operations automatically. The CCI scripts are:

- **HORCM startup script** (horcmstart.sh, horcmstart.exe): A script which starts HORCM (/etc/horcmgr), sets environmental variables as needed (e.g., HORCM_CONF, HORCM_LOG, HORCM_LOGS), and starts HORCM.
- **HORCM shutdown script** (horcmshutdown.sh, horcmshutdown.exe): A script for stopping the HORCM (/etc/horcmgr).
- **HA control script**: A script for executing takeover processing automatically when the cluster manager (CM) detects a server error.

When constructing the HORCM environment, the system administrator should make a copy of the **HORCM_CONF** file. The copied file should be set according to the system environment and registered as the following file (* is the instance number):

UNIX-based systems: **/etc/horcm.conf** or **/etc/horcm*.conf**
Windows-based systems: **\WINNT\horcm.conf** or **\WINNT\horcm*.conf**

2.9 Configuration Definition File

Figure 2.36 - Figure 2.44 show examples of CCI configurations, the configuration definition file(s) for each configuration, and examples of CCI command use for each configuration.

The command device is defined using the system raw device name (character-type device file name). For example, the command devices for Figure 2.40 would be:

- HP-UX: HORCM_CMD of HOSTA = /dev/rdsk/c0t0d1
  HORCM_CMD of HOSTB = /dev/rdsk/c1t0d1
- Solaris: HORCM_CMD of HOSTA = /dev/rdsk/c0t0d1s2
  HORCM_CMD of HOSTB = /dev/rdsk/c1t0d1s2

  Note: For Solaris operations with CCI version 01-09-03/04 and higher, the command device does not need to be labeled during format command.
- AIX: HORCM_CMD of HOSTA = /dev/rhdiskXX
  HORCM_CMD of HOSTB = /dev/rhdiskXX
  where XX = device number assigned by AIX
- Tru64 UNIX: HORCM_CMD of HOSTA = /dev/rrzbXXc
  HORCM_CMD of HOSTB = /dev/rrzbXXc
  where XX = device number assigned by Tru64 UNIX
- DYNIX/ptx®: HORCM_CMD of HOSTA = /dev/rdsk/sdXX
  HORCM_CMD of HOSTB = /dev/rdsk/sdXX
  where XX = device number assigned by DYNIX/ptx®
- Windows 2000/2003/2008: HORCM_CMD of HOSTA = \\.\CMD-Ser#-ldev#-Port#
  HORCM_CMD of HOSTB = \\.\CMD-Ser#-ldev#-Port#
- Windows NT®: HORCM_CMD of HOSTA = \\.\CMD-Ser#-ldev#-Port#
  HORCM_CMD of HOSTB = \\.\CMD-Ser#-ldev#-Port#
- Linux, zLinux HORCM_CMD of HOSTA = /dev/sdX
  HORCM_CMD of HOSTB = /dev/sdX
  where X = device number assigned by Linux, zLinux
- IRIX: HORCM_CMD for HOSTA ... /dev/rdsk/dks0d0l1vol **or**
  /dev/rdsk/node_wwn/lun1vol/c0p0
  HORCM_CMD for HOSTB ... /dev/rdsk/dks1d0l1vol **or**
  /dev/rdsk/node_wwn/lun1vol/c1p0

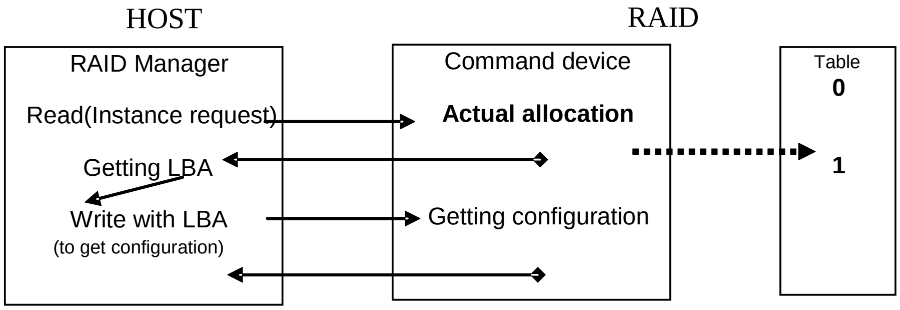


Figure 2.40 Hitachi TrueCopy Remote Configuration Example

Example of CCI commands with HOSTA:

- Designate a group name (Oradb) and a local host P-VOL a case.
  # paircreate -g Oradb -f never -vl

  This command creates pairs for all LUs assigned to group **Oradb** in the configuration definition file (two pairs for the configuration in Figure 2.40.

- Designate a volume name (oradev1) and a local host P-VOL a case.
  # paircreate -g Oradb -d oradev1 -f never -vl

  This command creates pairs for all LUs designated as **oradev1** in the configuration definition file (CL1-A,T1,L1 and CL1-D,T2,L1 for the configuration in Figure 2.40).

- Designate a group name and display pair status.
  # pairdisplay -g Oradb

```
Group  PairVol(L/R)   (P,T#,L#),  Seq#, LDEV#..P/S,   Status,  Fence,    Seq#,  P-LDEV#  M
oradb    oradev1(L) (CL1-A, 1,1) 30053    18...P-VOL    COPY   NEVER,   30054       19   -
oradb    oradev1(R) (CL1-D, 2,1) 30054    19...S-VOL    COPY   NEVER,   -----       18   -
oradb    oradev2(L) (CL1-A, 1,2) 30053    20...P-VOL    COPY   NEVER,   30054       21   -
oradb    oradev2(R) (CL1-D, 2,2) 30054    21...S-VOL    COPY   NEVER ,  -----       20   -
```

Example of CCI commands with HOSTB:

- Designate a group name and a remote host P-VOL a case.
  # paircreate -g Oradb -f never -vr

  This command creates pairs for all LU designated as **Oradb** in the configuration definition file (two pairs for the configuration in Figure 2.40).

- Designate a volume name (oradev1) and a remote host P-VOL a case.
  # paircreate -g Oradb -d oradev1 -f never -vr

  This command creates pairs for all LUs designated as **oradev1** in the configuration definition file (CL1-A,T1,L1 and CL1-D,T2,L1 for the configuration in Figure 2.40).

- Designate a group name and display pair status.
  # pairdisplay -g Oradb

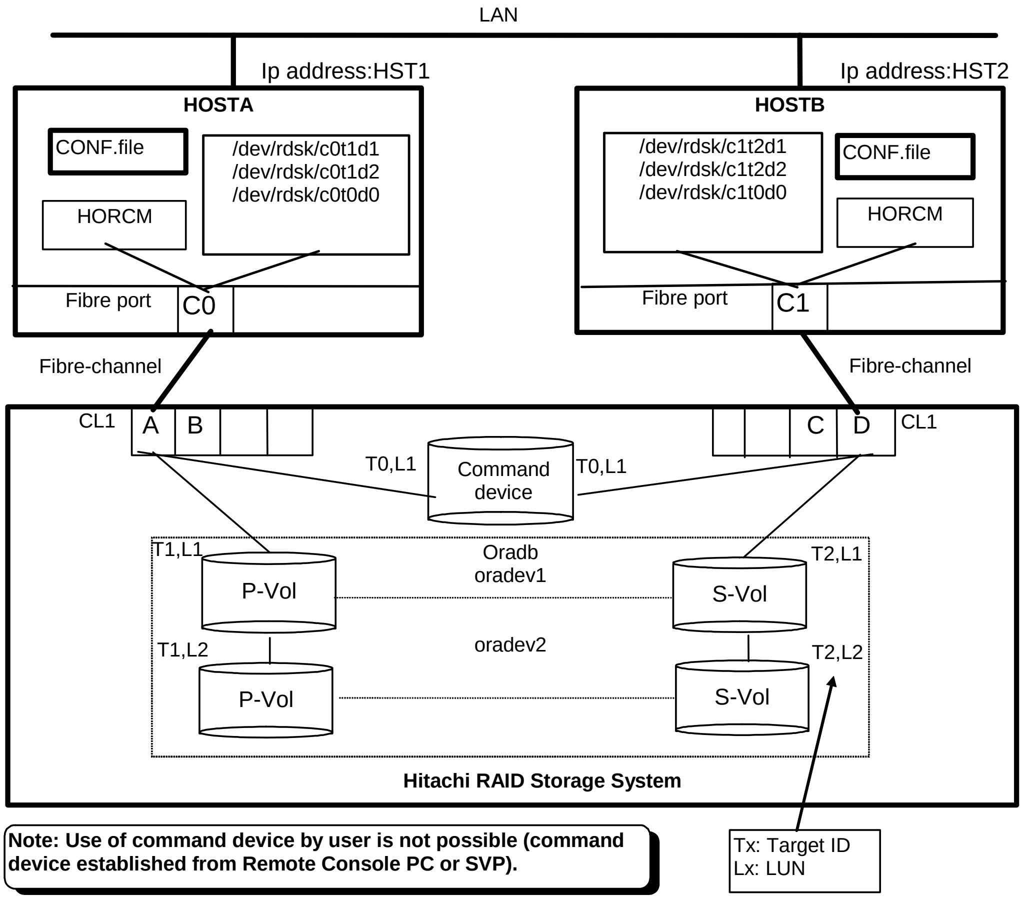
```
Group   PairVol(L/R)   (P,T#,L#),  Seq#,LDEV#..P/S,    Status,  Fence,    Seq#,P-LDEV#  M
oradb   oradev1(L)   (CL1-D, 2,1)  30054  19...S-VOL   COPY     NEVER,   -----      18  -
oradb   oradev1(R)   (CL1-A, 1,1)  30053  18...P-VOL   COPY     NEVER,   30054      19  -
oradb   oradev2(L)   (CL1-D, 2,2)  30054  21...S-VOL   COPY     NEVER,   -----      20  -
oradb   oradev2(R)   (CL1-A, 1,2)  30053  20...P-VOL   COPY     NEVER,   30054      21  -
```

The command device is defined using the system raw device name (character-type device file name). For example, the command devices for Figure 2.41 would be:

- **HP-UX:**
  HORCM_CMD of HOSTA = /dev/rdsk/c0t0d1
  HORCM_CMD of HOSTB = /dev/rdsk/c1t0d1
- **Solaris:**
  HORCM_CMD of HOSTA = /dev/rdsk/c0t0d1s2
  HORCM_CMD of HOSTB = /dev/rdsk/c1t0d1s2

  Note: For Solaris operations with CCI version 01-09-03/04 and higher, the command device does not need to be labeled during format command.
- **AIX:**
  HORCM_CMD of HOSTA = /dev/rhdiskXX
  HORCM_CMD of HOSTB = /dev/rhdiskXX
  where XX = device number assigned by AIX
- **Tru64 UNIX:**
  HORCM_CMD of HOSTA = /dev/rrzbXXc
  HORCM_CMD of HOSTB = /dev/rrzbXXc
  where XX = device number assigned by Tru64 UNIX
- **DYNIX/ptx®:**
  HORCM_CMD of HOSTA = /dev/rdsk/sdXX
  HORCM_CMD of HOSTB = /dev/rdsk/sdXX
  where XX = device number assigned by DYNIX/ptx®
- **Windows 2008/2003/2000:**
  HORCM_CMD of HOSTA = \\.\CMD-Ser#-ldev#-Port#
  HORCM_CMD of HOSTB = \\.\CMD-Ser#-ldev#-Port#
- **Windows NT:**
  HORCM_CMD of HOSTA = \\.\CMD-Ser#-ldev#-Port#
  HORCM_CMD of HOSTB = \\.\CMD-Ser#-ldev#-Port#
- **Linux, zLinux:**
  HORCM_CMD of HOSTA = /dev/sdX
  HORCM_CMD of HOSTB = /dev/sdX
  where X = device number assigned by Linux, zLinux
- **IRIX:**

HORCM_CMD for HOSTA ...	/dev/rdsk/dks0d0l1vol **or** /dev/rdsk/node_wwn/lun1vol/c0p0
HORCM_CMD for HOSTB ...	/dev/rdsk/dks1d0l1vol **or** /dev/rdsk/node_wwn/lun1vol/c1p0



Note: Use of command device by user is not possible (command device established from Remote Console PC or SVP).

Configuration file for HOSTA (/etc/horcm.conf)

```
HORCM_MON
#ip_address   service    poll(10ms)    timeout(10ms)
HST1          horcm      1000          3000

HORCM_CMD
#dev_name
/dev/xxx  [Note 1]

HORCM_DEV
#dev_group     dev_name     port#     TargetID  LU#
 Oradb         oradev1      CL1-A          1     1
 Oradb         oradev2      CL1-A          1     2

HORCM_INST
#dev_group      ip_address        service
 Oradb          HST2              horcm
```

Configuration file for HOSTB (/etc/horcm.conf)

```
HORCM_MON
#ip_address   service    poll(10ms)    timeout(10ms)
HST2          horcm      1000          3000

HORCM_CMD
#dev_name
 /dev/xxx  [Note 1]

HORCM_DEV
#dev_group     dev_name     port#     TargetID  LU#
 Oradb         oradev1      CL1-D          2     1
 Oradb         oradev2      CL1-D          2     2

HORCM_INST
#dev_group      ip_address        service
 Oradb          HST1              horcm
```

Figure 2.41 Hitachi TrueCopy Local Configuration Example

Example of CCI commands with HOSTA:

- Designate a group name (Oradb) and a local host P- VOL a case.
  # paircreate -g Oradb -f never -vl

  This command creates pairs for all LUs assigned to group **Oradb** in the configuration definition file (two pairs for the configuration in Figure 2.41).

- Designate a volume name (oradev1) and a local host P-VOL a case.
  # paircreate -g Oradb -d oradev1 -f never -vl

  This command creates pairs for all LUs designated as **oradev1** in the configuration definition file (CL1-A,T1,L1 and CL1-D,T2,L1 for the configuration in Figure 2.41).

- Designate a group name and display pair status.
  # pairdisplay -g Oradb

```
Group   PairVol(L/R) (P,T#,L#),  Seq#, LDEV#..P/S,      Status,  Fence,     Seq#,  P-LDEV# M
oradb   oradev1(L)   (CL1-A, 1,1) 30053    18..    P-VOL  COPY  NEVER ,30053       19     -
oradb   oradev1(R)   (CL1-D, 2,1) 30053    19..    S-VOL  COPY  NEVER ,-----        18     -
oradb   oradev2(L)   (CL1-A, 1,2) 30053    20..    P-VOL  COPY  NEVER ,30053       21     -
oradb   oradev2(R)   (CL1-D, 2,2) 30053    21..    S-VOL  COPY  NEVER ,-----         20     -
```

Example of CCI commands with HOSTB:

- Designate a group name and a remote host P-VOL a case.
  # paircreate -g Oradb -f never -vr

  This command creates pairs for all LU designated as **Oradb** in the configuration definition file (two pairs for the configuration in Figure 2.41).
- Designate a volume name (oradev1) and a remote host P-VOL a case.
  # paircreate -g Oradb -d oradev1 -f never -vr

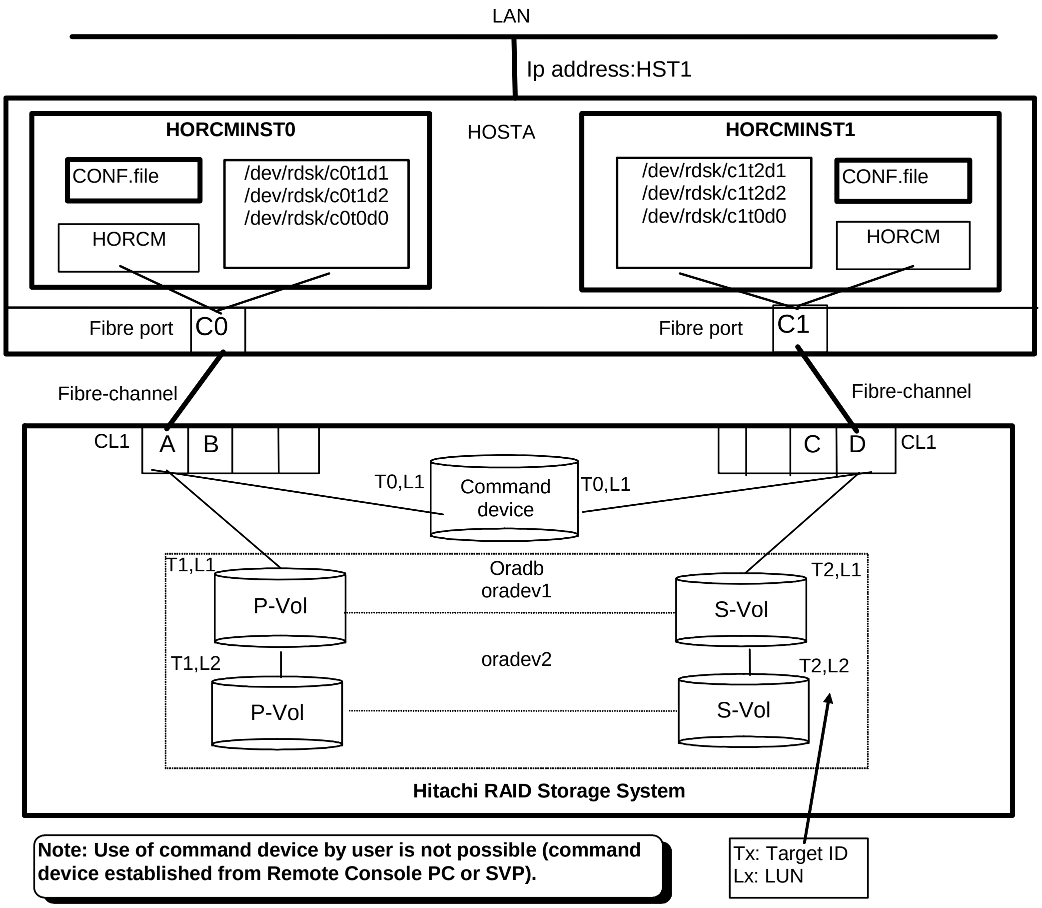
  This command creates pairs for all LUs designated as **oradev1** in the configuration definition file (CL1-A,T1,L1 and CL1-D,T2,L1 for the configuration in Figure 2.41).
- Designate a group name and display pair status.
  # pairdisplay -g Oradb

```
Group   PairVol(L/R) (P,T#,L#),   Seq#,LDEV#..P/S,      Status,  Fence,    Seq#,P-LDEV# M
oradb   oradev1(L)   (CL1-D, 2,1) 30053   19..    S-VOL COPY  NEVER ,-----          18  -
oradb   oradev1(R)   (CL1-A, 1,1) 30053   18..    P-VOL COPY  NEVER ,30053        19  -
oradb   oradev2(L)   (CL1-D, 2,2) 30053   21..    S-VOL COPY  NEVER ,-----          20  -
oradb   oradev2(R)   (CL1-A, 1,2) 30053   20..    P-VOL COPY  NEVER ,30053        21  -
```

The command device is defined using the system raw device name (character-type device file name). The command device defined in the configuration definition file must be established in a way to be following either every instance. If one command device is used between different instances on the same SCSI port, then the number of instances is up to 16 per command device. If this restriction is exceeded, then use a different SCSI path for each instance. For example, the command devices for Figure 2.42 would be:

- **HP-UX:**
  HORCM_CMD of HORCMINST0 = /dev/rdsk/c0t0d1
  HORCM_CMD of HORCMINST1 = /dev/rdsk/c1t0d1
- **Solaris:**
  HORCM_CMD of HORCMINST0 = /dev/rdsk/c0t0d1s2
  HORCM_CMD of HORCMINST1 = /dev/rdsk/c1t0d1s2

  Note: For Solaris operations with CCI version 01-09-03/04 and higher, the command device does not need to be labeled during format command.
- **AIX:**
  HORCM_CMD of HORCMINST0 = /dev/rhdiskXX
  HORCM_CMD of HORCMINST1 = /dev/rhdiskXX
  where XX = device number assigned by AIX
- **Tru64 UNIX:**
  HORCM_CMD of HORCMINST0 = /dev/rrzbXXc
  HORCM_CMD of HORCMINST1 = /dev/rrzbXXc
  where XX = device number assigned by Tru64 UNIX
- **DYNIX/ptx®:**
  HORCM_CMD of HORCMINST0 = /dev/rdsk/sdXX
  HORCM_CMD of HORCMINST1 = /dev/rdsk/sdXX
  where XX = device number assigned by DYNIX/ptx®
- **Windows 2008/2003/2000:**
  HORCM_CMD of HORCMINST0 = \\.\CMD-Ser#-ldev#-Port#
  HORCM_CMD of HORCMINST1 = \\.\CMD-Ser#-ldev#-Port#
- **Windows NT:**
  HORCM_CMD of HORCMINST0 = \\.\CMD-Ser#-ldev#-Port#
  HORCM_CMD of HORCMINST1 = \\.\CMD-Ser#-ldev#-Port#
- **Linux, zLinux:**
  HORCM_CMD of HORCMINST0 = /dev/sdX
  HORCM_CMD of HORCMINST1 = /dev/sdX
  where X = device number assigned by Linux, zLinux
- **IRIX:**
  HORCM_CMD for HOSTA (/etc/horcm0.conf)... /dev/rdsk/dks0d0l1vol **or** /dev/rdsk/node_wwn/lun1vol/c0p0
  HORCM_CMD for HOSTA (/etc/horcm1.conf)... /dev/rdsk/dks1d0l1vol **or** /dev/rdsk/node_wwn/lun1vol/c1p0



Note: Use of command device by user is not possible (command device established from Remote Console PC or SVP).

Configuration file for HORCMINST0 (**horcm0.conf**)

```
HORCM_MON
#ip_address  service   poll(10ms)   timeout(10ms)
HST1         horcm0       1000          3000

HORCM_CMD
#dev_name
 /dev/xxx  [Note 1]

HORCM_DEV
#dev_group    dev_name    port#    TargetID  LU#
 Oradb        oradev1     CL1-A           1    1
 Oradb        oradev2     CL1-A           1    2

HORCM_INST
#dev_group      ip_address       service
 Oradb          HST1             horcm1
```

Configuration file for HORCMINST1 (**horcm1.conf**)

```
HORCM_MON
#ip_address  service   poll(10ms)   timeout(10ms)
HST1         horcm1       1000          3000

HORCM_CMD
#dev_name
 /dev/xxx  [Note 1]

HORCM_DEV
#dev_group    dev_name    port#    TargetID  LU#
 Oradb        oradev1     CL1-D           2    1
 Oradb        oradev2     CL1-D           2    2

HORCM_INST
#dev_group      ip_address       service
 Oradb          HST1             horcm0
```

Figure 2.42 Hitachi TrueCopy Configuration Example for Two Instances

Example of CCI commands with Instance-0 on HOSTA:

- When the command execution environment is not set, set an instance number.

  For C shell: **# setenv HORCMINST 0**
  For Windows: **set HORCMINST=0**

- Designate a group name (Oradb) and a local instance P- VOL a case.
  # paircreate -g Oradb -f never -vl

  This command creates pairs for all LUs assigned to group **Oradb** in the configuration definition file (two pairs for the configuration in Figure 2.42).

- Designate a volume name (oradev1) and a local instance P-VOL a case.
  # paircreate   -g Oradb -d oradev1 -f never   -vl

  This command creates pairs for all LUs designated as **oradev1** in the configuration definition file (CL1-A,T1,L1 and CL1-D,T2,L1 for the configuration in Figure 2.42).

- Designate a group name and display pair status.

```
# pairdisplay  -g Oradb
Group  PairVol(L/R) (P,T#,L#),  Seq#,    LDEV#.. P/S,   Status, Fence,  Seq#,  P-LDEV# M
oradb  oradev1(L)   (CL1-A, 1,1) 30053   18..    P-VOL  COPY    NEVER , 30053  19      -
oradb  oradev1(R)   (CL1-D, 2,1) 30053   19..    S-VOL  COPY    NEVER , -----  18      -
oradb  oradev2(L)   (CL1-A, 1,2) 30053   20..    P-VOL  COPY    NEVER , 30053  21      -
oradb  oradev2(R)   (CL1-D, 2,2) 30053   21..    S-VOL  COPY    NEVER , -----  20      -
```

Example of CCI commands with Instance-1 on HOSTA:

- When the command execution environment is not set, set an instance number.

  For C shell: **# setenv HORCMINST 1**
  For Windows: **set HORCMINST=1**

- Designate a group name and a remote instance P-VOL a case.
  # paircreate -g Oradb -f never -vr

  This command creates pairs for all LU designated as **Oradb** in the configuration definition file (two pairs for the configuration in Figure 2.42).

- Designate a volume name (oradev1) and a remote instance P-VOL a case.
  # paircreate -g Oradb -d oradev1 -f never -vr

  This command creates pairs for all LUs designated as **oradev1** in the configuration definition file (CL1-A,T1,L1 and CL1-D,T2,L1 for the configuration in Figure 2.42).

- Designate a group name and display pair status.

```
# pairdisplay  -g  Oradb
Group  PairVol(L/R) (P,T#,L#),   Seq#,   LDEV#.. P/S,  Status, Fence,  Seq#,  P-LDEV#  M
oradb  oradev1(L)   (CL1-D, 2,1) 30053   19..    S-VOL COPY    NEVER , -----  18       -
oradb  oradev1(R)   (CL1-A, 1,1) 30053   18..    P-VOL COPY    NEVER , 30053  19       -
oradb  oradev2(L)   (CL1-D, 2,2) 30053   21..    S-VOL COPY    NEVER , -----  20       -
oradb  oradev2(R)   (CL1-A, 1,2) 30053   20..    P-VOL COPY    NEVER , 30053  21       -
```

The command device is defined using the system raw device name (character-type device file name). For example, the command devices for Figure 2.43 would be:

- **HP-UX:**
  HORCM_CMD of HOSTA = /dev/rdsk/c0t0d1
  HORCM_CMD of HOSTB = /dev/rdsk/c1t0d1
  HORCM_CMD of HOSTC = /dev/rdsk/c1t0d1
  HORCM_CMD of HOSTD = /dev/rdsk/c1t0d1

- **Solaris:**
  HORCM_CMD of HOSTA = /dev/rdsk/c0t0d1s2
  HORCM_CMD of HOSTB = /dev/rdsk/c1t0d1s2
  HORCM_CMD of HOSTC = /dev/rdsk/c1t0d1s2
  HORCM_CMD of HOSTD = /dev/rdsk/c1t0d1s2

  Note: For Solaris operations with CCI version 01-09-03/04 and higher, the command device does not need to be labeled during format command.

- **AIX:**
  HORCM_CMD of HOSTA = /dev/rhdiskXX
  HORCM_CMD of HOSTB = /dev/rhdiskXX
  HORCM_CMD of HOSTC = /dev/rhdiskXX
  HORCM_CMD of HOSTD = /dev/rhdiskXX
  where XX = device number assigned by AIX

- **Tru64 UNIX:**
  HORCM_CMD of HOSTA = /dev/rrzbXXc
  HORCM_CMD of HOSTB = /dev/rrzbXXc
  HORCM_CMD of HOSTC = /dev/rrzbXXc
  HORCM_CMD of HOSTD = /dev/rrzbXXc
  where XX = device number assigned by Tru64 UNIX

- **DYNIX/ptx®:**
  HORCM_CMD of HOSTA = /dev/rdsk/sdXX
  HORCM_CMD of HOSTB = /dev/rdsk/sdXX
  HORCM_CMD of HOSTC = /dev/rdsk/sdXX
  HORCM_CMD of HOSTD = /dev/rdsk/sdXX
  where XX = device number assigned by DYNIX/ptx®

- **Windows 2008/2003/2000:**
  HORCM_CMD of HOSTA = \\.\CMD-Ser#-ldev#-Port#
  HORCM_CMD of HOSTB = \\.\CMD-Ser#-ldev#-Port#
  HORCM_CMD of HOSTC = \\.\CMD-Ser#-ldev#-Port#
  HORCM_CMD of HOSTD = \\.\CMD-Ser#-ldev#-Port#

- **Windows NT:**
  HORCM_CMD of HOSTA = \\.\CMD-Ser#-ldev#-Port#
  HORCM_CMD of HOSTB = \\.\CMD-Ser#-ldev#-Port#
  HORCM_CMD of HOSTC = \\.\CMD-Ser#-ldev#-Port#
  HORCM_CMD of HOSTD = \\.\CMD-Ser#-ldev#-Port#

- **Linux, zLinux:**
  HORCM_CMD of HOSTA = /dev/sdX
  HORCM_CMD of HOSTB = /dev/sdX
  HORCM_CMD of HOSTC = /dev/sdX
  HORCM_CMD of HOSTD = /dev/sdX
  where X = device number assigned by Linux, zLinux
- **IRIX:**
  ```
  HORCM_CMD for HOSTA ...  /dev/rdsk/dks0d0l1vol  or
                           /dev/rdsk/node_wwn/lun1vol/c0p0
  HORCM_CMD for HOSTB ...  /dev/rdsk/dks1d0l1vol  or
                           /dev/rdsk/node_wwn/lun1vol/c1p0
  HORCM_CMD for HOSTC ...  /dev/rdsk/dks1d0l1vol  or
                           /dev/rdsk/node_wwn/lun1vol/c1p0
  HORCM_CMD for HOSTD ...  /dev/rdsk/dks1d0l1vol  or
                           /dev/rdsk/node_wwn/lun1vol/c1p0
  ```

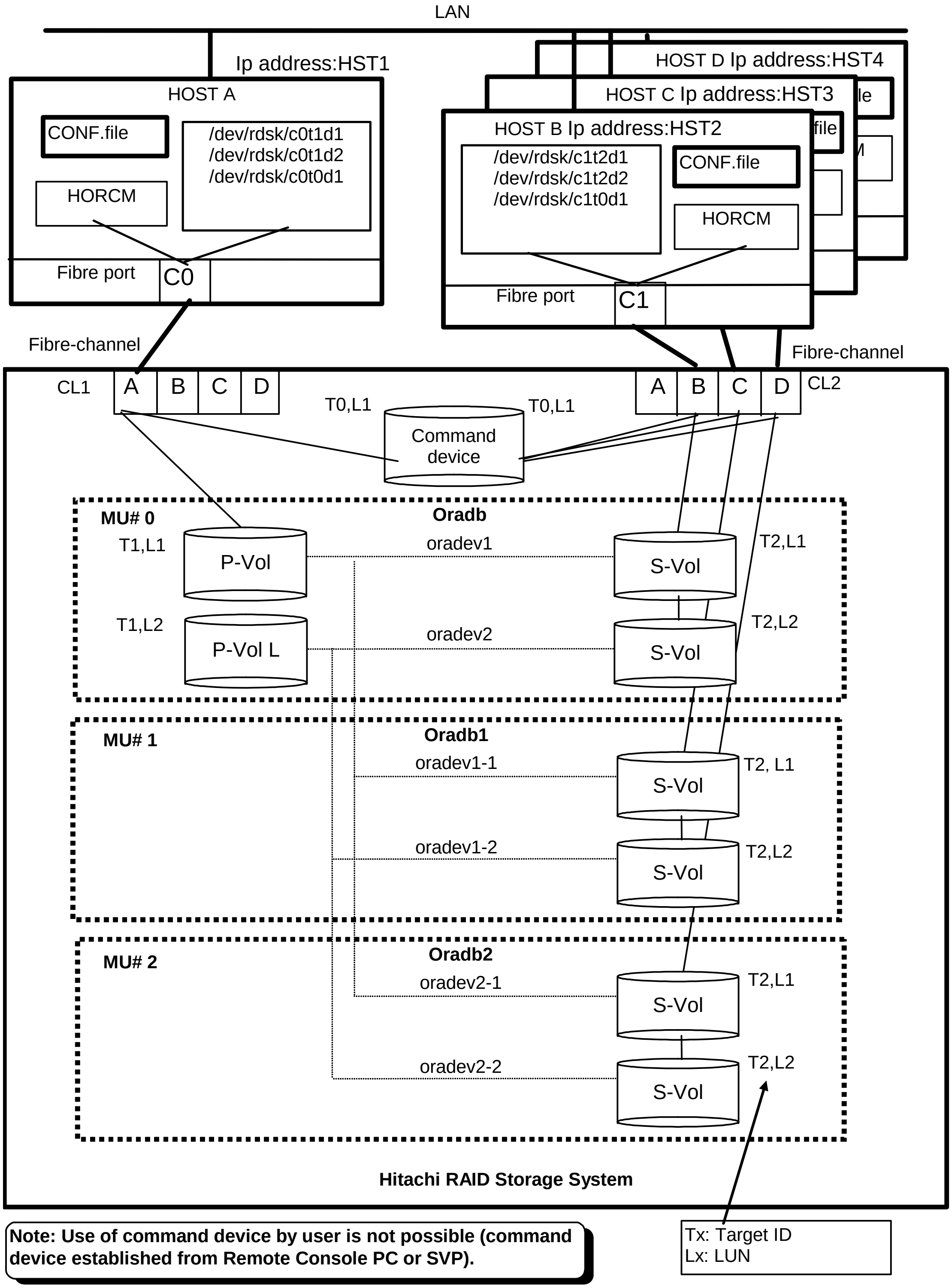
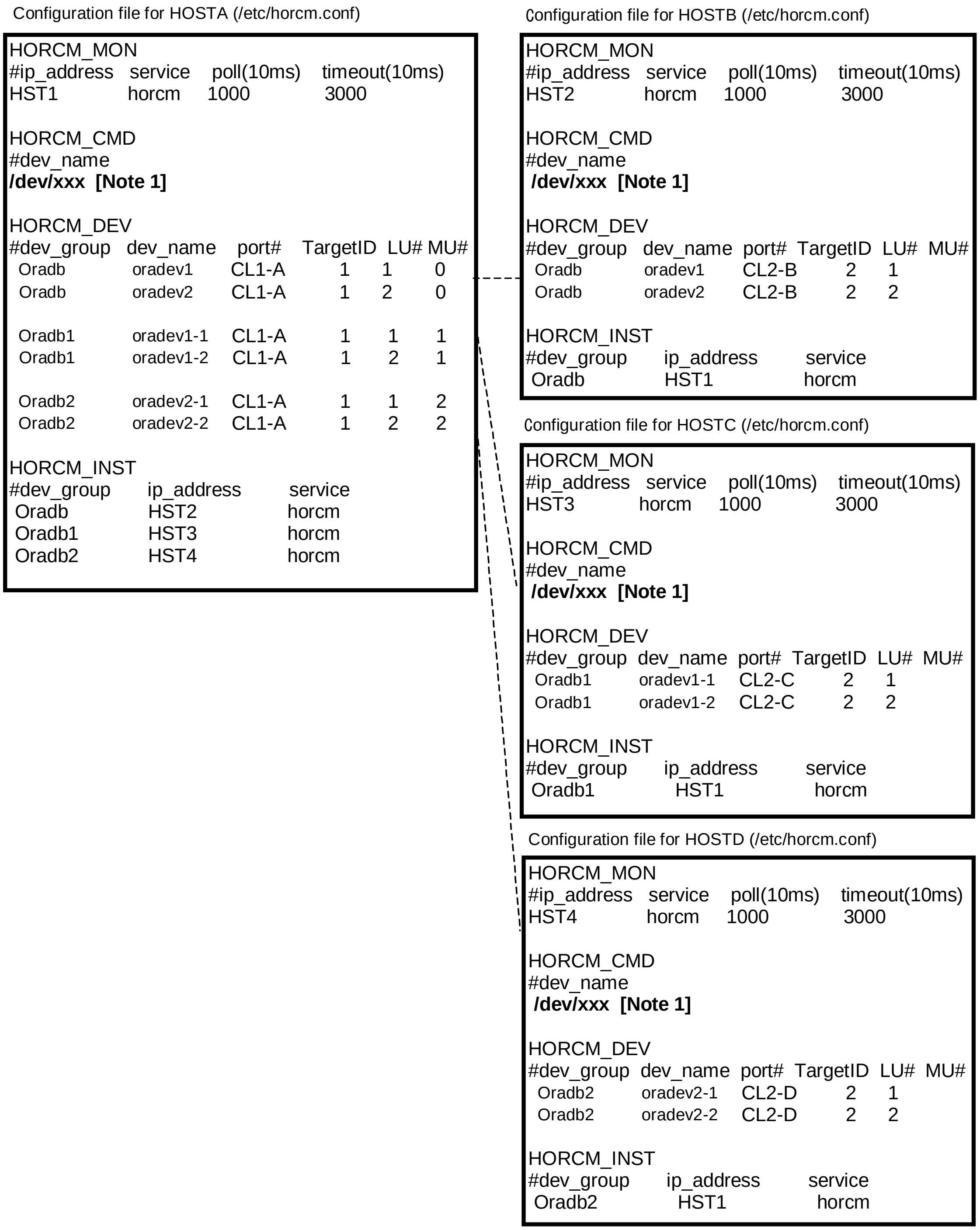


Figure 2.43 ShadowImage Configuration Example (continues on the next page)



Configuration file for HOSTA (/etc/horcm.conf)

```
HORCM_MON
#ip_address   service    poll(10ms)    timeout(10ms)
HST1          horcm      1000          3000

HORCM_CMD
#dev_name
/dev/xxx  [Note 1]

HORCM_DEV
#dev_group   dev_name    port#    TargetID  LU#  MU#
 Oradb       oradev1     CL1-A       1      1     0
 Oradb       oradev2     CL1-A       1      2     0

 Oradb1      oradev1-1   CL1-A       1      1     1
 Oradb1      oradev1-2   CL1-A       1      2     1

 Oradb2      oradev2-1   CL1-A       1      1     2
 Oradb2      oradev2-2   CL1-A       1      2     2

HORCM_INST
#dev_group      ip_address       service
 Oradb          HST2             horcm
 Oradb1         HST3             horcm
 Oradb2         HST4             horcm
```

Configuration file for HOSTB (/etc/horcm.conf)

```
HORCM_MON
#ip_address   service    poll(10ms)    timeout(10ms)
HST2          horcm      1000          3000

HORCM_CMD
#dev_name
 /dev/xxx  [Note 1]

HORCM_DEV
#dev_group   dev_name   port#   TargetID   LU#   MU#
 Oradb       oradev1    CL2-B      2        1
 Oradb       oradev2    CL2-B      2        2

HORCM_INST
#dev_group      ip_address       service
 Oradb          HST1             horcm
```

Configuration file for HOSTC (/etc/horcm.conf)

```
HORCM_MON
#ip_address   service    poll(10ms)    timeout(10ms)
HST3          horcm      1000          3000

HORCM_CMD
#dev_name
 /dev/xxx  [Note 1]

HORCM_DEV
#dev_group   dev_name    port#   TargetID   LU#   MU#
 Oradb1      oradev1-1   CL2-C      2        1
 Oradb1      oradev1-2   CL2-C      2        2

HORCM_INST
#dev_group      ip_address       service
 Oradb1          HST1             horcm
```

Configuration file for HOSTD (/etc/horcm.conf)

```
HORCM_MON
#ip_address   service    poll(10ms)    timeout(10ms)
HST4          horcm      1000          3000

HORCM_CMD
#dev_name
 /dev/xxx  [Note 1]

HORCM_DEV
#dev_group   dev_name    port#   TargetID   LU#   MU#
 Oradb2      oradev2-1   CL2-D      2        1
 Oradb2      oradev2-2   CL2-D      2        2

HORCM_INST
#dev_group      ip_address       service
 Oradb2          HST1             horcm
```

Figure 2.43   ShadowImage Configuration Example (continued)

Example of CCI commands with HOSTA (group Oradb):

- When the command execution environment is not set, set HORCC_MRCF to the environment variable.

  For C shell: **# setenv HORCC_MRCF 1**
  Windows: **set HORCC_MRCF=1**

- Designate a group name (Oradb) and a local host P-VOL a case.
  # paircreate -g Oradb -vl

  This command creates pairs for all LUs assigned to group **Oradb** in the configuration definition file (two pairs for the configuration in Figure 2.43).

- Designate a volume name (oradev1) and a local host P-VOL a case.
  # paircreate -g Oradb -d oradev1 -vl

  This command creates pairs for all LUs designated as **oradev1** in the configuration definition file (CL1-A,T1,L1 and CL1-D,T2,L1 for the configuration in Figure 2.43).

- Designate a group name and display pair status.
  # pairdisplay -g Oradb

```
Group   PairVol(L/R) (Port#,TID,LU-M), Seq#,LDEV#..P/S,      Status, Seq#,P-LDEV# M
oradb   oradev1(L)  (CL1-A,  1,  1 - 0)      30053      18..P-VOL COPY  30053        20  -
oradb   oradev1(R)  (CL2-B,  2,  1 - 0)      30053      20..S-VOL COPY   -----       18  -
oradb   oradev2(L)  (CL1-A,  1,  2 - 0)      30053      19..P-VOL COPY  30053        21  -
oradb   oradev2(R)  (CL2-B,  2,  2 - 0)      30053      21..S-VOL COPY   -----        19  -
```

Example of CCI commands with HOSTB (group Oradb):

- When the command execution environment is not set, set HORCC_MRCF to the environment variable.

  For C shell: **# setenv HORCC_MRCF 1**
  Windows: **set HORCC_MRCF=1**

- Designate a group name and a remote host P-VOL a case.
  # paircreate -g Oradb -vr

  This command creates pairs for all LUs assigned to group **Oradb** in the configuration definition file (two pairs for the configuration in Figure 2.43).

- Designate a volume name (oradev1) and a remote host P-VOL a case.
  # paircreate -g Oradb -d oradev1 -vr

  This command creates pairs for all LUs designated as **oradev1** in the configuration definition file (CL1-A,T1,L1 and CL1-D,T2,L1 for the configuration in Figure 2.43).

- Designate a group name and display pair status.
  # pairdisplay -g Oradb

```
Group   PairVol(L/R) (Port#,TID,LU-M), Seq#,LDEV#..P/S,      Status, Seq#,P-LDEV# M
oradb   oradev1(L)  (CL2-B,  2,  1 - 0)    30053       20..S-VOL COPY   -----        18  -
oradb   oradev1(R)  (CL1-A,  1,  1 - 0)    30053       18..P-VOL COPY  30053        20  -
oradb   oradev2(L)  (CL2-B,  2,  2 - 0)    30053       21..S-VOL COPY   -----        19  -
oradb   oradev2(R)  (CL1-A,  1,  2 - 0)    30053       19..P-VOL COPY  30053        21  -
```

Example of CCI commands with HOSTA (group Oradb1):

- When the command execution environment is not set, set HORCC_MRCF to the environment variable.

  For C shell: **# setenv HORCC_MRCF 1**
  For Windows: **set HORCC_MRCF=1**

- Designate a group name (Oradb1) and a local host P-VOL a case.
  # paircreate -g Oradb1 -vl

  This command creates pairs for all LUs assigned to group **Oradb1** in the configuration definition file (two pairs for the configuration in Figure 2.43).

- Designate a volume name (oradev1-1) and a local host P-VOL a case.
  # paircreate -g Oradb1 -d oradev1-1 -vl

  This command creates pairs for all LUs designated as **oradev1-1** in the configuration definition file (CL1-A,T1,L1 and CL1-D,T2,L1 for the configuration in Figure 2.43).

- Designate a group name, and display pair status.
  # pairdisplay -g Oradb1

```
Group    PairVol(L/R) (Port#,TID,LU-M),   Seq#,LDEV#..P/S,      Status, Seq#,P-LDEV# M
oradb1   oradev1-1(L)  (CL1-A,  1,  1 - 1)    30053      18..P-VOL COPY  30053        22  -
oradb1   oradev1-1(R)  (CL2-C,  2,  1 - 0)    30053      22..S-VOL COPY   -----        18  -
oradb1   oradev1-2(L)  (CL1-A,  1,  2 - 1)    30053      19..P-VOL COPY  30053        23  -
oradb1   oradev1-2(R)  (CL2-C,  2,  2 - 0)    30053      23..S-VOL COPY   -----        19  -
```

Example of CCI commands with HOSTC (group Oradb1):

- When the command execution environment is not set, set HORCC_MRCF to the environment variable.

  For C shell: **# setenv HORCC_MRCF 1**
  For Windows: **set HORCC_MRCF=1**

- Designate a group name and a remote host P-VOL a case.
  # paircreate -g Oradb1 -vr

  This command creates pairs for all LUs assigned to group **Oradb1** in the configuration definition file (two pairs for the configuration in Figure 2.43).

- Designate a volume name (oradev1-1) and a remote host P-VOL a case.
  # paircreate -g Oradb1 -d oradev1-1 -vr

  This command creates pairs for all LUs designated as **oradev1-1** in the configuration definition file (CL1-A,T1,L1 and CL1-D,T2,L1 for the configuration in Figure 2.43).

- Designate a group name and display pair status.
  # pairdisplay -g Oradb1

```
Group    PairVol(L/R) (Port#,TID,LU-M),    Seq#,  LDEV#..P/S,      Status, Seq#,P-LDEV# M
oradb1   oradev1-1(L)  (CL2-C,  2,  1 - 0)    30053       22..S-VOL COPY   -----        18  -
oradb1   oradev1-1(R)  (CL1-A,  1,  1 - 1)    30053       18..P-VOL COPY  30053        22  -
oradb1   oradev1-2(L)  (CL2-C,  2,  2 - 0)    30053       23..S-VOL COPY   -----        19  -
oradb1   oradev1-2(R)  (CL1-A,  1,  2 - 1)    30053       19..P-VOL COPY  30053        23  -
```

Example of CCI commands with HOSTA (group Oradb2):

- When the command execution environment is not set, set HORCC_MRCF to the environment variable.

  For C shell: **# setenv HORCC_MRCF 1**
  For Windows: **set HORCC_MRCF=1**

- Designate a group name (Oradb2) and a local host P-VOL a case.
  # paircreate -g Oradb2 -vl

  This command creates pairs for all LUs assigned to group **Oradb2** in the configuration definition file (two pairs for the configuration in Figure 2.43).

- Designate a volume name (oradev2-1) and a local host P-VOL a case.
  # paircreate -g Oradb2 -d oradev2-1 -vl

  This command creates pairs for all LUs designated as **oradev2-1** in the configuration definition file (CL1-A,T1,L1 and CL1-D,T2,L1 for the configuration in Figure 2.43).

- Designate a group name and display pair status.
  # pairdisplay -g Oradb2

```
Group   PairVol(L/R) (Port#,TID,LU-M),   Seq#,LDEV#..P/S,      Status, Seq#,P-LDEV# M
oradb2  oradev2-1(L)  (CL1-A,  1,  1 - 2)   30053      18..P-VOL COPY  30053        24  -
oradb2  oradev2-1(R)  (CL2-D,  2,  1 - 0)   30053      24..S-VOL COPY   -----        18  -
oradb2  oradev2-2(L)  (CL1-A,  1,  2 - 2)   30053      19..P-VOL COPY  30053        25  -
oradb2  oradev2-2(R)  (CL2-D,  2,  2 - 0)   30053      25..S-VOL COPY   -----        19  -
```

Example of CCI commands with HOSTD (group Oradb2):

- When the command execution environment is not set, set HORCC_MRCF to the environment variable.

  For C shell: **# setenv HORCC_MRCF 1**
  For Windows: **set HORCC_MRCF=1**

- Designate a group name and a remote host P-VOL a case.
  # paircreate -g Oradb2 -vr

  This command creates pairs for all LUs assigned to group **Oradb2** in the configuration definition file (two pairs for the configuration in Figure 2.43).

- Designate a volume name (oradev2-1) and a remote host P-VOL a case.
  # paircreate -g Oradb2 -d oradev2-1 -vr

  This command creates pairs for all LUs designated as **oradev2-1** in the configuration definition file (CL1-A,T1,L1 and CL1-D,T2,L1 for the configuration in Figure 2.43).

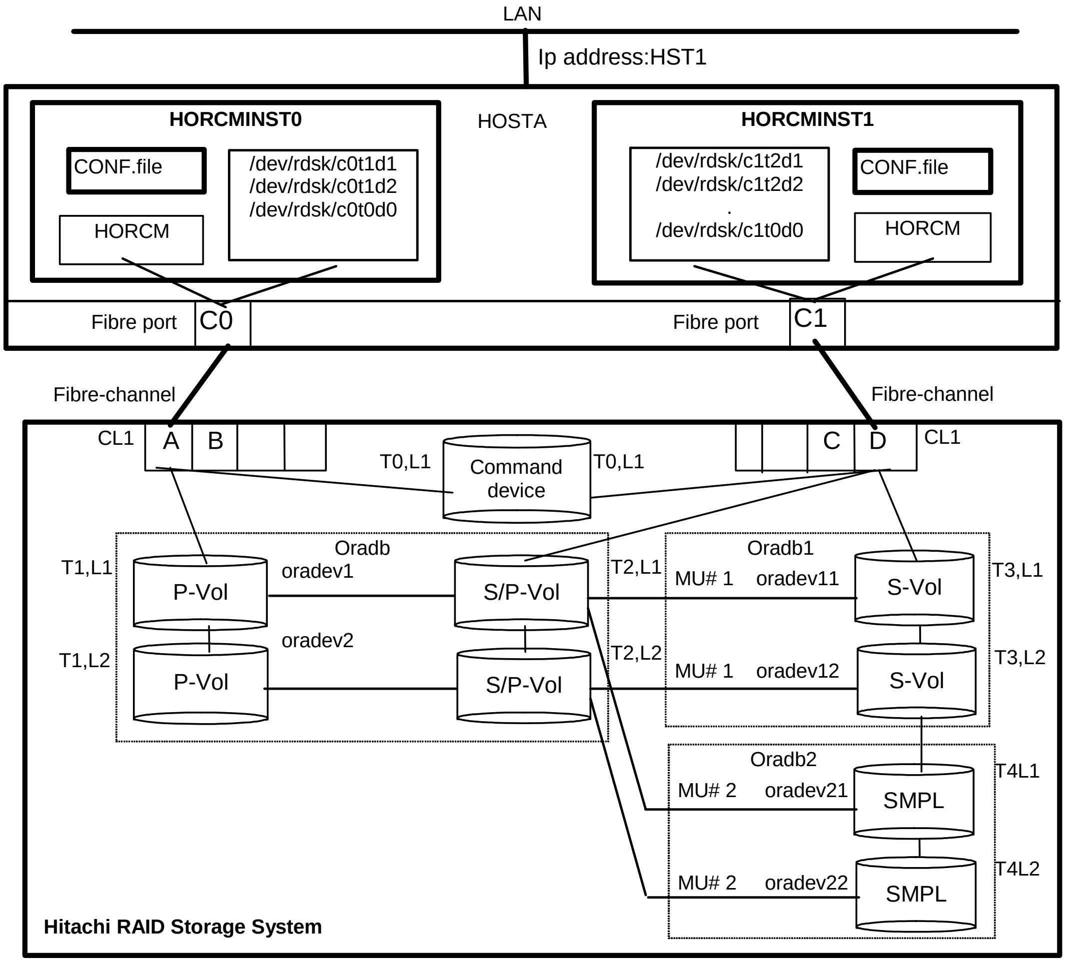
- Designate a group name and display pair status.
  # pairdisplay -g Oradb2

```
Group   PairVol(L/R) (Port#,TID,LU-M),    Seq#,  LDEV#..P/S,      Status, Seq#,P-LDEV# M
oradb2  oradev2-1(L)  (CL2-D,  2,  1 - 0)    30053       24..S-VOL COPY   -----        18  -
oradb2  oradev2-1(R)  (CL1-A,  1,  1 - 2)    30053       18..P-VOL COPY  30053        24  -
oradb2  oradev2-2(L)  (CL2-D,  2,  2 - 0)    30053       25..S-VOL COPY   -----        19  -
oradb2  oradev2-2(R)  (CL1-A,  1,  2 - 2)    30053       19..P-VOL COPY  30053        25  -
```

The command device is defined using the system raw device name (character-type device file name). The command device defined in the configuration definition file must be established in a way to be following either every instance. If one command device is used between different instances on the same SCSI port, then the number of instances is up to 16 per command device. If this restriction is exceeded, then use a different SCSI path for each instance. For example, the command devices for Figure 2.44 would be:

- **HP-UX:**
  HORCM_CMD of HORCMINST0 = /dev/rdsk/c0t0d1
  HORCM_CMD of HORCMINST1 = /dev/rdsk/c1t0d1
- **Solaris:**
  HORCM_CMD of HORCMINST0 = /dev/rdsk/c0t0d1s2
  HORCM_CMD of HORCMINST1 = /dev/rdsk/c1t0d1s2

  Note: For Solaris operations with CCI version 01-09-03/04 and higher, the command device does not need to be labeled during format command.
- **AIX:**
  HORCM_CMD of HORCMINST0 = /dev/rhdiskXX
  HORCM_CMD of HORCMINST1 = /dev/rhdiskXX
  where XX = device number assigned by AIX
- **Tru64 UNIX:**
  HORCM_CMD of HORCMINST0 = /dev/rrzbXXc
  HORCM_CMD of HORCMINST1 = /dev/rrzbXXc
  where XX = device number assigned by Tru64 UNIX
- **DYNIX/ptx®:**
  HORCM_CMD of HORCMINST0 = /dev/rdsk/sdXX
  HORCM_CMD of HORCMINST1 = /dev/rdsk/sdXX
  where XX = device number assigned by DYNIX/ptx®
- **Windows 2008/2003/2000:**
  HORCM_CMD of HORCMINST0 = \\.\CMD-Ser#-ldev#-Port#
  HORCM_CMD of HORCMINST1 = \\.\CMD-Ser#-ldev#-Port#
- **Windows NT:**
  HORCM_CMD of HORCMINST0 = \\.\CMD-Ser#-ldev#-Port#
  HORCM_CMD of HORCMINST1 = \\.\CMD-Ser#-ldev#-Port#
- **Linux, zLinux:**
  HORCM_CMD of HORCMINST0 = /dev/sdX
  HORCM_CMD of HORCMINST1 = /dev/sdX
  where X = device number assigned by Linux, zLinux
- **IRIX:**
  HORCM_CMD for HOSTA (/etc/horcm0.conf)... /dev/rdsk/dks0d0l1vol **or**
  /dev/rdsk/node_wwn/lun1vol/c0p0
  HORCM_CMD for HOSTA (/etc/horcm1.conf)... /dev/rdsk/dks1d0l1vol **or**
  /dev/rdsk/node_wwn/lun1vol/c1p0



Configuration file for HOSTA (**/etc/horcm0.conf**)

```
HORCM_MON
#ip_address  service   poll(10ms)   timeout(10ms)
HST1         horcm0       1000           3000

HORCM_CMD
#dev_name
 /dev/xxx  [Note 1]

HORCM_DEV
#dev_group    dev_name    port#   TargetID  LU#   MU#
Oradb          oradev1    CL1-A        1     1     0
Oradb          oradev2    CL1-A        1     2     0
Oradb1         oradev11   CL1-D        3     1     0
Oradb1         oradev12   CL1-D        3     2     0
Oradb2         oradev21   CL1-D        4     1     0
Oradb2         oradev22   CL1-D        4     2     0

HORCM_INST
#dev_group     ip_address    service
 Oradb         HST1          horcm1
 Oradb1        HST1          horcm1
 Oradb2        HST1          horcm1
```

Configuration file for HOSTA (**/etc/horcm1.conf**)

```
HORCM_MON
#ip_address  service   poll(10ms)   timeout(10ms)
HST1         horcm1       1000           3000

HORCM_CMD
#dev_name
 /dev/xxx  [Note 1]

HORCM_DEV
#dev_group    dev_name    port#   TargetID  LU#   MU#
Oradb          oradev1    CL1-D        2     1     0
Oradb          oradev2    CL1-D        2     2     0
Oradb1         oradev11   CL1-D        2     1     1
Oradb1         oradev12   CL1-D        2     2     1
Oradb2         oradev21   CL1-D        2     1     2
Oradb2         oradev22   CL1-D        2     2     2

HORCM_INST
#dev_group     ip_address    service
 Oradb         HST1          horcm0
 Oradb1        HST1          horcm0
 Oradb2        HST1          horcm0
```

Figure 2.44 ShadowImage Configuration Example with Cascade Pairs

Note: See section 2.9.1 for further information on ShadowImage cascading configurations.

Example of CCI commands with Instance-0 on HOSTA:

- When the command execution environment is not set, set an instance number.

```
For C shell:    # setenv  HORCMINST  0
                # setenv  HORCC_MRCF  1
For Windows:      set  HORCMINST=0
                  set  HORCC_MRCF=1
```

- Designate a group name (Oradb) and a local instance P- VOL a case.

```
# paircreate  -g Oradb  -vl
# paircreate  -g Oradb1  -vr
```

  These commands create pairs for all LUs assigned to groups **Oradb** and **Oradb1** in the configuration definition file (four pairs for the configuration in Figure 2.44).

- Designate a group name and display pair status.

```
# pairdisplay -g oradb -m cas
```

```
Group   PairVol(L/R) (Port#,TID,LU-M),Seq#,LDEV#.P/S,Status, Seq#,P-LDEV# M
oradb   oradev1(L)    (CL1-A , 1,  1-0)   30053  266.. P-VOL  PAIR, 30053    268  -
oradb   oradev1(R)    (CL1-D , 2,  1-0)   30053  268.. S-VOL  PAIR, -----    266  -
oradb1  oradev11(R)  (CL1-D , 2,  1-1)   30053  268.. P-VOL  PAIR, 30053    270  -
oradb2  oradev21(R)  (CL1-D , 2,  1-2)   30053  268.. SMPL   ----, -----   ----  -
oradb   oradev2(L)    (CL1-A , 1,  2-0)   30053  267.. P-VOL  PAIR, 30053    269  -
oradb   oradev2(R)    (CL1-D , 2,  2-0)   30053  269.. S-VOL  PAIR, -----    267  -
oradb1  oradev12(R)  (CL1-D , 2,  2-1)   30053  269.. P-VOL  PAIR, 30053    271  -
oradb2  oradev22(R)  (CL1-D , 2,  2-2)   30053  269.. SMPL   ----, -----   ----  -
```

Example of CCI commands with Instance-1 on HOSTA:

- When the command execution environment is not set, set an instance number.

```
For C shell:    # setenv  HORCMINST  1
                # setenv  HORCC_MRCF  1
For Windows:      set  HORCMINST=1
                  set  HORCC_MRCF=1
```

- Designate a group name and a remote instance P-VOL a case.

```
# paircreate  -g Oradb  -vr
# paircreate  -g Oradb1  -vl
```

  These commands create pairs for all LUs assigned to groups **Oradb** and **Oradb1** in the configuration definition file (four pairs for the configuration in Figure 2.44).

- Designate a group name and display pair status.
  # pairdisplay -g oradb -m cas

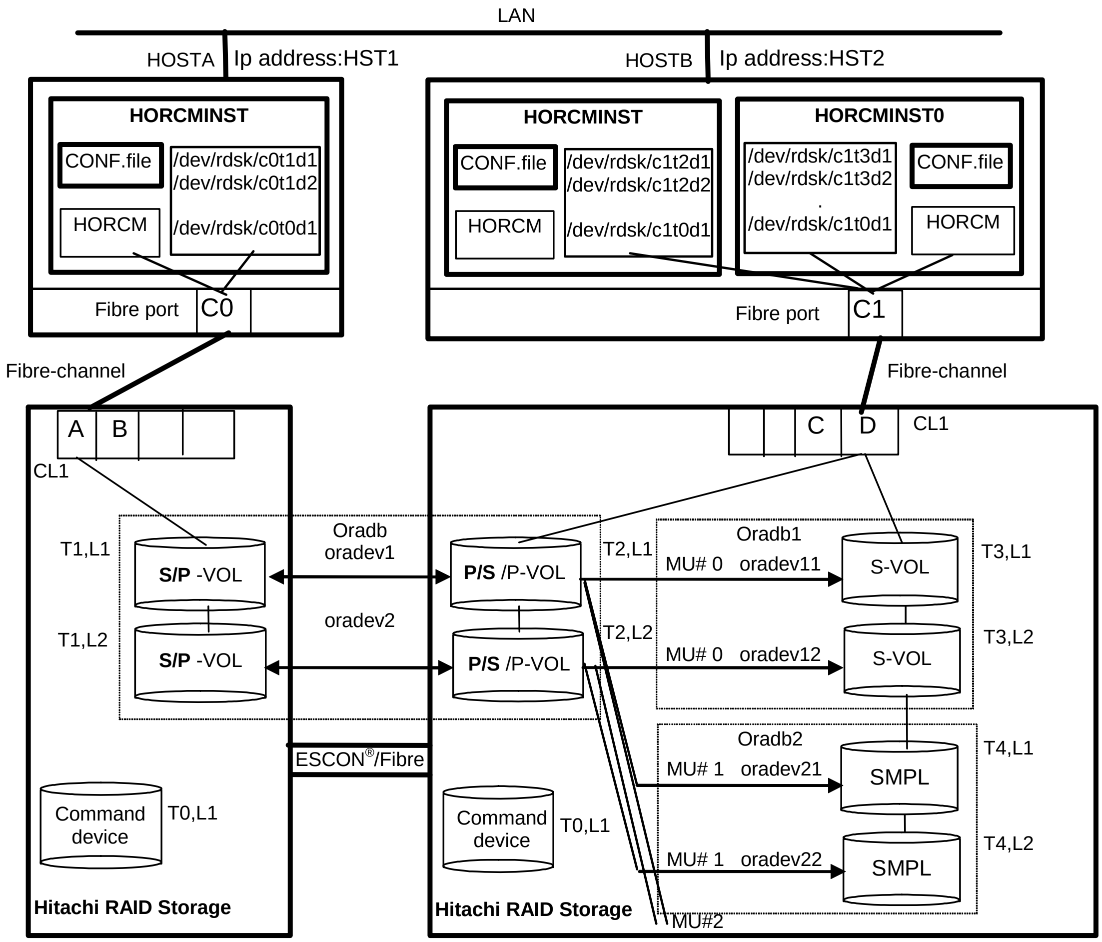
```
Group   PairVol(L/R) (Port#,TID,LU-M),Seq#,LDEV#.P/S,Status, Seq#,P-LDEV# M
oradb   oradev1(L)  (CL1-D , 2,  1-0)30053  268..S-VOL PAIR,-----    266  -
oradb1  oradev11(L) (CL1-D , 2,  1-1)30053  268..P-VOL PAIR,30053    270  -
oradb2  oradev21(L) (CL1-D , 2,  1-2)30053  268..SMPL  ----,-----   ----  -
oradb   oradev1(R)  (CL1-A , 1,  1-0)30053  266..P-VOL PAIR,30053    268  -
oradb   oradev2(L)  (CL1-D , 2,  2-0)30053  269..S-VOL PAIR,-----    267  -
oradb1  oradev12(L) (CL1-D , 2,  2-1)30053  269..P-VOL PAIR,30053    271  -
oradb2  oradev22(L) (CL1-D , 2,  2-2)30053  269..SMPL  ----,-----   ----  -
oradb   oradev2(R)  (CL1-A , 1,  2-0)30053  267..P-VOL PAIR,30053    269  -
```

The command device is defined using the system raw device name (character-type device file name). The command device defined in the configuration definition file must be established in a way to be following either every instance. If one command device is used between different instances on the same SCSI port, then the number of instances is up to 16 per command device. If this restriction is exceeded, then use a different SCSI path for each instance. For example, the command devices for Figure 2.45 would be:

- **HP-UX:**
  HORCM_CMD of HOSTA (/etc/horcm.conf) ... /dev/rdsk/c0t0d1
  HORCM_CMD of HOSTB (/etc/horcm.conf) ... /dev/rdsk/c1t0d1
  HORCM_CMD of HOSTB (/etc/horcm0.conf) ... /dev/rdsk/c1t0d1
- **Solaris:**
  HORCM_CMD of HOSTA(/etc/horcm.conf) ... /dev/rdsk/c0t0d1s2
  HORCM_CMD of HOSTB(/etc/horcm.conf) ... /dev/rdsk/c1t0d1s2
  HORCM_CMD of HOSTB(/etc/horcm0.conf) ... /dev/rdsk/c1t0d1s2

  Note: For Solaris operations with CCI version 01-09-03/04 and higher, the command device does not need to be labeled during format command.
- **AIX:**
  HORCM_CMD of HOSTA(/etc/horcm.conf) ... /dev/rhdiskXX
  HORCM_CMD of HOSTB(/etc/horcm.conf) ... /dev/rhdiskXX
  HORCM_CMD of HOSTB(/etc/horcm0.conf)... /dev/rhdiskXX
  where XX = device number assigned by AIX
- **Tru64 UNIX:**
  HORCM_CMD of HOSTA(/etc/horcm.conf) ... /dev/rrzbXXc
  HORCM_CMD of HOSTB(/etc/horcm.conf) ... /dev/rrzbXXc
  HORCM_CMD of HOSTB(/etc/horcm0.conf)... /dev/rrzbXXc
  where XX = device number assigned by Tru64 UNIX
- **DYNIX/ptx®:**
  HORCM_CMD of HOSTA(/etc/horcm.conf) ... /dev/rdsk/sdXX
  HORCM_CMD of HOSTB(/etc/horcm.conf) ... /dev/rdsk/sdXX
  HORCM_CMD of HOSTB(/etc/horcm0.conf)... /dev/rdsk/sdXX
  where XX = device number assigned by DYNIX/ptx®

- **Windows 2008/2003/2000:**
  HORCM_CMD of HOSTA(/etc/horcm.conf) ... \\.\CMD-Ser#-ldev#-Port#
  HORCM_CMD of HOSTB(/etc/horcm.conf) ... \\.\CMD-Ser#-ldev#-Port#
  HORCM_CMD of HOSTB(/etc/horcm0.conf) ... \\.\CMD-Ser#-ldev#-Port#
- **Windows NT:**
  HORCM_CMD of HOSTA(/etc/horcm.conf) ... \\.\CMD-Ser#-ldev#-Port#
  HORCM_CMD of HOSTB(/etc/horcm.conf) ... \\.\CMD-Ser#-ldev#-Port#
  HORCM_CMD of HOSTB(/etc/horcm0.conf) ... \\.\CMD-Ser#-ldev#-Port#
- **Linux, zLinux:**
  HORCM_CMD of HOSTA(/etc/horcm.conf) ... /dev/sdX
  HORCM_CMD of HOSTB(/etc/horcm.conf) ... /dev/sdX
  HORCM_CMD of HOSTB(/etc/horcm0.conf) ... /dev/sdX
  where X = device number assigned by Linux, zLinux
- **IRIX:**
  HORCM_CMD for HOSTA (/etc/horcm.conf) ... /dev/rdsk/dks0d0l1vol **or** /dev/rdsk/node_wwn/lun1vol/c0p0
  HORCM_CMD for HOSTB (/etc/horcm.conf) ... /dev/rdsk/dks1d0l1vol **or** /dev/rdsk/node_wwn/lun1vol/c1p0
  HORCM_CMD for HOSTB (/etc/horcm0.conf)... /dev/rdsk/dks1d0l1vol **or** /dev/rdsk/node_wwn/lun1vol/c1p0



Config file-HOSTA (**/etc/horcm.conf**)

```
HORCM_MON
#ip_address service poll(10ms) timeout
HST1        horcm       1000     3000
HORCM_CMD
#dev_name
 /dev/xxx  [Note 1]
HORCM_DEV
#dev_groupdev_name port#  TID LU# MU#
Oradb      oradev1    CL1-A   1     1
Oradb      oradev2    CL1-A   1     2




HORCM_INST
#dev_group       ip_address        service
 Oradb           HST2              horcm
 Oradb           HST2              horcm0
```

Config file-HOSTB (**/etc/horcm.conf**)

```
HORCM_MON
#ip_address service poll(10ms) timeout
HST2        horcm       1000     3000
HORCM_CMD
#dev_name
 /dev/xxx  [Note 1]
HORCM_DEV
#dev_groupdev_name port#  TID LU# MU#
Oradb      oradev1    CL1-D   2     1
Oradb      oradev2    CL1-D   2     2
Oradb1       oradev11  CL1-D   2     1    0
Oradb1       oradev12  CL1-D   2     2    0
Oradb2       oradev21  CL1-D   2     1    1
Oradb2       oradev22  CL1-D   2     2    1

HORCM_INST
#dev_group       ip_address        service
 Oradb           HST1              horcm
 Oradb1          HST2              horcm0
 Oradb2          HST2              horcm0
```

Config file-HOSTB (**/etc/horcm0.conf**)

```
HORCM_MON
#ip_address service poll(10ms) timeout
HST2        horcm0      1000     3000
HORCM_CMD
#dev_name
 /dev/xxx  [Note 1]
HORCM_DEV
#dev_groupdev_name port#  TID LU# MU#
Oradb      oradev1    CL1-D   2     1
Oradb      oradev2    CL1-D   2     2
Oradb1       oradev11  CL1-D   3     1    0
Oradb1       oradev12  CL1-D   3     2    0
Oradb2       oradev21  CL1-D   4     1    0
Oradb2       oradev22  CL1-D   4     2    0

HORCM_INST
#dev_group       ip_address        service
 Oradb           HST1              horcm
 Oradb1          HST2              horcm
 Oradb2          HST2              horcm
```

Shaded portions: If HORCMINST0 needs to operate Hitachi TrueCopy's paired volume, then describe **oradb**.

Figure 2.45 Hitachi TrueCopy/ShadowImage Configuration Example with Cascade Pairs

Example of CCI commands with HOSTA and HOSTB:

- Designate a group name (Oradb) on Hitachi TrueCopy environment of HOSTA.
  # paircreate -g Oradb -vl
- Designate a group name (Oradb1) on ShadowImage environment of HOSTB. When the command execution environment is not set, set HORCC_MRCF.

  For C shell: **# setenv HORCC_MRCF 1**
  For Windows: **set HORCC_MRCF=1**
  # paircreate -g Oradb1 -vl

  These commands create pairs for all LUs assigned to groups **Oradb** and **Oradb1** in the configuration definition file (four pairs for the configuration in Figure 2.45).
- Designate a group name and display pair status on HOSTA.
  # pairdisplay -g oradb -m cas

```
Group   PairVol(L/R) (Port#,TID,LU-M),Seq#,LDEV#.P/S,Status, Seq#,P-LDEV# M
oradb   oradev1(L)  (CL1-A , 1,  1-0)30052  266..SMPL  ----,-----   ----  -
oradb   oradev1(L)  (CL1-A , 1,  1)  30052  266..P-VOL COPY,30053    268  -
oradb1  oradev11(R) (CL1-D , 2,  1-0)30053  268..P-VOL COPY,30053    270  -
oradb2  oradev21(R) (CL1-D , 2,  1-1)30053  268..SMPL  ----,-----   ----  -
oradb   oradev1(R)  (CL1-D , 2,  1)  30053  268..S-VOL COPY,-----    266  -
oradb   oradev2(L)  (CL1-A , 1,  2-0)30052  267..SMPL  ----,-----   ----  -
oradb   oradev2(L)  (CL1-A , 1,  2)  30052  267..P-VOL COPY,30053    269  -
oradb1  oradev12(R) (CL1-D , 2,  2-0)30053  269..P-VOL COPY,30053    271  -
oradb2  oradev22(R) (CL1-D , 2,  2-1)30053  269..SMPL  ----,-----   ----  -
oradb   oradev2(R)  (CL1-D , 2,  2)  30053  269..S-VOL COPY,-----    267  -
```

Example of CCI commands with HOSTB:

- Designate a group name (oradb) on Hitachi TrueCopy environment of HOSTB.
  # paircreate -g Oradb -vr
- Designate a group name (Oradb1) on ShadowImage environment of HOSTB. When the command execution environment is not set, set HORCC_MRCF.

  For C shell: **# setenv HORCC_MRCF 1**
  For Windows: **set HORCC_MRCF=1**
  # paircreate -g Oradb1 -vl

  This command creates pairs for all LUs assigned to group **Oradb1** in the configuration definition file (four pairs for the configuration in Figure 2.45).

- Designate a group name and display pair status on TrueCopy environment of HOSTB.
  # pairdisplay -g oradb -m cas

```
Group   PairVol(L/R) (Port#,TID,LU-M),Seq#,LDEV#.P/S,Status, Seq#,P-LDEV# M
oradb1  oradev11(L) (CL1-D , 2,  1-0)30053  268..P-VOL PAIR,30053    270  -
oradb2  oradev21(L) (CL1-D , 2,  1-1)30053  268..SMPL  ----,-----   ----  -
oradb   oradev1(L)  (CL1-D , 2,  1)  30053  268..S-VOL PAIR,-----    266  -
oradb   oradev1(R)  (CL1-A , 1,  1-0)30052  266..SMPL  ----,-----   ----  -
oradb   oradev1(R)  (CL1-A , 1,  1)  30052  266..P-VOL PAIR,30053    268  -
oradb1  oradev12(L) (CL1-D , 2,  2-0)30053  269..P-VOL PAIR,30053    271  -
oradb2  oradev22(L) (CL1-D , 2,  2-1)30053  269..SMPL  ----,-----   ----  -
oradb   oradev2(L)  (CL1-D , 2,  2)  30053  269..S-VOL PAIR,-----    267  -
oradb   oradev2(R)  (CL1-A , 1,  2-0)30052  267..SMPL  ----,-----   ----  -
oradb   oradev2(R)  (CL1-A , 1,  2)  30052  267..P-VOL PAIR,30053    269  -
```

- Designate a group name and display pair status on ShadowImage environment of HOSTB.
  # pairdisplay -g oradb1 -m cas

```
Group   PairVol(L/R) (Port#,TID,LU-M),Seq#,LDEV#.P/S,Status, Seq#,P-LDEV# M
oradb1  oradev11(L) (CL1-D , 2,  1-0)30053  268..P-VOL PAIR,30053    270  -
oradb2  oradev21(L) (CL1-D , 2,  1-1)30053  268..SMPL  ----,-----   ----  -
oradb   oradev1(L)  (CL1-D , 2,  1)  30053  268..S-VOL PAIR,-----    266  -
oradb1  oradev11(R) (CL1-D , 3,  1-0)30053  270..S-VOL PAIR,-----    268  -
oradb1  oradev12(L) (CL1-D , 2,  2-0)30053  269..P-VOL PAIR,30053    271  -
oradb2  oradev22(L) (CL1-D , 2,  2-1)30053  269..SMPL  ----,-----   ----  -
oradb   oradev2(L)  (CL1-D , 2,  2)  30053  269..S-VOL PAIR,-----    267  -
oradb1  oradev12(R) (CL1-D , 3,  2-0)30053  271..S-VOL PAIR,-----    269  -
```

- Designate a group name and display pair status on ShadowImage environment of HOSTB (HORCMINST0).
  # pairdisplay -g oradb1 -m cas

```
Group   PairVol(L/R) (Port#,TID,LU-M),Seq#,LDEV#.P/S,Status, Seq#,P-LDEV# M
oradb1  oradev11(L) (CL1-D , 3,  1-0)30053  270..S-VOL PAIR,-----    268  -
oradb1  oradev11(R) (CL1-D , 2,  1-0)30053  268..P-VOL PAIR,30053    270  -
oradb2  oradev21(R) (CL1-D , 2,  1-1)30053  268..SMPL  ----,-----   ----  -
oradb   oradev1(R)  (CL1-D , 2,  1)  30053  268..S-VOL PAIR,-----    266  -
oradb1  oradev12(L) (CL1-D , 3,  2-0)30053  271..S-VOL PAIR,-----    269  -
oradb1  oradev12(R) (CL1-D , 2,  2-0)30053  269..P-VOL PAIR,30053    271  -
oradb2  oradev22(R) (CL1-D , 2,  2-1)30053  269..SMPL  ----,-----   ----  -
oradb   oradev2(R)  (CL1-D , 2,  2)  30053  269..S-VOL PAIR,-----    267  -
```

2.9.1 Configuration Definition for Cascading Volume Pairs

The CCI software (HORCM) is capable of keeping track of up to seven pair associations per LDEV (1 for TC/UR, 3 for UR, 3 for SI/Snapshot, 1 for Snapshot). By this management, CCI can be assigned to seven groups per LU that describes seven mirror descriptors for a configuration definition file.

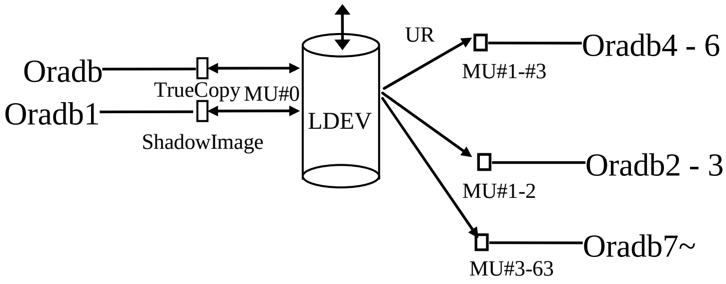


Figure 2.46 Mirror Descriptors and Group Assignment

2.9.1.1 Correspondence of the Configuration File and Mirror Descriptors

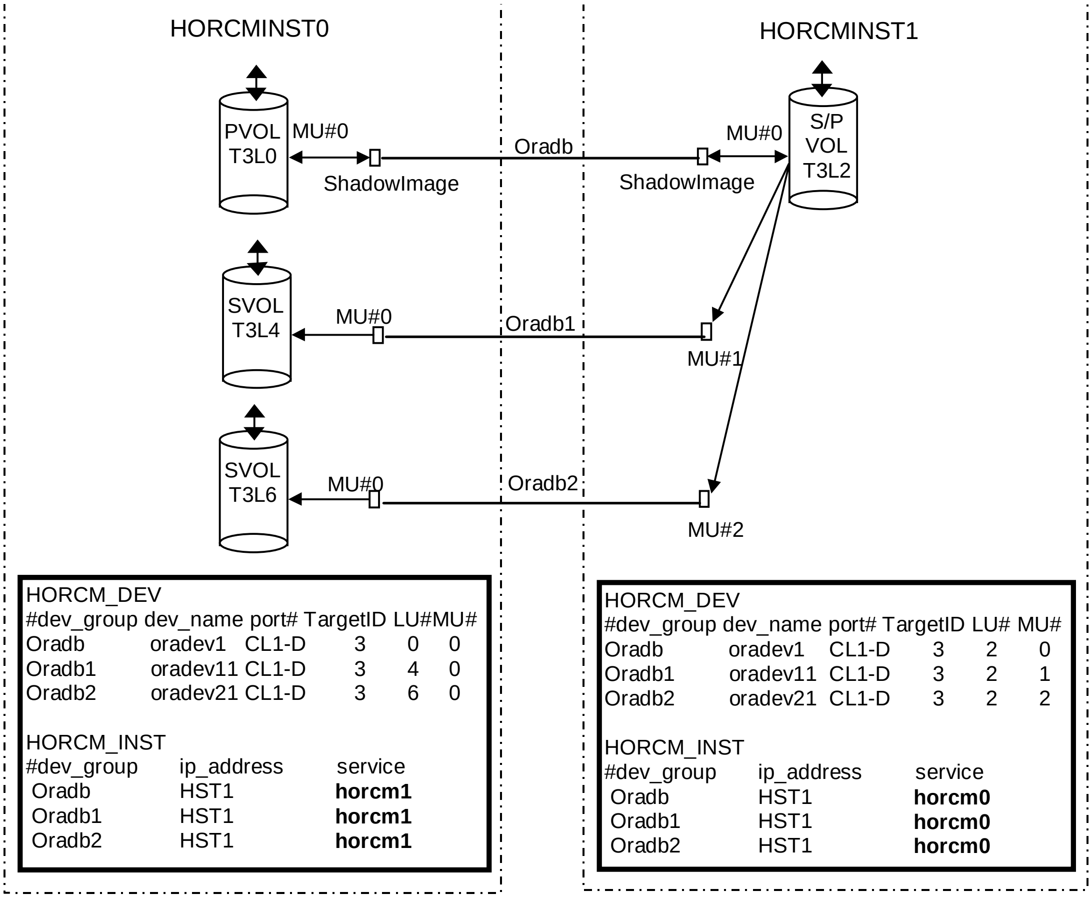
The group name and MU# which are described in HORCM_DEV of a configuration definition file are assigned the corresponding mirror descriptors, as outlined in Table 2.13. “Omission of MU#” is handled as MU#0, and the specified group is registered to MU#0 on ShadowImage and TrueCopy. Also, the MU# that is noted for HORCM_DEV in Table 2.13 reflects a random numbering sequence (for example, 2, 1, 0).

Table 2.13 Mirror Descriptors and Group Assignments

HORCM_DEV Parameter in Configuration File	MU#0		ShadowImage (Snapshot) Only	Univ Rep Only
	TrueCopy/ Univ Repl	ShadowImage	MU#1-#2 (MU#3-#63)	MU#1-#3
HORCM_DEV #dev_group dev_name port# TargetID LU# MU# Oradb oradev1 CL1-D 2 1	oradev1	oradev1		
HORCM_DEV #dev_group dev_name port# TargetID LU# MU# Oradb oradev1 CL1-D 2 1 Oradb1 oradev11 CL1-D 2 1 1 Oradb2 oradev21 CL1-D 2 1 2	oradev1	oradev1	oradev11 oradev21	
HORCM_DEV #dev_group dev_name port# TargetID LU# MU# Oradb oradev1 CL1-D 2 1 Oradb1 oradev11 CL1-D 2 1 0 Oradb2 oradev21 CL1-D 2 1 1 Oradb3 oradev31 CL1-D 2 1 2	oradev1	oradev11	oradev21 oradev31	
HORCM_DEV #dev_group dev_name port# TargetID LU# MU# Oradb oradev1 CL1-D 2 1 0		oradev1		
HORCM_DEV #dev_group dev_name port# TargetID LU# MU# Oradb oradev1 CL1-D 2 1 0 Oradb1 oradev1 CL1-D 2 1 1 Oradb2 oradev21 CL1-D 2 1 2		oradev1	oradev11 oradev21	
HORCM_DEV #dev_group dev_name port# TargetID LU# MU# Oradb oradev1 CL1-D 2 1 Oradb1 oradev11 CL1-D 2 1 0 Oradb2 oradev21 CL1-D 2 1 h1 Oradb3 oradev31 CL1-D 2 1 h2 Oradb4 oradev41 CL1-D 2 1 h3	oradev1	oradev11		oradev21 oradev31 oradev41

2.9.1.2 Cascade Function and Configuration Files

A volume of the cascading connection describes entity in a configuration definition file on the same instance, and classifies connection of volume through the mirror descriptor. In case of Hitachi TrueCopy/ShadowImage cascading connection, too, the volume entity describes to a configuration definition file on the same instance. Figure 2.47 shows an example of this.



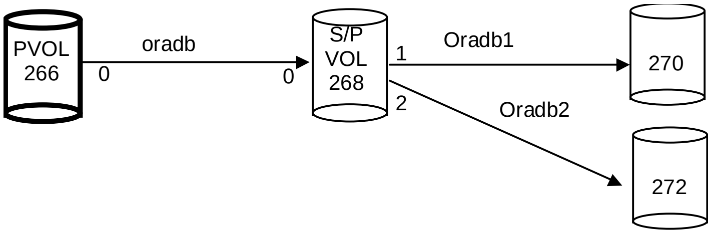
```
HORCM_DEV
#dev_group dev_name port# TargetID LU#MU#
Oradb       oradev1   CL1-D      3      0    0
Oradb1      oradev11 CL1-D      3      4    0
Oradb2      oradev21 CL1-D      3      6    0

HORCM_INST
#dev_group      ip_address       service
 Oradb          HST1             horcm1
 Oradb1         HST1             horcm1
 Oradb2         HST1             horcm1
```

```
HORCM_DEV
#dev_group dev_name port# TargetID LU# MU#
Oradb       oradev1   CL1-D      3      2      0
Oradb1      oradev11  CL1-D      3      2      1
Oradb2      oradev21  CL1-D      3      2      2

HORCM_INST
#dev_group      ip_address       service
 Oradb          HST1             horcm0
 Oradb1         HST1             horcm0
 Oradb2         HST1             horcm0
```

Figure 2.47 ShadowImage Cascade Connection and Configuration File

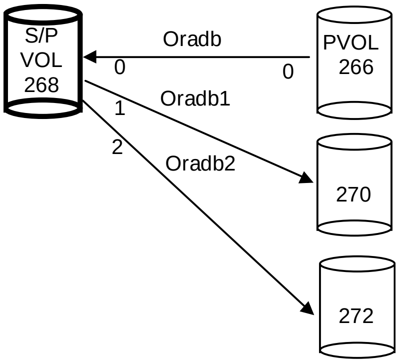
2.9.1.3 ShadowImage

ShadowImage is a mirror configuration within one storage system. Therefore, ShadowImage can be described a volume of the cascading connection according to two configuration definition files. In case of cascading connection of ShadowImage only, the specified group is assigned to the mirror descriptor (MU#) of ShadowImage that describes definitely “0” as MU# for ShadowImage. Figure 2.48 - Figure 2.50 show ShadowImage cascading configurations and the pairdisplay information for each configuration.



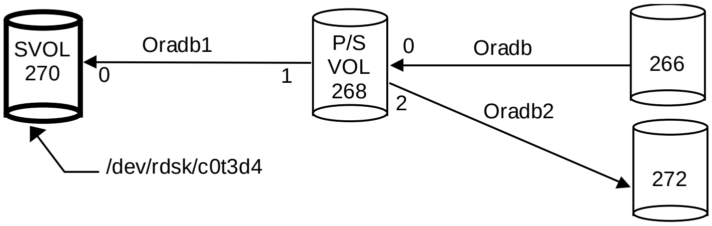
```
# pairdisplay -g oradb -m cas
Group   PairVol(L/R) (Port#,TID,LU-M),Seq#,LDEV#.P/S,Status, Seq#,P-LDEV# M
oradb   oradev1(L)  (CL1-D , 3,  0-0)30053  266..P-VOL PAIR,30053    268  -
oradb   oradev1(R)  (CL1-D , 3,  2-0)30053  268..S-VOL PAIR,-----    266  -
oradb1  oradev11(R) (CL1-D , 3,  2-1)30053  268..P-VOL PAIR,30053    270  -
oradb2  oradev21(R) (CL1-D , 3,  2-2)30053  268..P-VOL PAIR,30053    272  -
```

Figure 2.48 Pairdisplay on HORCMINST0



```
# pairdisplay -g oradb -m cas
Group   PairVol(L/R) (Port#,TID,LU-M),Seq#,LDEV#.P/S,Status, Seq#,P-LDEV# M
oradb   oradev1(L)  (CL1-D , 3,  2-0)30053  268..S-VOL PAIR,-----    266  -
oradb1  oradev11(L) (CL1-D , 3,  2-1)30053  268..P-VOL PAIR,30053    270  -
oradb2  oradev21(L) (CL1-D , 3,  2-2)30053  268..P-VOL PAIR,30053    272  -
oradb   oradev1(R)  (CL1-D , 3,  0-0)30053  266..P-VOL PAIR,30053    268  -
```

Figure 2.49 Pairdisplay on HORCMINST1

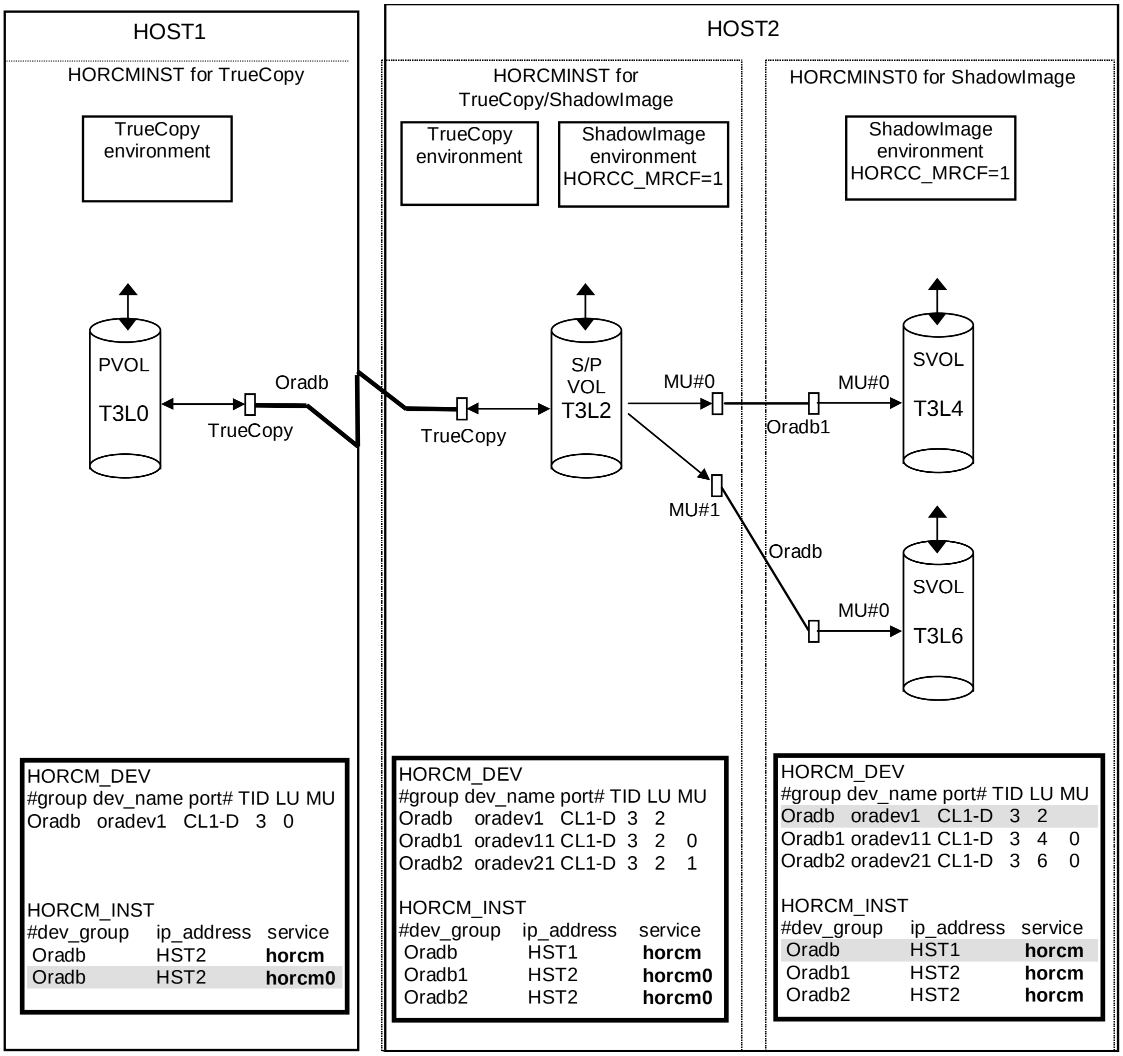


```
# pairdisplay -d /dev/rdsk/c0t3d4 -m cas
Group   PairVol(L/R) (Port#,TID,LU-M),Seq#,LDEV#.P/S,Status, Seq#,P-LDEV# M
oradb1  oradev11(L) (CL1-D , 3,  4-0)30053  270..S-VOL PAIR,-----    268  -
oradb1  oradev11(R) (CL1-D , 3,  2-1)30053  268..P-VOL PAIR,30053    270  -
oradb   oradev1(R)  (CL1-D , 3,  2-0)30053  268..S-VOL PAIR,-----    266  -
oradb2  oradev21(R) (CL1-D , 3,  2-2)30053  268..P-VOL PAIR,30053    272  -
```

Figure 2.50 Pairdisplay on HORCMINST0

2.9.1.4 Cascading Connections for Hitachi TrueCopy and ShadowImage

The cascading connections for Hitachi TrueCopy/ShadowImage can be set up by using three configuration definition files that describe the cascading volume entity in a configuration definition file on the same instance. The mirror descriptor of ShadowImage and Hitachi TrueCopy definitely describe “0” as MU#, and the mirror descriptor of Hitachi TrueCopy does not describe “0” as MU#.



```
HORCM_DEV
#group dev_name port# TID LU MU
Oradb   oradev1   CL1-D   3   0


HORCM_INST
#dev_group    ip_address    service
 Oradb        HST2          horcm
 Oradb        HST2          horcm0
```

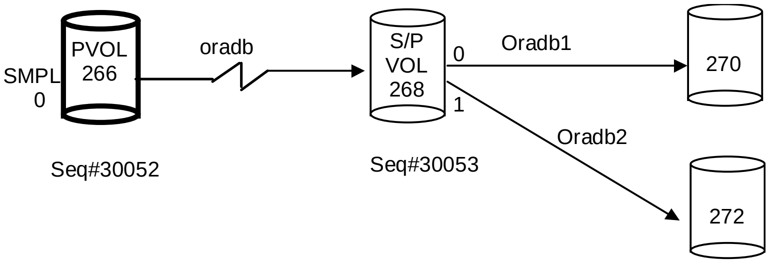
```
HORCM_DEV
#group dev_name port# TID LU MU
Oradb    oradev1  CL1-D  3   2
Oradb1  oradev11 CL1-D  3   2   0
Oradb2  oradev21 CL1-D  3   2   1

HORCM_INST
#dev_group    ip_address    service
 Oradb         HST1          horcm
 Oradb1        HST2          horcm0
 Oradb2        HST2          horcm0
```

```
HORCM_DEV
#group dev_name port# TID LU MU
Oradb   oradev1   CL1-D   3   2
Oradb1 oradev11 CL1-D   3   4   0
Oradb2 oradev21 CL1-D   3   6   0

HORCM_INST
#dev_group    ip_address   service
 Oradb         HST1          horcm
 Oradb1        HST2          horcm
 Oradb2        HST2          horcm
```

Note: Shaded portions: If HORCMINST0 needs to operate Hitachi TrueCopy’s paired volume, then “oradb” must describe that there is a connection to HST1 via HORCMINST0.

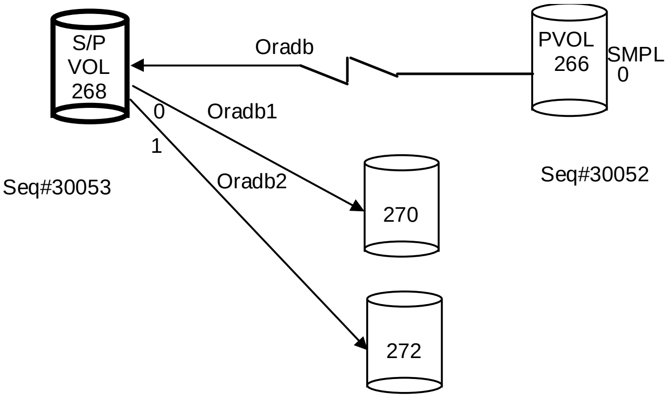
Figure 2.51 TrueCopy/ShadowImage Cascading Connection and Configuration File

Figure 2.50 - Figure 2.53 show Hitachi TrueCopy/ShadowImage cascading configurations and the pairdisplay information for each configuration.



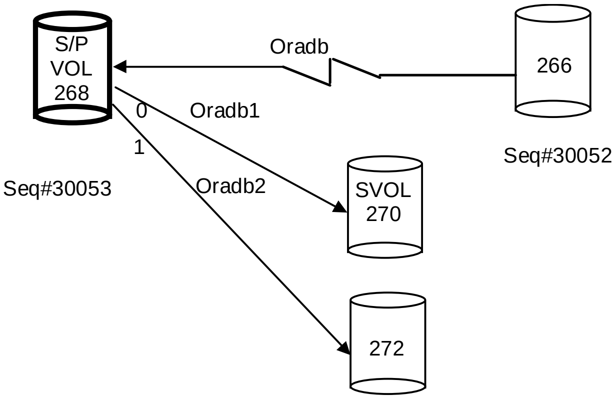
```
# pairdisplay -g oradb -m cas
Group   PairVol(L/R) (Port#,TID,LU-M),Seq#,LDEV#.P/S,Status, Seq#,P-LDEV# M
oradb   oradev1(L)  (CL1-D , 3,  0-0)30052  266..SMPL  ----,-----   ----  -
oradb   oradev1(L)  (CL1-D , 3,  0)  30052  266..P-VOL COPY,30053    268  -
oradb1  oradev11(R) (CL1-D , 3,  2-0)30053  268..P-VOL COPY,30053    270  -
oradb2  oradev21(R) (CL1-D , 3,  2-1)30053  268..P-VOL PSUS,30053    272  W
oradb   oradev1(R)  (CL1-D , 3,  2)  30053  268..S-VOL COPY,-----    266  -
```

Figure 2.52 Pairdisplay for Hitachi TrueCopy on HOST1



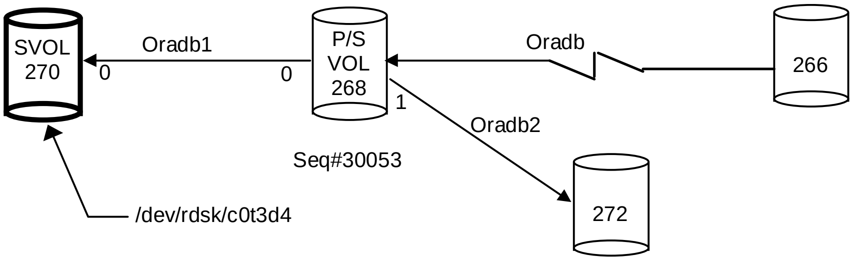
```
# pairdisplay -g oradb -m cas
Group   PairVol(L/R) (Port#,TID,LU-M),Seq#,LDEV#.P/S,Status, Seq#,P-LDEV# M
oradb1  oradev11(L) (CL1-D , 3,  2-0)30053  268..P-VOL PAIR,30053    270  -
oradb2  oradev21(L) (CL1-D , 3,  2-1)30053  268..P-VOL PSUS,30053    272  W
oradb   oradev1(L)  (CL1-D , 3,  2)  30053  268..S-VOL PAIR,-----    266  -
oradb   oradev1(R)  (CL1-D , 3,  0-0)30052  266..SMPL  ----,-----   ----  -
oradb   oradev1(R)  (CL1-D , 3,  0)  30052  266..P-VOL PAIR,30053    268  -
```

Figure 2.53 Pairdisplay for Hitachi TrueCopy on HOST2 (HORCMINST)



```
# pairdisplay -g oradb1 -m cas
Group   PairVol(L/R) (Port#,TID,LU-M),Seq#,LDEV#.P/S,Status, Seq#,P-LDEV# M
oradb1  oradev11(L) (CL1-D , 3,  2-0)30053  268..P-VOL PAIR,30053    270  -
oradb2  oradev21(L) (CL1-D , 3,  2-1)30053  268..P-VOL PSUS,30053    272  W
oradb   oradev1(L)  (CL1-D , 3,  2)  30053  268..S-VOL PAIR,-----    266  -
oradb1  oradev11(R) (CL1-D , 3,  4-0)30053  270..S-VOL PAIR,-----    268  -
```

Figure 2.54   Pairdisplay for ShadowImage on HOST2 (HORCMINST)



```
# pairdisplay -g oradb1 -m cas
Group   PairVol(L/R) (Port#,TID,LU-M),Seq#,LDEV#.P/S,Status, Seq#,P-LDEV# M
oradb1  oradev11(L) (CL1-D , 3,  4-0)30053  270..S-VOL PAIR,-----    268  -
oradb1  oradev11(R) (CL1-D , 3,  2-0)30053  268..P-VOL PAIR,30053    270  -
oradb2  oradev21(R) (CL1-D , 3,  2-1)30053  268..P-VOL PSUS,30053    272  W
oradb   oradev1(R)  (CL1-D , 3,  2)  30053  268..S-VOL PAIR,-----    266  -

# pairdisplay -d /dev/rdsk/c0t3d4 -m cas
Group   PairVol(L/R) (Port#,TID,LU-M),Seq#,LDEV#.P/S,Status, Seq#,P-LDEV# M
oradb1  oradev11(L) (CL1-D , 3,  4-0)30053  270..S-VOL PAIR,-----    268  -
oradb1  oradev11(R) (CL1-D , 3,  2-0)30053  268..P-VOL PAIR,30053    270  -
oradb2  oradev21(R) (CL1-D , 3,  2-1)30053  268..P-VOL PSUS,30053    272  W
oradb   oradev1(R)  (CL1-D , 3,  2)  30053  268..S-VOL PAIR,-----    266  -
```

Figure 2.55   Pairdisplay for ShadowImage on HOST2 (HORCMINST0)

2.10 Error Monitoring and Configuration Confirmation

CCI supports error monitoring and configuration confirmation commands for linkage with the system operation management of the UNIX/PC server.

2.10.1 Error Monitoring for Paired Volumes

The HORC Manager (HORCM) monitors all volumes defined in the configuration definition file at a certain interval regardless of the Hitachi TrueCopy/ShadowImage commands.

- **Objects and scope of monitoring:** The HORCM operates as a daemon process on the host server and monitors all the paired volumes defined in the configuration definition file, not the volume groups. The HORC Manager's monitoring applies to the primary volumes only (since the primary volumes control the status). The HORC Manager monitors the changes in the pair status of these volumes. Only when the PAIR status changes to the PSUS status and that change is caused by an error (such as PVol error or SVOL SUS), the HORC Manager regards the change as an error.
- **Monitoring time and interval:** This command always issues I/O instructions to the storage system to obtain information for monitoring. It is possible to specify the monitoring interval in the configuration definition file in order to adjust the daemon load.
- **Error notification by HORCM:** If the mirroring status is suspended in the normal Hitachi TrueCopy operation, an error message is displayed by Storage Navigator (and SVP). However, no error message may be displayed, depending on the system operation form. Since the operation management of the UNIX server checks Syslog to find system errors in many cases, Hitachi TrueCopy error messages are output to Syslog for linkage with the system operation management.
- **Error notification command:** Hitachi TrueCopy supports the error notification function using commands in order to allow the UNIX server client to monitor errors. This command is connected to the HORCM (daemon) to obtain the transition of the pairing status and report it. When an error is detected, this command outputs an error message. This command waits until an error occurs or reports that "No" error occurs if it finds no errors in pairing status transition queue of the HORCM's pairing monitor. These operations can be specified using the options. If the command finds the status transition data in the status transition queue, it displays the data of all volumes. Data in the HORCM's status transition queue can be erased by specifying the option of this command.

Note: CCI (HORCM) does not support the syslog function for OpenVMS systems. As an alternative, the HORCM daemon uses a HORCM logging file.

2.10.2 Error Monitoring for Database Validator

CCI will report the following message to the syslog file as validation error when each statistical information counted an error will be updated.

- **[HORCM_103] Detected a validation check error on this volume (¡¡¡¡ unit#¡,ldev#¡) : CfEC=n, MNEC=n, SCEC=n, BNEC=n**

2.10.3 Pair Status Display and Configuration Confirmation

The CCI pairing function (configuration definition file) combines the physical volumes in the storage system used independently by the servers. Therefore, you should make sure that the servers' volumes are combined as intended by the server system administrator.

The pairdisplay command displays the pairing status to enable you to verify the completion of pair creation or pair resynchronization (see Figure 2.56). This command is also used to confirm the configuration of the paired volume connection path (physical link of paired volumes among the servers). For further information on the pairdisplay command, see section 4.8.

```
                           --Link info. of ①----     ----Link information of ②------------
Group PairVol(Local/Remote) P,T#,L#,  Seq#, LDEV#    P/S,  Status, Fence,  Seq#, Pair-LDEV#

G1     Oradb1(L)           P1,T1,L1,  Seq#,  20      P-VOL, Pair,  Never,  Seq#,   30
G1     Oradb1(R)           P2,T2,L2,  Seq#,  30      S-VOL, Pair,  Never,  Seq#,   20
```

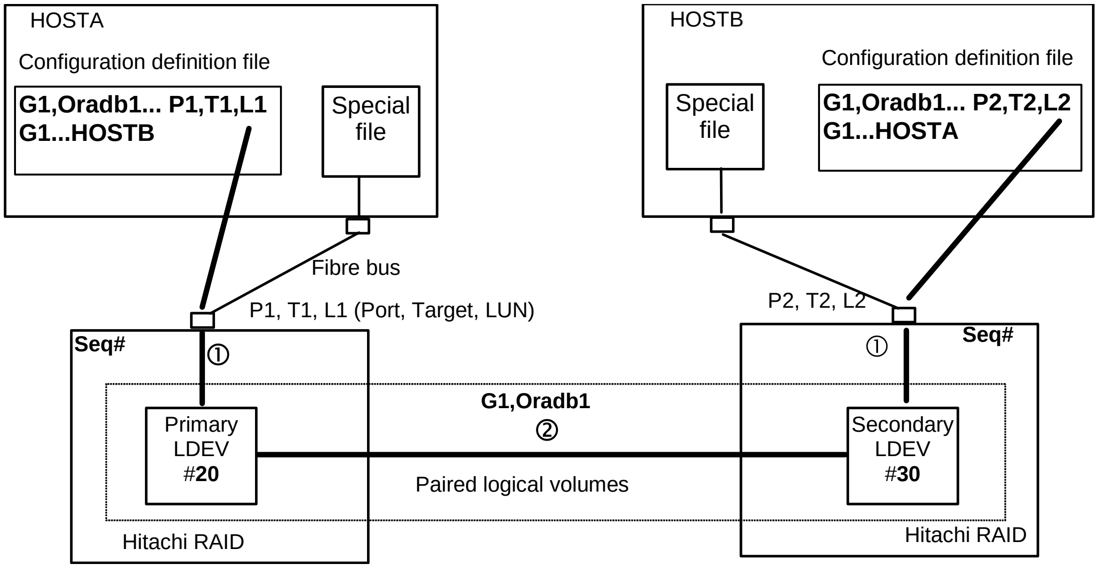


Figure 2.56 Example of Pair Configuration Confirmation (Pairdisplay)

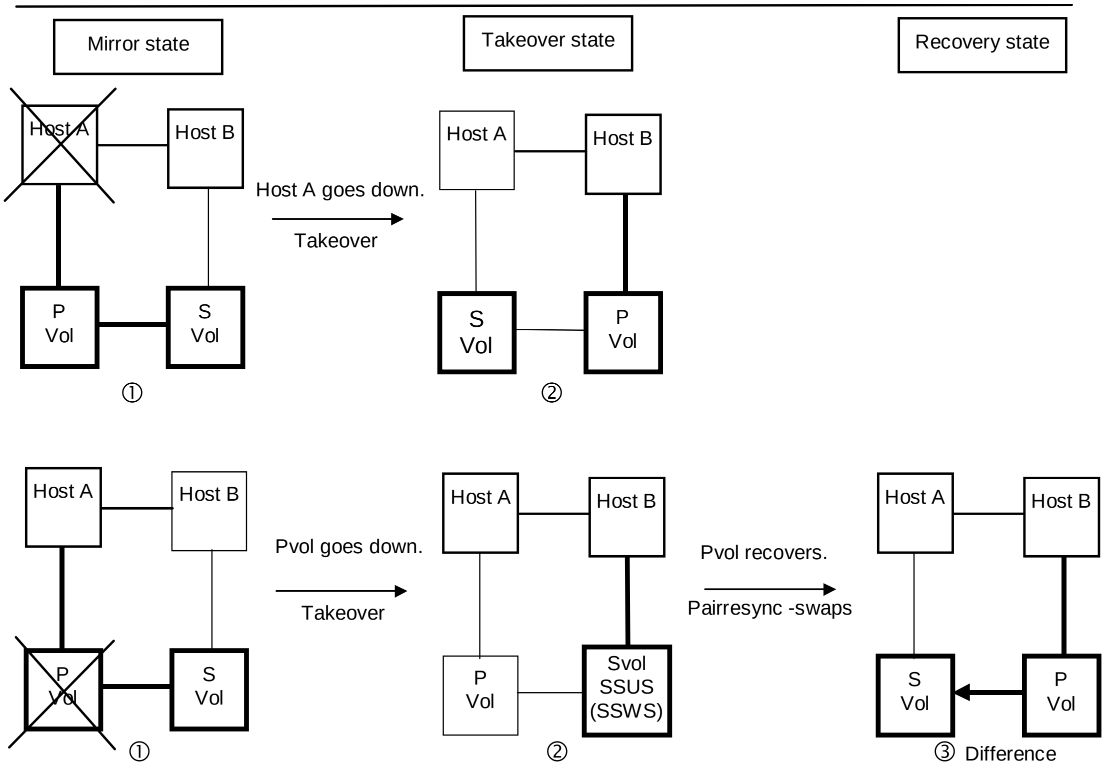
The **raidscan** command displays the SCSI port, target ID, LDEVs mapped to LUNs, and status of those LDEVs, regardless of the configuration definition file (see Figure 2.57). When a port number is specified, this command displays information about all target IDs and LUNs of that port. For further information on the **raidscan** command, see section 4.11.1.

```
Port#, TargetID#, Lun# Number of LDEVs,LDEV#,  P/S, Status, Fence, LDEV#  Seq#,  Pair-LDEV#
CL1-A    3         1      3(3,5,6)             P-VOL, Pair, Never,   3    Seq#,   30
```

Figure 2.57 Example of Raidscan Command

2.11 Recovery Procedures for HA Configurations

After configuring and starting Hitachi TrueCopy operations, the system administrator should conduct operational tests for possible failures in the system. In normal operation, service personnel obtain information for identifying the failure cause on the SVP. However, a motive for the action above should be given by the Hitachi TrueCopy operation command. Figure 2.58 shows the system failover and recovery procedure. Figure 2.59 shows the regression and Hitachi TrueCopy recovery procedure.



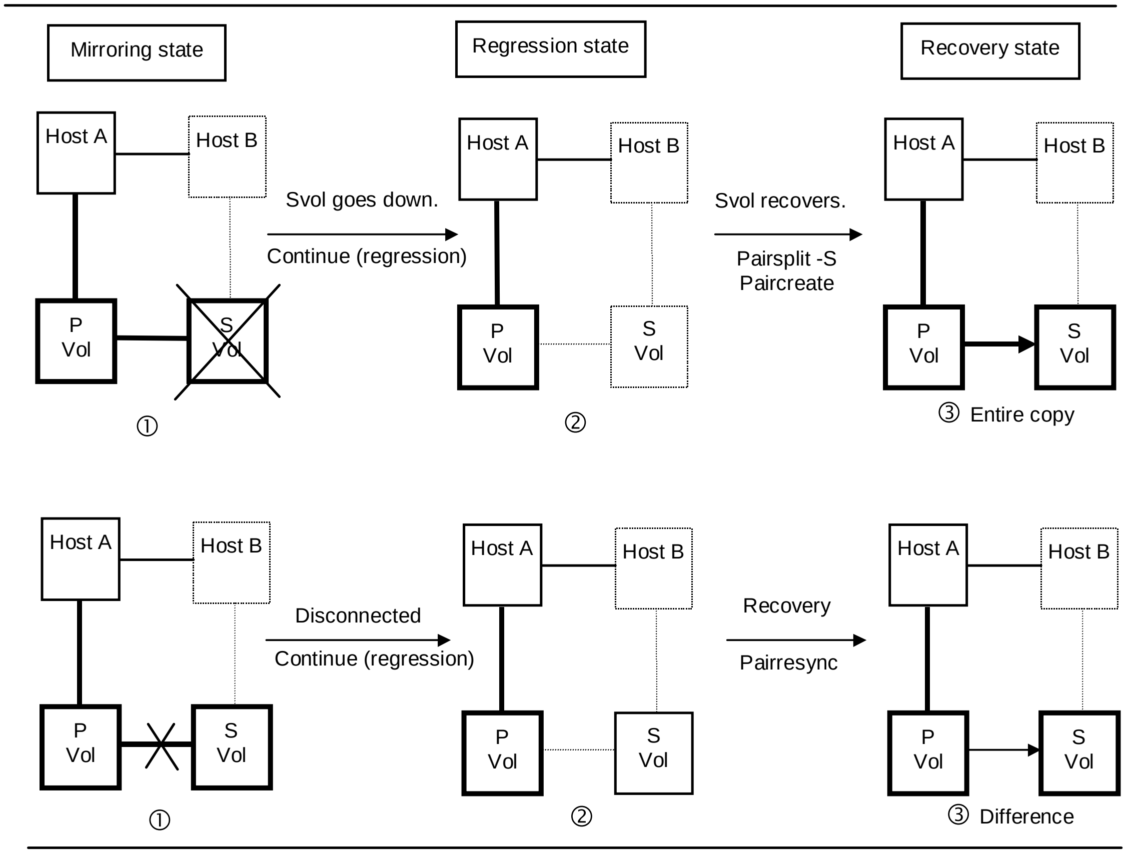
① A failure occurs in the host A server (1-top) or in the Pvol (1-bottom).

② Host B detects the failure of host A or the Pvol and issues a takeover command to make the SVOL usable. Host B takes over processing from host A. In the case of host A failure (1-top), the Swap-takeover command will be executed. In the case of Pvol failure (1-bottom), the SVOL-SSUS-takeover command will be executed.

③ While host B continues processing, PVOL and SVOL are swapped (pairresync -swaps), and the delta data (BITMAP) updated by host B is fed back to host A.

④ After host A or the Pvol has recovered, host A can take over processing from host B by executing the swap-takeover (horctakeover) command.

Figure 2.58 System Failover and Recovery



① The PVOL detects a failure in the SVOL and causes suspension of the duplicated writing. (The fence level determines whether host A continues processing or host B takes over the processing from host A.)

② The PVOL changes the paired volume status to PSUE and keeps track of the difference data. The HORCM detects the status change and outputs a message to syslog. If the client of host A has initiated the monitoring command, the message concerned is displayed on the screen of the client.

③ The SVOL recovers from the failure. The host A issues the pairsplit -S, paircreate -vl, or pairresync command to update the PVOL data by copying entire data or copying differential data only. The updated data is fed back to the SVOL.

Figure 2.59 Degeneracy and Recovery in Case of System Error

Chapter 3 Preparing for CCI Operations

This chapter covers the following topics:

- System requirements (section 3.1)
- Hardware installation (section 3.2)
- Software installation (section 3.3)
- Creating/editing the configuration file (section 3.4)
- Porting notice for OpenVMS (section 3.5)
- CCI startup (section 3.6)
- Starting CCI as a Service (Windows Systems) (section 3.7)

3.1 System Requirements

CCI operations involve the CCI software on the UNIX/PC server host and the RAID storage system(s) containing the command device(s) and the Hitachi TrueCopy and/or ShadowImage pair volumes. The system requirements for CCI are:

- **CCI software product.** The CCI software is supplied on CD-ROM or diskette. The CCI software files take up 2.5 MB of space. The log files can take up to 3 MB of space.
- **Host platform.** CCI is supported on the following host platforms.
  See Table 3.1 – Table 3.8 for detailed information on supported OS versions.

  Solaris, Solaris/x86, HP-UX, AIX, Linux, Linux/IA64, DYNIX/ptx®, IRIX, OpenVMS, OpenVMS/IA, VMware, Windows 2008, Windows 2003, Windows 2000, Windows NT, Windows CE .NET

  Note: TrueCopy Asynchronous platform and storage system support may vary. Please contact your Hitachi Data Systems team for the latest information on Hitachi RAID storage system support for CCI.

  - Root/administrator access to the host is required to perform CCI operations.
  - Static memory capacity: minimum = 300 KB, maximum = 500 KB
    Dynamic memory capacity (set in HORCM_CONF): maximum = 500 KB per unit ID
  - CCI supports several failover products, including FirstWatch, MC/ServiceGuard, HACMP, TruCluster, and ptx/CLUSTERS. Please contact your Hitachi Data Systems account team for the latest information on failover software support for CCI.
  - The system which runs and operates Hitachi TrueCopy in an HA configuration must be a duplex system having a hot standby configuration or mutual hot standby (mutual takeover) configuration. The remote copy system must be designed for remote backup among servers and configured so that servers cannot share the primary and secondary volumes at the same time. The information in this document does not apply to fault-tolerant system configurations such as Oracle Parallel Server (OPS) in which nodes execute parallel accesses. However, two or more nodes can share the primary volumes of the shared OPS database, and must use the secondary volumes as backup volumes.
  - Host servers which are combined when paired logical volumes are defined should run on the operating system of the same architecture. If not, one host may not be able to recognize a paired volume of another host, even though HORCM can run properly.

- **Hitachi RAID storage system(s).** The Hitachi TagmaStore USP, Hitachi TagmaStore NSC, Lightning 9900V, and Lightning 9900 storage systems support CCI operations. Hitachi TrueCopy Synchronous and Asynchronous are supported for all storage system models. Please contact your Hitachi Data Systems representative for further information on storage system configurations.

  Microcode:

  The minimum microcode levels for CCI software version **01-22-03/02** are:

  - Universal Storage Platform V/VM: **60-03-xx**
  - TagmaStore USP/NSC: **50-08-05** (same as for CCI 01-20-03/02)
  - Lightning 9900V: **21-14-28** (same as for CCI 01-20-03/02)
  - Lightning 9900: **01-19-93** (same as for CCI 01-20-03/02)

  The CCI function for Oracle10g H.A.R.D. requires USP V/VM microcode 60-03-xx or higher.

  The CCI function for command device guarding requires USP/NSC microcode 50-07-30 or higher and 9900V microcode 21-14-24 or higher.

  - **Command Device**: The CCI command device must be defined and accessed as a raw device (no file system, no mount operation).
  - **TrueCopy**: TrueCopy option must be installed and enabled on the storage systems. Bi-directional swap must be enabled between the primary and secondary volumes. The port modes (LCP, RCP, RCU target, etc.) and MCU-RCU paths must be defined.
  - **TrueCopy Async**: TrueCopy Async option must be installed and enabled.
  - **ShadowImage**: ShadowImage must be installed and enabled on the storage system(s). Minimum 9900V microcode for Host Group support is 21-06-00.
  - **Database Validator**: All USP V/VM and USP/NSC features support Database Validator. The 9900V DB Validator feature (DKC-F460I-8HSF, -8HLF, or -16HSF) must be installed in the 9900V. Minimum 9900V microcode for DB Validator support is 21-02-00/00.
  - **Data Retention Utility**: The Data Retention Utility feature (Open LDEV Guard on 9900V) must be installed and enabled on the storage system(s). Minimum 9900V microcode for Open LDEV Guard support is 21-06-00.
  - **Universal Replicator**: The Universal Replicator feature (USP V/VM, USP/NSC) must be installed and enabled on the storage system. Additionally, the path between the CUs must be set (using Storage Navigator or SVP), and the bi-directional swap must be enabled between the primary and secondary volumes.
  - **Copy-on-Write Snapshot**: Both ShadowImage and Copy-on-Write Snapshot must be installed and enabled on the storage system(s). Minimum USP/NSC microcode for Copy-on-Write Snapshot support via CCI is 50-04-05.
  - **Other RAID storage systems:** See section 3.1.2 for information on using CCI with Hitachi and other RAID storage systems.

3.1.1 Supported Platforms

Table 3.1 – Table 3.8 list the supported platforms for CCI operations.

Table 3.1 Supported Platforms for TrueCopy

Vendor	Operating System	Failover Software	Volume Manager	I/O Interface
Sun	Solaris 2.5	First Watch	VxVM	SCSI/Fibre
	Solaris 10 /x86	—	VxVM	Fibre
HP	HP-UX 10.20/11.0/11.2x	MC/Service Guard	LVM, SLVM	SCSI/Fibre
	HP-UX 11.2x on IA64*	MC/Service Guard	LVM, SLVM	Fibre
	Digital UNIX 4.0	TruCluster	LSM	SCSI
	Tru64 UNIX 5.0	TruCluster	LSM	SCSI/Fibre
	OpenVMS 7.3-1	—	—	Fibre
IBM	DYNIX/ptx 4.4	ptx/Custer	LVM	SCSI/Fibre
	AIX 4.3	HACMP	LVM	SCSI/Fibre
	zLinux (Suse 8) For restrictions on zLinux, see section 3.1.3.	—	—	Fibre (FCP)
Microsoft	Windows NT 4.0; Windows 2000, 2003, 2008	MSCS	LDM	Fibre/iSCSI
	Windows 2003/2008 on IA64* Windows 2003/2008 on EM64T	MSCS	LDM	Fibre
Red Hat	Red Hat Linux 6.0/7.0/AS2.1, 3.0, 4.0	—	—	SCSI/Fibre**
	AS 2.1, 3.0 Update2, 4.0 on IA64* AS 4.0 on EM64T	—	—	Fibre
SGI	IRIX64 6.5	—	—	SCSI/Fibre

* IA64: using IA-32EL on IA64 (except CCI for Linux/IA64)
** Please refer to section 5.1.1 about RHEL 4.0 using Kernel 2.6.9.XX.

Table 3.2 Supported Platforms for ShadowImage

Vendor	Operating System	Failover Software	Volume Manager	I/O Interface
Sun	Solaris 2.5	First Watch	VxVM	SCSI/Fibre
	Solaris 10 /x86	-—	VxVM	Fibre
HP	HP-UX 10.20/11.0/11.2x	MC/Service Guard	LVM, SLVM	SCSI/Fibre
	HP-UX 11.2x on IA64*	MC/Service Guard	LVM, SLVM	Fibre
	Digital UNIX 4.0	TruCluster	LSM	SCSI
	Tru64 UNIX 5.0	TruCluster	LSM	SCSI/Fibre
	OpenVMS 7.3-1	—	—	Fibre
IBM	DYNIX/ptx 4.4	ptx/Custer	LVM	SCSI/Fibre
	AIX 4.3	HACMP	LVM	SCSI/Fibre
	zLinux (Suse 8) For restrictions on zLinux, see section 3.1.3.	—	—	Fibre (FCP)
Microsoft	Windows NT 4.0; Windows 2000, 2003, 2008	MSCS	LDM	iSCSI/Fibre
	Windows 2003/2008 on IA64* Windows 2003/2008 on EM64T	MSCS	LDM	Fibre
Red Hat	Red Hat Linux 6.0/7.0/AS2.1, 3.0, 4.0	—	—	SCSI/Fibre**
	AS2.1, 3.0 Update2, 4.0 on IA64* AS 4.0 on EM64T	—	—	Fibre
SGI	IRIX64 6.5	—	—	SCSI/Fibre

* IA64: using IA-32EL on IA64 (except CCI for Linux/IA64)

** Please refer to section 5.1.1 about RHEL 4.0 using Kernel 2.6.9.XX.

Table 3.3 Supported Platforms for TrueCopy Async

Vendor	Operating System	Failover Software	Volume Manager	I/O Interface
Sun	Solaris 2.5	First Watch	VxVM	SCSI/Fibre
	Solaris 10 /x86	—	VxVM	Fibre
HP	HP-UX 10.20/11.0/11.2x	MC/Service Guard	LVM, SLVM	SCSI/Fibre
	HP-UX 11.2x on IA64*	MC/Service Guard	LVM, SLVM	Fibre
	Digital UNIX 4.0	TruCluster	LSM	SCSI
	Tru64 UNIX 5.0	TruCluster	LSM	SCSI/Fibre
	OpenVMS 7.3-1	—	—	Fibre
IBM	DYNIX/ptx 4.4	ptx/Custer	LVM	SCSI/Fibre
	AIX 4.3	HACMP	LVM	SCSI/Fibre
	zLinux (Suse 8) For restrictions on zLinux, see section 3.1.3.	—	—	Fibre (FCP)
Microsoft	Windows NT 4.0; Windows 2000, 2003, 2008	MSCS	LDM	iSCSI/Fibre
	Windows 2003/2008 on IA64* Windows 2003/2008 on EM64T	MSCS	LDM	Fibre
Red Hat	Red Hat Linux 6.0/7.0/AS 2.1, 3.0, 4.0	—	—	SCSI/Fibre**
	AS 2.1, 3.0 Update2, 4.0 on IA64* AS 4.0 on EM64T	—	—	Fibre
SGI	IRIX64 6.5	—	—	SCSI/Fibre

* IA64: using IA-32EL on IA64 (except CCI for Linux/IA64)

** Please refer to section 5.1.1 about RHEL 4.0 using Kernel 2.6.9.XX.

Table 3.4 Supported Platforms for Universal Replicator

Vendor	Operating System	Failover Software	Volume Manager	I/O Interface
SUN	Solaris2.8	VCS	VxVM	Fibre
	Solaris 10 /x86	—	VxVM	Fibre
HP	HP-UX 11.0/11.2x	MC/Service Guard	LVM, SLVM	Fibre
	HP-UX 11.2x on IA64*	MC/Service Guard	LVM, SLVM	Fibre
IBM	AIX 5.1	HACMP	LVM	Fibre
Microsoft	Windows 2000, 2003, 2008	MSCS	LDM	Fibre
	Windows 2003/2008 on IA64* Windows 2003/2008 on EM64T	MSCS	LDM	Fibre/iSCSI
Red Hat	Red Hat Linux AS 2.1, 3.0, 4.0	—	—	Fibre**
	AS 2.1, 3.0 Update2, 4.0 on IA64* AS 4.0 on EM64T	—	—	Fibre**
HP	Tru64 UNIX 5.0	TruCluster	LSM	Fibre
	OpenVMS 7.3-1	TruCluster	LSM	Fibre
SGI	IRIX 64 6.5	—	—	Fibre

* IA64: using IA-32EL on IA64 (except CCI for Linux/IA64)
** Please refer to section 5.1.1 about RHEL 4.0 using Kernel 2.6.9.XX.

Table 3.5 Supported Platforms for Copy-on-Write Snapshot

Vendor	Operating System	Failover Software	Volume Manager	I/O Interface
SUN	Solaris 2.8	—	VxVM	Fibre
	Solaris 10 /x86	—	VxVM	Fibre
HP	HP-UX 11.0/11.2x	—	LVM, SLVM	Fibre
	HP-UX 11.2x on IA64*	—	LVM, SLVM	Fibre
IBM	AIX 5.1	—	LVM	Fibre
Microsoft	Windows 2000, 2003, 2008	—	LDM	Fibre
	Windows 2003/2008 on IA64* Windows 2003/2008 on EM64T	—	LDM	Fibre/iSCSI
Red Hat	Red Hat Linux AS 2.1, 3.0, 4.0	—	—	Fibre**
	AS 2.1, 3.0 Update2, 4.0 on IA64* AS 4.0 on EM64T	—	—	Fibre**
HP	Tru64 UNIX 5.0	—	LSM	Fibre
	OpenVMS 7.3-1	—	—	Fibre
SGI	IRIX64 6.5	—	—	Fibre

* IA64: using IA-32EL on IA64 (except CCI for Linux/IA64)
** Please refer to section 5.1.1 about RHEL 4.0 using Kernel 2.6.9.XX.

Table 3.6 Supported Guest OS for VMware

VM Vendor	Layer	Guest OS	CCI Support Confirmation	Volume Mapping	I/O Interface
VMware ESX Server 2.5.1 or later using Linux Kernel 2.4.9 [Note 1]	Guest	Windows 2003 SP1	Confirmed	RDM*	Fibre
		Windows 2000 Server	Unconfirmed	RDM*	Fibre
		Windows NT 4.0	Unconfirmed		
		RHAS 3.0	Confirmed	RDM*	Fibre
		SLES 9.0	Unconfirmed		
		Solaris 10 u3 (x86)	Confirmed	RDM*	Fibre
	SVC	Linux Kernel 2.4.9	Confirmed	Direct	Fibre
IBM AIX 5.3 VIO Server [Note 2]	Client	AIX 5.3	Confirmed	Physical mode	Fibre
	Server	AIX 5.3	See (4) in section 3.1.4.2.	Direct	Fibre

* RDM: Raw Device Mapping using Physical Compatibility Mode.
Note 1: Please refer to section 3.1.4.1 about restrictions on VMware ESX Server.
Note 2: Please refer to section 3.1.4.2 about restrictions on AIX VIO.

Table 3.7 Supported Platforms: IPv6 vs IPv6

IPv6	CCI / IPv6 [Note 1]							
IPv6	HP-UX	Solaris	AIX	Windows	Linux	Tru64	HP-UX	OpenVMS
CCI / IPv6	HP-UX	–	AV	AV	AV	AV	AV	N/A
	Solaris	–	AV	AV	AV	AV	AV	N/A
	AIX	–	–	AV	AV	AV	AV	N/A
	Windows	–	–	–	AV	AV	AV	N/A
	Linux	–	–	–	–	AV	AV	N/A
	Tru64	–	–	–	–	–	AV	N/A
	OpenVMS	–	–	–	–	–	–	AV

Note 1: Please refer to section 3.1.5 about platform support for IPv6.
AV: Available for communicating with different platforms.
N/A: Not Applicable (Windows LH does not support IPv4 mapped IPv6).

Table 3.8 Supported Platforms: IPv4 vs IPv6

IPv6 IPv6	CCI / IPv6 [Note 1]							
	HP-UX	Solaris	AIX	Windows	Linux	Tru64	HP-UX	OpenVMS
CCI / IPv4	HP-UX	AV	AV	AV	N/A	AV	AV	N/A
	Solaris	AV	AV	AV	N/A	AV	AV	N/A
	AIX	AV	AV	AV	N/A	AV	AV	N/A
	Windows	AV	AV	AV	N/A	AV	AV	N/A
	Linux	AV	AV	AV	N/A	AV	AV	N/A
	Tru64	AV	AV	AV	N/A	AV	AV	N/A
	OpenVMS	AV	AV	AV	N/A	AV	AV	AV
	IRIX64	AV	AV	AV	N/A	AV	AV	N/A
	DYNIX	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Note 1: Please refer to section 3.1.5 about platform support for IPv6.
AV: Available for communicating with different platforms.
N/A: Not Applicable (Windows LH does not support IPv4 mapped IPv6).

Minimum platform versions for CCI/IPv6 support:

- HP-UX: HP-UX 11.23 (PA/IA) or later
- Solaris: Solaris 8/Sparc or later, Solaris 10/x86/64 or later
- AIX: AIX 5.1 or later
- Windows: Windows 2008(LH), Windows 2003 + IPv6 Install
- Linux: Linux Kernel 2.4 (RH8.0) or later
- Tru64: Tru64 v5.1A or later. Note that v5.1A does not support the **getaddrinfo()** function, so this must be specified by IP address directly.
- OpenVMS: OpenVMS 8.3 or later

3.1.2 Using CCI with Hitachi and Other RAID Storage Systems

Table 3.9 shows the related two controls between CCI and the RAID storage system type (Hitachi or HP® XP). Figure 3.1 shows the relationship between the APP, CCI, and RAID storage system.

- The following common API/CLI commands are rejected with EX_ERPERM(*1) by connectivity of CCI with RAID storage system:

  horctakeover, paircurchk, paircreate, pairsplit, pairresync, pairvolchk, pairevtwait, pairdisplay, raidscan (except -find option only), raidar, raidvchkset, raidvchkdsp, raidvchkscan

- The following XP API/CLI commands are rejected with EX_ERPERM(*2) on HITACHI storage system even when both CCI and Raid Manager XP (provided by HP) are installed:

  pairvolchk -s, pairdisplay -CLI, raidscan -CLI, paircreate -m noread for TrueCopy, paircreate -m dif/inc for ShadowImage

Table 3.9 Relationship between CCI and RAID Storage System

CCI Version	Installation	RAID System	Common API/CLI	XP API/CLI
CCI 01-08-03/00 or higher	CCI	Hitachi	Enable	Cannot use (except CLI)
		HP® XP	EX_ERPERM(*1)	
	CCI and Raid Manager XP	Hitachi	Enable	
		HP® XP	Enable	
Raid Manager XP 01.08.00 or higher (provided by HP®)	Raid Manager XP	HP® XP	Enable	Enable
		Hitachi	EX_ERPERM(*1)	EX_ERPERM(*2)
	Raid Manager XP and CCI	HP® XP	Enable	Enable
		Hitachi	Enable	EX_ERPERM(*2)

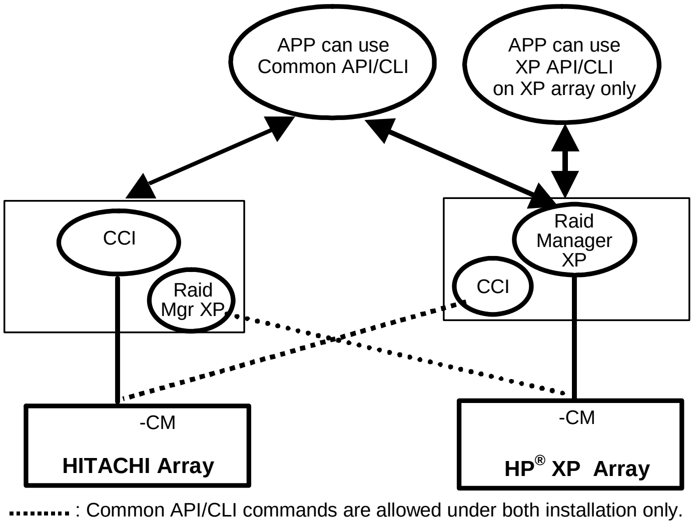


Figure 3.1 Relationship between APP, CCI, and Storage System

3.1.3 Restrictions on zLinux

In the following example, zLinux defines the Open Volumes that are connected to FCP as /dev/sd*. Also, the mainframe volumes (3390-xx) that are connected to FICON are defined as /dev/dasd*.

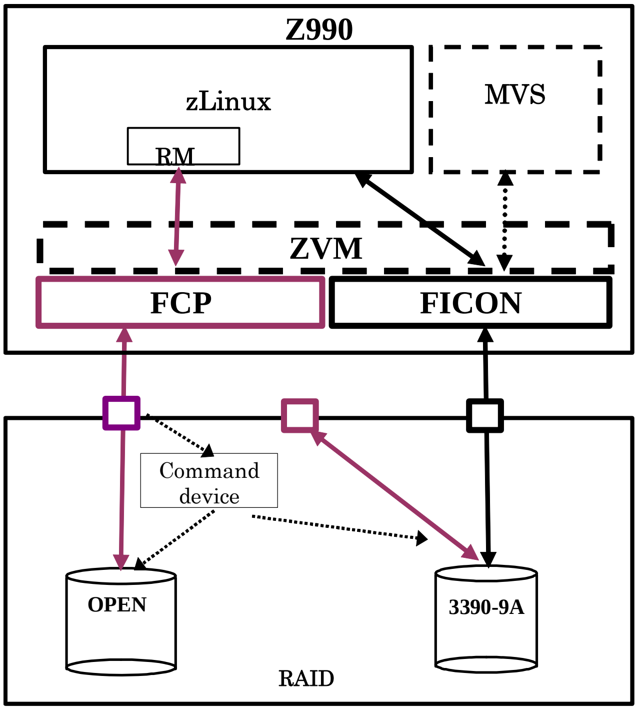


Figure 3.2 Example of a RAID Manager Configuration on zLinux

The restrictions for using CCI with zLinux are:

- **Command device.** CCI uses a SCSI Path-through driver to access the command device. As such, the command device must be connected through FCP adaptors.
- **Open Volumes via FCP.** You can control the ShadowImage and TrueCopy pair operations without any restrictions.
- **Mainframe (3390-9A) Volumes via FICON.** You cannot control the volumes (3390-9A) that are directly connected to FICON for ShadowImage pair operations. Also, mainframe volumes must be mapped to a CHF port to address target volumes using a command device, as shown in Figure 3.2. The mainframe volume does not have to be connected to an FCP adaptor.

  Note: ShadowImage supports only 3390-9A multiplatform volumes. TrueCopy does not support multiplatform volumes (including 3390-9A) via FICON.
- **Volume discovery via FICON.** The inqraid command discovers the FCP volume information by using SCSI inquiry. FICON volumes can only be discovered by using RAID Manager to convert the mainframe interface (Read_device_characteristics or Read_configuration_data) to SCSI Inquiry. As such, the information that is required to run the inqraid command cannot be implemented, as shown in the following example:

```
sles8z:/HORCM/usr/bin# ls /dev/dasd* | ./inqraid
/dev/dasda -> [ST] Unknown Ser =   1920 LDEV =   4 [HTC     ] [0704_3390_0A]
/dev/dasdaa -> [ST] Unknown Ser =  62724 LDEV =4120 [HTC     ] [C018_3390_0A]
/dev/dasdab -> [ST] Unknown Ser =  62724 LDEV =4121 [HTC     ] [C019_3390_0A]

sles8z:/HORCM/usr/bin# ls /dev/dasd* | ./inqraid -CLI
DEVICE_FILE     PORT    SERIAL  LDEV CTG  H/M/12  SSID R:Group PRODUCT_ID
dasda           -         1920     4   -       -  00C0       - 0704_3390_0A
dasdaa          -        62724  4120   -       -  9810       - C018_3390_0A
dasdab          -        62724  4121   -       -  9810       - C019_3390_0A
```

In the previous example, the Product_ID, C019_3390_0A, has the following associations:

- C019 indicates the Devno
- 3390 indicates the Dev_type
- 0A indicates the Dev_model

Note: The following commands cannot be used because there is no PORT information:

- raidscan -pd <device>, raidar -pd <device>, raidvchkscan -pd <device>
- raidscan -find [conf] , mkconf

3.1.4 Restrictions on VM

3.1.4.1 VMware ESX Server

Whether CCI (RM) runs or not depends on the support of guest OS by VMware. In addition, the guest OS depends on VMware support of virtual H/W (HBA). Therefore, the following guest OS and restrictions must be followed when using CCI on VMware.

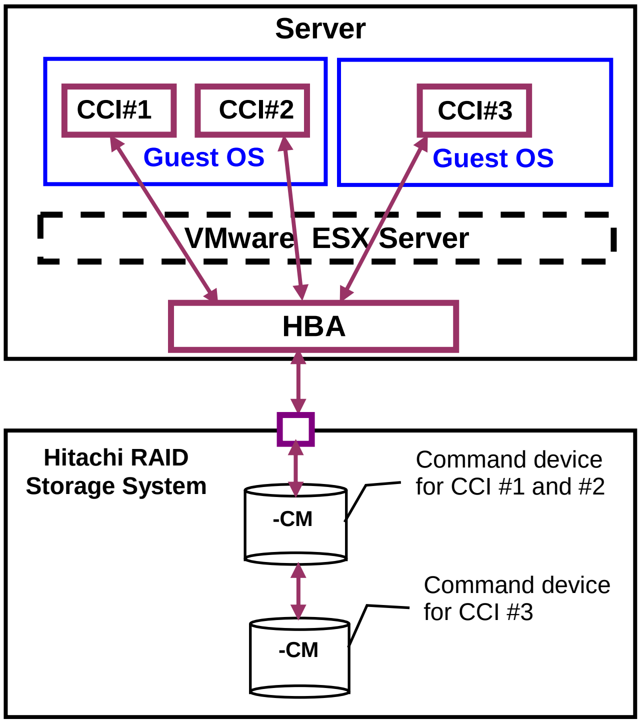


Figure 3.3 RAID Manager Configuration on Guest OS/VMware

The restrictions for using CCI with VMware are:

1. **Guest OS.** CCI needs to use guest OS that is supported by CCI, and also VMware supported guest OS (e.g., Windows Server 2003, Red Hat Linux, SuSE Linux). Refer to Table 3.6 in section 3.1.1.
2. **Command device.** CCI uses SCSI path-through driver to access the command device. Therefore, the command device must be mapped as **Raw Device Mapping** using Physical Compatibility Mode. At least one command device must be assigned for each guest OS.
3. CCI (RM) instance numbers among different guest OS must be **different**, even if the command will be assigned for each guest OS, because the command device cannot distinguish a difference among guest OS due to the same WWN as VMHBA.
4. **About invisible Lun.** Assigned Lun for the guest OS must be visible from SCSI Inquiry on when VMware (host OS) will be started. For example, the SVOL on VSS will be used as Read Only and Hidden, and this SVOL will be hidden from SCSI Inquiry. If VMware (host OS) will be started on this volume state, the host OS will hang.

5. **Lun sharing between Guest and Host OS.** It is not supported to share a command device or a normal Lun between guest OS and host OS.

6. **About running on SVC.** The ESX Server 3.0 SVC (service console) is a limited distribution of Linux based on Red Hat Enterprise Linux 3, Update 6 (RHEL 3 U6). The service console provides an execution environment to monitor and administer the entire ESX Server host. The CCI user will be able to run CCI by installing “CCI for Linux” on SVC. The volume mapping (/dev/sd??) on SVC is a physical connection without converting SCSI Inquiry, so CCI will perform like running on Linux regardless of guest OS. However, VMware protects the service console with a firewall. According to current documentation, the firewall allows only PORT# 902,80,443,22(SSH) and ICMP(ping), DHCP,DNS as defaults, so the CCI user must enable a PORT for CCI (HORCM) using the “iptables” command.

3.1.4.2 Restrictions on AIX VIO

Whether CCI can function completely or not depends on how VIO Client/Server supports virtual HBA(vscsi), and there are some restrictions in the case of volume discovery. Figure 3.4 shows CCI configuration on AIX VIO client.

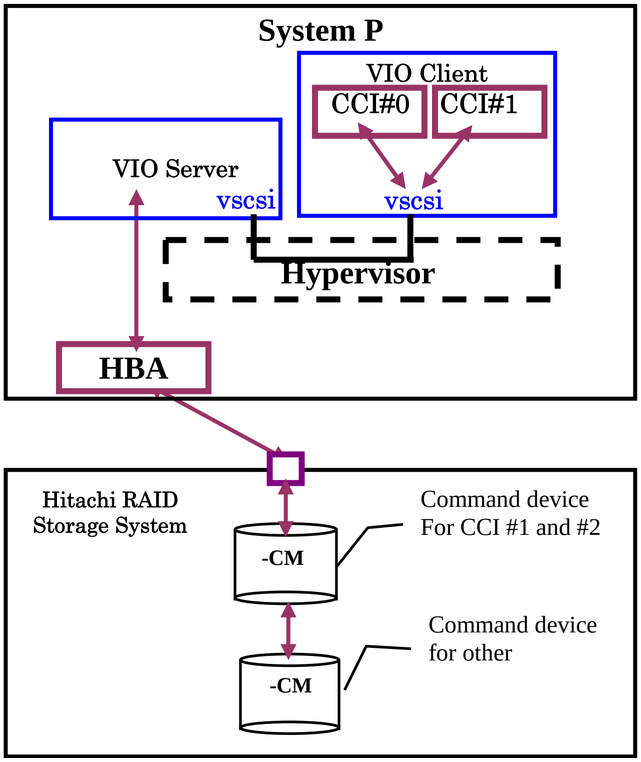


Figure 3.4 CCI Configuration on VIO Client

CCI on AIX VIO should be used with the following restrictions:

1. **Command device.** CCI uses SCSI Path-through driver for the purpose of access of the command device. Therefore the command device must be mapped as RAW device of Physical Mapping Mode. At least one command device must be assigned for each VIO Client. The CCI instance numbers among different VIO Clients must be different, even if the command will be assigned for each VIO Client, because the command device cannot distinguish between VIO Clients due to use of the same WWN via vscsi.
2. **Lun sharing between VIO Server and VIO Clients.** It is not possible to share a command device between VIO Server and VIO Clients, and a normal Lun also cannot be shared between VIO Server and VIO Clients.
3. **Volume discovery via vscsi on VIO Client.** The inqraid command discovers the volume information by using SCSI inquiry, but VIO Client cannot report the real SCSI inquiry (Page0 and Page83) as shown below.

   Example for inqraid command:

   ```
   lsdev -Cc disk | /HORCM/usr/bin/inqraid
   hdisk0 -> NOT supported INQ.            [AIX     ] [VDASD          ]
   hdisk1 -> NOT supported INQ.            [AIX     ] [VDASD          ]
   hdisk2 -> NOT supported INQ.            [AIX     ] [VDASD          ]
   :
   :
   hdisk19 -> NOT supported INQ.           [AIX     ] [VDASD          ]
   ```

   The following commands option discovers the volumes by issuing SCSI inquiry. These commands option cannot be used, because there is no Port/LDEV for RAID information.

   raidscan -pd **<device>**, **raidar** -pd **<device>**, **raidvchkscan** -pd **<device>**

   raidscan -find [conf] , **mkconf.sh**, **inqraid**

   pairxxx -d[g] **<device>**, **raidvchkdsp** -d[g] **<device>**, **raidvchkset** -d[g] **<device>**

   \\.\CMD-Serial#-LDEV#-Port#:/dev/rhdisk on horcm.conf

   So the user needs to know the volume mapping information (/dev/rhdisk??) on VIO Client by referring to the physical volume mapping through the VIO Server.
4. **About running on VIO Server.** The volume mapping(/dev/rhdisk??) on VIO Server is a physical connection without converting SCSI Inquiry, so CCI will perform like running on AIX 5.3. However, IBM does not allow running applications in the VIO server. Since commands or scripts would have to be run outside the restricted shell, it may be necessary to get IBM's approval to run in the VIO server. So the user would have to change their scripts to run in a VIO server to issue the oem_setup_env command to access the non-restricted shell.

3.1.5 About Platforms Supporting IPv6

Library and System Call for IPv6

CCI uses the following functions of IPv6 library to get and convert from hostname to IPv6 address.

- IPv6 library to resolve hostname and IPv6 address:
  - getaddrinfo()
  - inet_pton()
  - inet_ntop()
- Socket System call to communicate using UDP/IPv6:
  - socket(**AF_INET6**)
  - bind(), sendmsg(), sendto(), rcvmsg(), recvfrom()…

If CCI links above function in the object(exe), a core dump may occur if an OLD platform (e.g., Windows NT, HP-UX 10.20, Solaris 5) does not support it. So CCI links dynamically above functions by resolving the symbol after determining whether the shared library and function for IPv6 exists. It depends on supporting of the platform whether CCI can support IPv6 or not. If platform does not support IPv6 library, then CCI uses its own internal function corresponding to “inet_pton(),inet_ntop()”; in this case, IPv6 address will not be allowed to describe hostname.

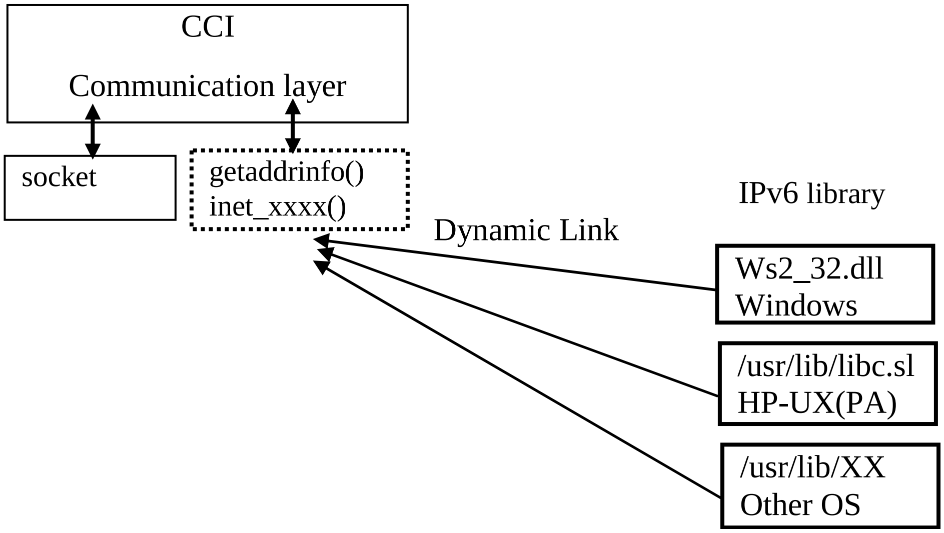


Figure 3.5 Library and System Call for IPv6

Environment Variable

CCI loads and links the library for IPv6 by specifying a PATH as follows.

For Windows systems: **Ws2_32.dll**

For HP-UX (PA/IA) systems: **/usr/lib/libc.sl**

However, CCI may need to specify a different PATH to use the library for IPv6. After this consideration, CCI also supports the following environment variables for specifying a PATH:

- **$IPV6_DLLPATH** (valid for only HP-UX, Windows): This variable is used to change the default PATH for loading the Library for IPv6. For example:

```
export IPV6_DLLPATH=/usr/lib/hpux32/lib.so
horcmstart.sh 10
```

- **$IPV6_GET_ADDR:** This variable is used to change “**AI_PASSIVE**” value as default for specifying to the getaddrinfo() function for IPv6. For example:

```
export IPV6_GET_ADDR=9
horcmstart.sh 10
```

HORCM Start-Up Log

Support level of IPv6 feature depends on the platform and OS version. In certain OS platform environments, CCI will not be able to perform IPv6 communication completely, so CCI logs the results of whether the OS environment supports the IPv6 feature or not.

/HORCM/log*/curlog/horcm_*HOST NAME*.log

```
*****************************************************************************
            -  HORCM STARTUP LOG - Fri Aug 31 19:09:24 2007
*****************************************************************************
19:09:24-cc2ec-02187- horcmgr started on Fri Aug 31 19:09:24 2007
:
:
19:09:25-3f3f7-02188- ******** starts Loading library for IPv6 *******
[ AF_INET6 = 26, AI_PASSIVE = 1 ]
19:09:25-47ca1-02188- dlsym() : Symbl = 'getaddrinfo' : dlsym: symbol "getaddrinfo" not
found in "/etc/horcmgr"
getaddrinfo() : Unlinked on itself
inet_pton()   : Linked on itself
inet_ntop()   : Linked on itself
19:09:25-5ab3e-02188- ******** finished Loading library **************
:
HORCM set to IPv6 ( INET6 value = 26)
:
```

3.2 Hardware Installation

Installation of the hardware required for CCI is performed by the user and the Hitachi Data Systems representative. To install the hardware required for CCI operations:

1. **User:**
   a) Identify the Hitachi TrueCopy and/or ShadowImage primary and secondary volumes, so that the CCI hardware and software components can be installed and configured properly.

   b) Make sure that the UNIX/PC server hardware and software are properly installed and configured (see section 3.1 for configuration requirements for Hitachi TrueCopy).

2. **Hitachi Data Systems representative:**
   a) Connect the RAID storage system(s) to the UNIX/PC server host(s). Please refer to the Maintenance Manual and the Configuration Guide for the platform (e.g., *Microsoft Windows Configuration Guide*, *IBM AIX Configuration Guide*).

   b) Install and enable the Hitachi TrueCopy and ShadowImage features on the RAID storage system(s).

   c) Configure the RAID storage systems which will contain the Hitachi TrueCopy and/or ShadowImage primary volumes to report sense information to the host(s).

   d) Set the SVP clock to local time so the TrueCopy/ShadowImage time stamps will be correct.

   e) Hitachi TrueCopy only: install the remote copy connections between the TrueCopy main and remote control units (MCUs and RCUs). For detailed information on installing the TrueCopy remote copy connections, please refer to the *Hitachi TrueCopy User and Reference Guide* for the storage system.

3. **User and Hitachi Data Systems Rep:** Ensure that the storage systems are accessible via Storage Navigator. For older storage systems, install, configure, and connect the Remote Console PC to the storage systems. Enable the applicable options (e.g., TrueCopy, ShadowImage, LUN Manager, Data Retention Utility).

   For information and instructions, see the *Storage Navigator User's Guide* for the storage system (e.g., *Hitachi TagmaStore USP/NSC Storage Navigator User's Guide*).

4. **User:** For Hitachi TrueCopy only, you must configure the RAID storage system for TrueCopy operations as follows before you can create TrueCopy volume pairs using CCI. For detailed instructions on configuring Hitachi TrueCopy operations, please refer to the *Hitachi TrueCopy User and Reference Guide* for the storage system.
   a) For 9900V and later, make sure that all TrueCopy MCUs are connected to the Storage Navigator LAN.

      For 9900, add all TrueCopy MCUs to the 9900 Remote Console PC at the main site.

   b) Change the MCU and RCU remote copy ports to the correct mode (LCP, RCP, initiator, target, RCU target).

   c) Establish the MCU-RCU paths.

3.3 Software Installation

Installation of the CCI software on the host server(s) is performed by the user, with assistance as needed from the Hitachi Data Systems representative.

3.3.1 Software Installation for UNIX Systems

If you are installing CCI from CD-ROM, please use the **RMinstsh** and **RMuninst** scripts on the CD-ROM to automatically install and uninstall the CCI software. For other media, please use the following instructions. *Note:* The following instructions refer to UNIX commands which may be different on your platform. Please consult your operating system documentation (e.g., UNIX man pages) for platform-specific command information.

New Installation into Root Directory:

1. Insert the installation medium into the proper I/O device.
2. Move to the current root directory: `# cd  /`
3. Copy all files from the installation medium using the **cpio** command:
   ```
   # cpio  -idmu  <  /dev/XXXX              XXXX = I/O device
   ```
   Preserve the directory structure (**d** flag) and file modification times (**m** flag), and copy unconditionally (**u** flag). For floppy disks, load them sequentially, and repeat the command. An I/O device name of floppy disk designates a surface partition of the raw device file (unpartitioned raw device file).
4. Execute the HORCM installation command: `# /HORCM/horcminstall.sh`
5. Verify installation of the proper version using the **raidqry** command:
   ```
   # raidqry -h
   ```
   ```
   Model: RAID-Manager/HP-UX
   Ver&Rev: 01-22-03/02
   Usage: raidqry [options]
   ```

New Installation into Non-Root Directory:

1. Insert the installation medium (e.g., CD-ROM) into the proper I/O device.
2. Move to the desired directory for CCI. The specified directory must be mounted by a partition of except root disk or an external disk.
   ```
   # cd  /Specified Directory
   ```
3. Copy all files from the installation medium using the **cpio** command:
   ```
   # cpio  -idmu  <  /dev/XXXX              XXXX = I/O device
   ```
   Preserve the directory structure (**d** flag) and file modification times (**m** flag), and copy unconditionally (**u** flag). For floppy disks, load them sequentially, and repeat the command. An I/O device name of floppy disk designates a surface partition of the raw device file (unpartitioned raw device file).
4. Make a symbolic link for /HORCM:
   ```
   # ln  -s   /Specified Directory/HORCM   /HORCM
   ```

5. Execute the HORCM installation command: **# /HORCM/horcminstall.sh**
6. Verify installation of the proper version using the **raidqry** command:

   ```
   # raidqry -h

   Model: RAID-Manager/HP-UX
   Ver&Rev: 01-22-03/02
   Usage: raidqry [options]
   ```

Version Up. To install a new version of the CCI software:

1. Confirm that HORCM is not running. If it is running, shut it down:
   One CCI instance: **# horcmshutdown.sh**
   Two CCI instances: **# horcmshutdown.sh 0 1**

   If Hitachi TrueCopy/ShadowImage commands are running in the interactive mode, terminate the interactive mode and exit these commands using **-q** option.
2. Insert the installation medium (e.g., CD-ROM) into the proper I/O device.
3. Move to the directory containing the HORCM directory (e.g., **# cd /** for root directory).
4. Copy all files from the installation medium using the **cpio** command:

   ```
   # cpio -idmu  <  /dev/XXXX              XXXX = I/O device
   ```

   Preserve the directory structure (**d** flag) and file modification times (**m** flag) and copy unconditionally (**u** flag). For floppy disks, load them sequentially, and repeat the command. An input/output device name of floppy disk designates a surface partition of the raw device file (unpartitioned raw device file).
5. Execute the HORCM installation command: **# /HORCM/horcminstall.sh**
6. Verify installation of the proper version using the **raidqry** command:

   ```
   # raidqry -h

   Model: RAID-Manager/HP-UX
   Ver&Rev: 01-22-03/02
   Usage: raidqry [options]
   ```

3.3.2 Software Installation for Windows Systems

Make sure to install CCI on all servers involved in CCI operations. If network (TCP/IP) is not established, install a network of Windows attachment, and add TCP/IP protocol.

To install the CCI software on a Windows system:

1. If a previous version of CCI is already installed, uninstall it as follows:
   a) Confirm that HORCM is not running. If it is running, shut it down:
   One CCI instance: **D:\HORCM\etc> horcmshutdown**
   Two CCI instances: **D:\HORCM\etc> horcmshutdown 0 1**
   b) If Hitachi TrueCopy/ShadowImage commands are running in the interactive mode, terminate the interactive mode and exit these commands using **-q** option.
   c) Remove the previous version of CCI using the **Add/Remove Programs** control panel.
2. Insert the installation medium (e.g., CD-ROM) into the proper I/O device.
3. Run **Setup.exe**, and follow the instructions on screen to complete the installation.
4. Verify installation of the proper version using the **raidqry** command:
   D:\HORCM\etc> raidqry -h

```
Model: RAID-Manager/Windows2000
Ver&Rev: 01-22-03/02
Usage: raidqry [options]
```

3.3.3 Software Installation for OpenVMS® Systems

Make sure to install CCI on all servers involved in CCI operations. Establish the network (TCP/IP), if not already established. CCI will be provided as the following PolyCenter Software Installation (PCSI) file:
HITACHI-ARMVMS-RM-V0122-2-1.PCSI
HITACHI-I64VMS-RM-V0122-2-1.PCSI

Follow the requirements and restrictions in section 3.5 for porting for OpenVMS.

CCI also requires that **POSIX_ROOT** is existing on the system, so you must define the **POSIX_ROOT** before installing the CCI software. It is recommended that you define the following three logical names for CCI in **LOGIN.COM**:

```
$ DEFINE/TRANSLATION=(CONCEALED,TERMINAL) SYS$POSIX_ROOT “Device:[directory]”
$ DEFINE DCL$PATH SYS$POSIX_ROOT:[horcm.usr.bin],SYS$POSIX_ROOT:[horcm.etc]
$ DEFINE/TABLE=LNM$PROCESS_DIRECTORY LNM$TEMPORARY_MAILBOX LNM$GROUP
$ DEFINE DECC$ARGV_PARSE_STYLE ENABLE
$ SET PROCESS/PARSE_STYLE=EXTENDED
```

where **Device:[directory]** is defined as SYS$POSIX_ROOT

New installation. To install the CCI software on an OpenVMS® system:

1. Insert and mount the provided CD or diskette.
2. Execute the following command:
   ```
   $ PRODUCT INSTALL RM /source=Device:[PROGRAM.RM.OVMS]/LOG -
   _$ /destination=SYS$POSIX_ROOT:[000000]
             Device:[PROGRAM.RM.OVMS] where HITACH-ARMVMS-RM-V0122-2-1.PCSI exists
   ```
3. Verify installation of the proper version using the **raidqry** command:
   ```
   $ raidqry -h

   Model: RAID-Manager/OpenVMS
   Ver&Rev: 01-22-03/02
   Usage: raidqry [options]
   ```
4. Follow the requirements and restrictions in section 3.5 for porting for OpenVMS.

Version update. To update the CCI software version on an OpenVMS® system:

1. Perform the update after making sure that HORCM is not in operation:
   $horcmshutdown for one HORCM instance
   $horcmshutdown 0 1 for two HORCM instances

   When a command is being used in interactive mode, terminate it using the "-q" option.
2. Insert and mount the provided CD or diskette.
3. Execute the following command:
   ```
   $ PRODUCT INSTALL RM /source=Device:[PROGRAM.RM.OVMS]/LOG
             Device:[PROGRAM.RM.OVMS] where HITACH-ARMVMS-RM-V0122-2-1.PCSI exists
   ```
4. Verify installation of the proper version using the **raidqry** command:
   ```
   $ raidqry -h

   Model: RAID-Manager/OpenVMS
   Ver&Rev: 01-22-03/02
   Usage: raidqry [options]
   ```
5. Follow the requirements and restrictions in section 3.5 for porting for OpenVMS.

3.3.4 Changing the CCI User (UNIX Systems)

The CCI software is initially configured to allow only the **root** user (system administrator) to execute CCI commands. If desired (e.g., CCI administrator does not have **root** access), the system administrator can change the CCI user from **root** to another user name.

To change the CCI user:

1. Change the owner of the following CCI files from the **root** user to the desired user name:
   /HORCM/etc/horcmgr
   All CCI commands in the /HORCM/usr/bin directory
   All CCI log directories in the /HORCM/log* directories
2. Change the owner of the raw device file of the HORCM_CMD command device in the configuration definition file from the **root** user to the desired user name.
3. *Optional*: Establishing the HORCM (/etc/horcmgr) start environment: If users have designation of the full environment variables (HORCM_LOG HORCM_LOGS), then they start horcmstart.sh command without an argument. In this case, the HORCM_LOG and HORCM_LOGS directories must be owned by the CCI administrator. The environment variable (HORCMINST, HORCM_CONF) establishes as the need arises.
4. *Optional*: Establishing the command execution environment: If users have designation of the environment variables (HORCC_LOG), then the HORCC_LOG directory must be owned by the CCI administrator. The environment variable (HORCMINST) establishes as the need arises.

Note: A user account for the Linux system must have the “CAP_SYS_ADMIN” and “CAP_SYS_RAWIO” privileges to use the SCSI Class driver (Command device). The system administrator can apply these privileges by using the PAM_capability module. However, if the system administrator cannot set those user privileges, then use the following method. This method starts the HORCM daemon only with the root user; as an alternative, the user can execute CCI commands.

- **System administrator**: Place the script that starts up horcmstart.sh in the following directory so that the system can start HORCM from /etc/rc.d/rc: `/etc/init.d`
- **Users**: When the log directory is only accessible by the system administrator, you cannot use the **inqraid** or **raidscan -find** commands. Therefore, set the command log directory by setting the environment variables (HORCC_LOG), and executing the RM command.

3.3.5 Changing the CCI User (Windows Systems)

Usually, RAID Manager commands can only be executed by the system administrator in order to directly open the PhysicalDrive.

When an administrator of CCI does not have an “administrator” privilege or there is a difference between the system administrator and the CCI administrator, the CCI administrator can use CCI commands as follows:

System Administrator Tasks

1. Add a user_name to the PhysicalDrive.
   Add the user name of the CCI administrator to the Device Objects of the command device for HORCM_CMD in the configuration definition file. For example:

```
C:\HORCM\tool\>chgacl /A:RMadmin Phys
PhysicalDrive0 -> \Device\Harddisk0\DR0
\\.\PhysicalDrive0 : changed to allow ‘RMadmin’
```

2. Add a user_name to the Volume{GUID}.
   If the CCI administrator needs to use the “-x mount/umount” option for CCI commands, the system administrator must add the user name of the CCI administrator to the Device Objects of the Volume{GUID}. For example:

```
C:\HORCM\tool\>chgacl /A:RMadmin Volume
Volume{b0736c01-9b14-11d8-b1b6-806d6172696f} -> \Device\CdRom0
\\.\Volume{b0736c01-9b14-11d8-b1b6-806d6172696f} : changed to allow ‘RMadmin’
Volume{b0736c02-9b14-11d8-b1b6-806d6172696f} -> \Device\Floppy0
\\.\Volume{b0736c02-9b14-11d8-b1b6-806d6172696f} : changed to allow ‘RMadmin’
Volume{b0736c00-9b14-11d8-b1b6-806d6172696f} -> \Device\HarddiskVolume1
\\.\Volume{b0736c00-9b14-11d8-b1b6-806d6172696f} : changed to allow ‘RMadmin’
```

3. Add a user_name to the ScsiX.
   If the CCI administrator needs to use the “-x portscan” option for CCI commands, the system administrator must add the user name of the CCI administrator to the Device Objects of the ScsiX. For example:

```
C:\HORCM\tool\>chgacl /A:RMadmin Scsi
Scsi0: -> \Device\Ide\IdePort0
\\.\Scsi0: : changed to allow ‘RMadmin’
Scsi1: -> \Device\Ide\IdePort1
\\.\Scsi1: : changed to allow  ‘RMadmin ‘
```

Note: Because the ACL (Access Control List) of the Device Objects is set every time Windows starts-up, the Device Objects are also required when Windows starts-up. The ACL is also required when new Device Objects are created.

CCI Administrator Tasks

1. Establish the HORCM (/etc/horcmgr) startup environment.
   By default, the configuration definition file is located in the following directory:
   `%SystemDrive%:\windows\`

   Because users cannot write to this directory, the CCI administrator must change the directory by using the HORCM_CONF variable. For example:

   ```
   C:\HORCM\etc\>set HORCM_CONF=C:\Documents and Settings\RMadmin\horcm10.conf
   C:\HORCM\etc\>set HORCMINST=10
   C:\HORCM\etc\>horcmstart   [This must be started without arguments]
   ```

   Notes: The mountvol command will be denied use by the users privilege, therefore "the directory mount" option of RM commands using mountvol command cannot be executed.

   •The inqraid "-gvinf" option uses `%SystemDrive%:\windows\` directory, so this option cannot use unless system administrator allow to write.

   However, RAID Manager will be able to change from `%SystemDrive%:\windows\` directory to `%TEMP%` directory by setting "HORCM_USE_TEMP" environment variable.

   For example:

   ```
   C:\HORCM\etc\>set HORCM_USE_TEMP=1
   C:\HORCM\etc\>inqraid $Phys -gvinf
   ```

2. Ensure that RAID Manager and CCI (HORCM) have the same privileges.
   If the RAID Manager command and CCI will be executing different privileges (different users), then the RAID Manager command will be unable to attach to CCI (the RAID Manager command and CCI are denied communication through the Mailslot).

   However, RAID Manager does permit a HORCM connection through the "HORCM_EVERYCLI" environment variable, as shown in the following example.

   ```
   C:\HORCM\etc\>set HORCM_CONF=C:\Documents and Settings\RMadmin\horcm10.conf
   C:\HORCM\etc\>set HORCMINST=10
   C:\HORCM\etc\>set HORCM_EVERYCLI=1
   C:\HORCM\etc\>horcmstart  [This must be started without arguments]
   ```

   In this example, users who execute the RAID Manager command must be restricted to use only that command. This can be done using the Windows "explore" or "cacls" commands.

3.3.6 Uninstallation

Uninstalling permanently removes software.

Uninstallation for UNIX systems. To uninstall the CCI software:

1. Confirm that CCI (HORCM) is not running. If it is running, shut it down:
   One CCI instance: **# horcmshutdown.sh**
   Two CCI instances: **# horcmshutdown.sh 0 1**

   If Hitachi TrueCopy/ShadowImage commands are running in the interactive mode, terminate the interactive mode and exit these commands using **-q** option.
2. When HORCM is installed in the root directory (/HORCM is not a symbolic link):
   Execute the horcmuninstall command: **# /HORCM/horcmuninstall.sh**
   Move to the root directory: **# cd /**
   Delete the product using the **rm** command: **# rm -rf /HORCM**
3. When HORCM is not installed in the root directory (/HORCM is a symbolic link):
   Execute the horcmuninstall command: **#** ***/Directory*****/HORCM/horcmuninstall.sh**
   Move to the root directory: **# cd /**
   Delete the symbolic link for /HORCM: **# rm /HORCM**
   Delete the product using the **rm** command: **# rm -rf** ***/Directory*****/HORCM**

Uninstallation for Windows systems. To uninstall the CCI software:

1. Confirm that CCI (HORCM) is not running. If it is running, shut it down:
   One CCI instance: **D:\HORCM\etc> horcmshutdown**
   Two CCI instances: **D:\HORCM\etc> horcmshutdown 0 1**
2. Delete the installed CCI (RAID Manager) using the **Add/Remove Programs** control panel.

Uninstallation for OpenVMS® systems. To uninstall the CCI software:

1. Confirm that CCI (HORCM) is not running. If it is running, shut it down:
   For one instance: **$ horcmshutdown**
   For two instances: **$ horcmshutdown 0 1**

   If a command is being used in interactive mode, terminate it using the **-q** option.
2. Delete the installed CCI software by using the following command:
   $ PRODUCT REMOVE RM /LOG

3.4 Creating/Editing the Configuration File

The configuration definition file is a text file which is created and/or edited using any standard text editor (e.g., UNIX vi editor, Windows Notepad). A sample configuration definition file, HORCM_CONF (/HORCM/etc/horcm.conf), is included with the CCI software. This file should be used as the basis for creating your configuration definition file(s). The system administrator should copy the sample file, set the necessary parameters in the copied file, and place the copied file in the proper directory.

See sections 2.8.3 and 2.9 for detailed descriptions of the configuration definition file(s) for sample CCI configurations. Table 3.10 contains the parameters defined in the configuration file and specifies the default value, type, and limit for each parameter.

Caution: Do not edit the configuration definition file while HORCM is running. Shut down HORCM, edit the configuration file as needed, and then restart HORCM.

Note: Do not mix pairs created with the At-Time Split option (**-m grp**) and pairs created without this option in the same group defined in the CCI configuration file. If you do, the pairsplit operation might end abnormally, or S-VOLs of the P-VOLs in the same consistency group might not be created correctly at the time when the pairsplit request is received.

Restrictions for a ShadowImage volume group (9900V and later) in the CCI configuration file:

- **ShadowImage volume group:**
  - A group cannot extend across multiple storage systems.
  - If a CT group contains more than one device group, pair operations act on the entire CT Group.
  - If a ShadowImage volume will be cascading with TrueCopy/UR volume, data consistency is not maintained with pairsplit.
- **CTGID number.** CCI assigns a CTGID to disk array automatically when a user makes ShadowImage volumes specified with “paircreate -m grp” command, and the group of configuration file is mapped to CTGID. If CCI cannot assign a free CTGID, the “paircreate -m grp” command is terminated with EX_ENOCTG.

  MAX CTGID:
  - USP V/VM: 256 (0-255)
  - USP/NSC: 256 (0-255)
  - 9900V: 128 (0-127)
- **Number of configurable LDEVs with “-m grp” option.** Maximum number of configurable LDEVs in the same CTGID:
  - USP V/VM: 8192
  - USP/NSC: 4096
  - 9900V: 1024

Table 3.10 Configuration (HORCM_CONF) Parameters

Parameter	Default value	Type	Limit
ip_address	None	Character string	64 characters
service	None	Character string or numeric value	15 characters
poll (10 ms)	1000	Numeric value See *Note*	None
timeout (10 ms)	3000	Numeric value See *Note*	None
dev_name for HORCM_DEV	None	Character string	31 characters
dev_group	None	Character string	31 characters Recommended value = 8 char. or less
port #	None	Character string	31 characters
target ID	None	Numeric value See *Note*	7 characters
LU#	None	Numeric value See Note	7 characters
MU#	0	Numeric value See *Note*	7 characters
Serial#	None	Numeric value	12 characters
CU:LDEV(LDEV#)	None	Numeric value	6 characters
dev_name for HORCM_CMD	None	Character string	63 characters Recommended value = 8 char. or less

Note: Use decimal notation for numeric values (not hexadecimal).

3.5 Porting Notice for OpenVMS

In the OpenVMS, the system call on UNIX are supported as the functions of CRTL (C Run Time Library) on the user process, and also the CRTL for OpenVMS does not support the POSIX and POSIX Shell fully such as UNIX. In addition to this, the RAID Manager uses the UNIX domain socket for IPC (Inter Process Communication), but OpenVMS does not support the AF_UNIX socket. As alternate method, RAID Manager has accomplished IPC between the Raid Manager command and HORCM daemon by using the Mailbox driver on OpenVMS.

So, RAID Manager has the following restrictions in porting for OpenVMS.

3.5.1 Requirements and Restrictions

(1) Version of OpenVMS.
CCI uses the CRTL and needs the following version supported the ROOT directory for POSIX.

- OpenVMS Version 7.3-1 or later
- CRTL version must be installed prior to running CCI. (Compaq C V6.5-001 was used in testing.)

(2) Defining the SYS$POSIX_ROOT.
CCI requires the POSIX_ROOT is existing on the system, so you must define the POSIX_ROOT before running the CCI. For example:
$ DEFINE/TRANSLATION=(CONCEALED,TERMINAL) SYS$POSIX_ROOT "**Device**:[**directory**]"
where **Device**:[**directory**] is defined as SYS$POSIX_ROOT

(3) IPC method using MailBox driver.
As alternate method of the UNIX domain socket for IPC (Inter Process Communication), RAID Manager use the mailbox driver to enable the communication between Raid Manager command and HORCM.

Therefore if the Raid Manager command and HORCM will be executing in different jobs (different terminal), then you must redefine **LNM$TEMPORARY_MAILBOX** in **LNM$PROCESS_DIRECTORY** table as follows:

```
$ DEFINE/TABLE=LNM$PROCESS_DIRECTORY LNM$TEMPORARY_MAILBOX LNM$GROUP
```

(4) Start-up method for HORCM daemon.
HORCM will be able to start as the daemon process from UNIX Shell. But in case of 'vfork' of CRTL, if a parent process has exit() then a child process also ends at the same time. In other words it looks that OpenVMS cannot make a daemon process from the POSIX program. Therefore, horcmstart.exe has been changed to wait until HORCM has been exiting by horcmshutdown.exe after start-up of the horcmgr. According to the rule for creating process in OpenVMS, to start-up the horcmstart.exe is to create the detached process or Batch JOB by using DCL command, as this method closely resembles the horcmd process on UNIX.

For example, using the Detached process:
If you want to have the HORCM daemon running in the background, you need to make the Detached LOGINOUT.EXE Process by using the ‘RUN /DETACHED’ command of the OpenVMS, and need to make the commands file for LOGINOUT.EXE.

The following are examples of “loginhorcm*.com” file given to SYS$INPUT for LOGINOUT.EXE, and are examples that “**VMS4$DKB100:[SYS0.SYSMGR.]**” was defined as SYS$POSIX_ROOT.

loginhorcm0.com

```
$ DEFINE/TRANSLATION=(CONCEALED,TERMINAL) SYS$POSIX_ROOT  "VMS4$DKB100:[SYS0.SYSMGR.]"
$ DEFINE DCL$PATH SYS$POSIX_ROOT:[horcm.usr.bin],SYS$POSIX_ROOT:[horcm.etc]
$ DEFINE/TABLE=LNM$PROCESS_DIRECTORY LNM$TEMPORARY_MAILBOX LNM$GROUP
$ horcmstart 0
```

loginhorcm1.com

```
$ DEFINE/TRANSLATION=(CONCEALED,TERMINAL) SYS$POSIX_ROOT   "VMS4$DKB100:[SYS0.SYSMGR.]"
$ DEFINE DCL$PATH SYS$POSIX_ROOT:[horcm.usr.bin],SYS$POSIX_ROOT:[horcm.etc]
$ DEFINE/TABLE=LNM$PROCESS_DIRECTORY LNM$TEMPORARY_MAILBOX LNM$GROUP
$ horcmstart 1
```

```
$ run /DETACHED SYS$SYSTEM:LOGINOUT.EXE /PROCESS_NAME=horcm0 -
_$ /INPUT=VMS4$DKB100:[SYS0.SYSMGR.][horcm]loginhorcm0.com -
_$ /OUTPUT=VMS4$DKB100:[SYS0.SYSMGR.][horcm]run0.out -
_$ /ERROR=VMS4$DKB100:[SYS0.SYSMGR.][horcm]run0.err
%RUN-S-PROC_ID, identification of created process is 00004160
$
$
$ run /DETACHED SYS$SYSTEM:LOGINOUT.EXE /PROCESS_NAME=horcm1 -
_$ /INPUT=VMS4$DKB100:[SYS0.SYSMGR.][horcm]loginhorcm1.com -
_$ /OUTPUT=VMS4$DKB100:[SYS0.SYSMGR.][horcm]run1.out -
_$ /ERROR=VMS4$DKB100:[SYS0.SYSMGR.][horcm]run1.err
%RUN-S-PROC_ID, identification of created process is 00004166
```

And also you will be able to verify that HORCM daemon is running as Detached Process by using ‘SHOW PROCESS’ command.

```
$ show process horcm0
25-MAR-2003 23:27:27.72   User: SYSTEM           Process ID:   00004160
                          Node: VMS4             Process name: "HORCM0"

Terminal:
User Identifier:    [SYSTEM]
Base priority:      4
Default file spec:  Not available
Number of Kthreads: 1

Soft CPU Affinity: off
$
$ horcmshutdown 0 1
inst 0:
HORCM Shutdown inst 0 !!!
inst 1:
HORCM Shutdown inst 1 !!!
$
```

(5) Command device.
CCI uses the SCSI class driver for the purpose of accessing the command device on the 9900V/9900, since OpenVMS does not provide the raw I/O device such as UNIX, and is defining “DG*,DK*,GK*” as the logical name for the device. The SCSI class driver requires the following privileges: DIAGNOSE and PHY_IO or LOG_IO (for details see the OpenVMS manual).

In CCI version 01-12-03/03 or earlier, you need to define the Physical device as either DG* or DK* or GK* by using DEFINE/SYSTEM command. For example:

```
$ show device

Device                  Device        Error    Volume         Free  Trans Mnt
Name                    Status        Count     Label        Blocks Count Cnt
VMS4$DKB0:              Online          0
VMS4$DKB100:            Mounted         0    ALPHASYS      30782220   414   1
VMS4$DKB200:            Online          0
VMS4$DKB300:            Online          0
VMS4$DQA0:              Online          0
$1$DGA145:      (VMS4)  Online          0
$1$DGA146:      (VMS4)  Online          0
:
:
$1$DGA153:      (VMS4)  Online          0

$ DEFINE/SYSTEM DKA145 $1$DGA145:
$ DEFINE/SYSTEM DKA146 $1$DGA146:
:
:
$ DEFINE/SYSTEM DKA153 $1$DGA153:
```

(6) -zx option for Raid Manager commands. ‘-zx option’ for Raid manager commands are using the select() function to wait a event from STDIN, but OpenVMS select() function does not support to wait any events from STDIN, and the behavior of select() for terminal(STDIN) is unable to echo back the terminal input.

Therefore ‘-zx option’ for Raid Manager commands will not be supported, and it will be deleted a display for ‘-zx option’ on Help & Usage.

(7) Syslog function. The OpenVMS does not support the syslog function like UNIX. Therefore, CCI does not support the syslog function. You can do an alternative by using HORCM logging file for HORCM daemon.

(8) Start up log files. In start up of HORCM, CCI does share a start up log file by two process for start-up, but CRTL does not work correctly to share from two processes.

As workaround, CCI has two start-up log files separated by using PID as follows.
For example, under the SYS$POSIX_ROOT:[HORCM.LOG*.CURLOG] directory:
HORCMLOG_VMS4 HORCM_VMS4_**10530**.LOG HORCM_VMS4_**10531**.LOG

(9) Option syntax and Case sensitivity.

VMS users are not accustomed to commands being case sensitive and syntax of the option, like UNIX. So CCI changes “case sensitivity” and “-xxx” syntax for options in order to match the expectations of VMS users as much as possible. CCI allows “**/xxx**” syntax for options as well as “**-xxx**” option, but this will be a minor option.

The followings upper-case strings are not case sensitive:

- **DG* or DK* or GK* for Logical Device Name**
- **-CLI or -FCA(-FHORC) or -FBC(-FMRCF) for the pair* command options**
- **-CLI or -CLIWP or -CLIWN or -CM for the inqraid options**
- **Environmental variable name such as HORCMINST … controlled by CRTL**

Also you need to define the following logical name to your **login.com** in order to distinguish the uppercase and the lowercase:

$ DEFINE DECC$ARGV_PARSE_STYLE ENABLE
$ SET PROCESS/PARSE_STYLE=EXTENDED

(10) Regarding using spawn command.

You can also start the HORCM process easily by using the spawn command. The following examples used SPAWN command on DCL.

For example, using spawn:

```
$ spawn /NOWAIT /PROCESS=horcm0 horcmstart 0
%DCL-S-SPAWNED, process HORCM0 spawned
$
   starting HORCM inst 0
$ spawn /NOWAIT /PROCESS=horcm1 horcmstart 1
%DCL-S-SPAWNED, process HORCM1 spawned
$
       starting HORCM inst 1
$
```

Note: the subprocess (HORCM) created by SPAWN will be terminated when the terminal will be LOGOFF or the session will be terminated. If you want independence Process to the terminal LOGOFF, then use the “RUN /DETACHED” command.

(11) Privileges for using RAID Manager.

- **A user account for RAID Manager must have the same privileges as “SYSTEM” that can be used the SCSI Class driver and Mailbox driver directly.**

  However some OpenVMS system administrators may not allow RAID Manager to run from the system account (equivalent to root on UNIX), therefore RAID Manager recommends to be created another account on the system such as “RMadmin” that has the equivalent privileges to “SYSTEM”.

  This would alleviate the problem of system administrators being nervous about giving out system passwords.

- **RAID Manager uses the Mailbox driver to enable communication between RAID Manager commands and HORCM. So, RAID Manager commands and HORCM must have the same privileges.**

  If the RAID Manager command and HORCM will be executing in different privileges (different user), then the RAID Manager command will be hang or unable to attach to HORCM because the RAID Manager command and HORCM will be denied to communicate through the Mailbox.

(12) Installation.

RAID Manager will be provided a file for installing as the following PCSI (PolyCenter Software Installation) file.

- **HITACHI-ARMVMS-RM-V0122-2-1.PCSI**
- **HITACHI-I64VMS-RM-V0122-2-1.PCSI**

RAID Manager also requires that **POSIX_ROOT** is existing on the system, so you must define the **POSIX_ROOT** before installing the RAID Manager.

RAID Manager recommends to be defined previously three logical names shown below for RAID Manager in LOGIN.COM.

```
$ DEFINE/TRANSLATION=(CONCEALED,TERMINAL) SYS$POSIX_ROOT  "Device:[directory]"
$ DEFINE DCL$PATH SYS$POSIX_ROOT:[horcm.usr.bin],SYS$POSIX_ROOT:[horcm.etc]
$ DEFINE/TABLE=LNM$PROCESS_DIRECTORY LNM$TEMPORARY_MAILBOX LNM$GROUP
$ DEFINE DECC$ARGV_PARSE_STYLE ENABLE
$ SET PROCESS/PARSE_STYLE=EXTENDED
```

where **Device**:[**directory**] is defined as SYS$POSIX_ROOT

For Installing:

```
$ PRODUCT INSTALL RM /source=Device:[directory]/LOG -
  _$ /destination=SYS$POSIX_ROOT:[000000]
                          Device:[directory]  where HITACHI-ARMVMS-RM-V0122-2-1.PCSI exists
:
:
  $ PRODUCT SHOW PRODUCT RM
-------------------------------------- ----------- ------------
PRODUCT                                KIT TYPE    STATE
-------------------------------------- ----------- ------------
HITACHI ARMVMS RM V1.22-2              Full LP     Installed
-------------------------------------- ----------- ------------

$ raidqry -h
Model  : RAID-Manager/OpenVMS
Ver&Rev: 01-22-03/02
:
:
```

For Installation history:

```
      $ PRODUCT SHOW HISTORY RM /FULL
```

For removing :

```
      $ PRODUCT REMOVE RM /LOG
```

(13) About exit code of the command on DCL

RAID Manager return codes are the same for all platform, however if the process was invoked by the DCL, the status is interpreted by DCL and a message is displayed as below.

```
---------------------------on DCL of OpenVMS------------------------
$ pairdisplay jjj
PAIRDISPLAY: requires '-jjj' or '/jjj' as argument
PAIRDISPLAY: [EX_REQARG] Required Arg list
Refer to the command log(SYS$POSIX_ROOT:[HORCM.LOG]HORCC_RMOVMS.LOG
(/HORCM/log/horcc_rmovms.log)) for details.

$ sh sym $status
  $STATUS == "%X0035A7F1"
$
$ pairdisplay -g aaa
PAIRDISPLAY: [EX_ATTHOR] Can't be attached to HORC manager
Refer to the command log(SYS$POSIX_ROOT:[HORCM.LOG]HORCC_RMOVMS.LOG
(/HORCM/log/horcc_rmovms.log)) for details.
$ sh sym $status
  $STATUS == "%X0035A7D9"
--------------------------on DCL of OpenVMS-------------------------
```

You can get “Exit code” of Raid Manager from $status of DCL using below formula.

Formula for calculating the exit code is:

```
Exit code of RM command =  ( $status % 2048 ) / 8
```

3.5.2 Known Issues

Rebooting on PAIR state (Writing disable)

OpenVMS does not show the volumes of writing disable (e.g., SVOL_PAIR) at start-up of system, therefore the SVOLs are hidden when rebooting in PAIR state or SUSPEND(read only) mode. You are able to verify that the "show device" and "inqraid"command does not show the SVOLs after reboot as below (notice that **DGA148** and **DGA150** devices are SVOL_PAIR).

```
$ sh dev dg
 Device                 Device           Error    Volume Free  Trans Mnt
  Name                  Status           Count    Label Blocks Count Cnt
$1$DGA145:      (VMS4)  Online               0
$1$DGA146:      (VMS4)  Online               0
$1$DGA147:      (VMS4)  Online               0
$1$DGA149:      (VMS4)  Online               0
$1$DGA151:      (VMS4)  Online               0
$1$DGA152:      (VMS4)  Online               0
$1$DGA153:      (VMS4)  Online               0

$ inqraid DKA145-153 -cli
DEVICE_FILE     PORT    SERIAL  LDEV CTG  H/M/12  SSID R:Group  PRODUCT_ID
DKA145          CL1-H    30009   145   -       -     -       -  OPEN-9-CM
DKA146          CL1-H    30009   146   -  s/P/ss  0004 5:01-11  OPEN-9
DKA147          CL1-H    30009   147   -  s/S/ss  0004 5:01-11  OPEN-9
DKA148          -            -     -   -       -     -       -  -
DKA149          CL1-H    30009   149   -  P/s/ss  0004 5:01-11  OPEN-9
DKA150          -            -     -   -       -     -       -  -
DKA151          CL1-H    30009   151   -  P/s/ss  0004 5:01-11  OPEN-9
DKA152          CL1-H    30009   152   -  s/s/ss  0004 5:01-11  OPEN-9
DKA153          CL1-H    30009   153   -  s/s/ss  0004 5:01-11  OPEN-9

$ inqraid DKA148
sys$assign : DKA148 -> errcode = 2312
DKA148 -> OPEN: no such device or address
```

After making the SVOL for Writing enable by using "pairsplit" or "horctakeover" command, you need to perform the "mcr sysman" command in order to use the SVOLs for back-up or disaster recovery.

```
$ pairsplit -g CAVG -rw
$ mcr sysman
SYSMAN> io auto
SYSMAN> exit

$ sh dev dg
Device                  Device           Error     Volume Free  Trans Mnt
 Name                   Status           Count     Label Blocks Count Cnt
$1$DGA145:      (VMS4)  Online               0
$1$DGA146:      (VMS4)  Online               0
$1$DGA147:      (VMS4)  Online               0
$1$DGA148:      (VMS4)  Online               0
$1$DGA149:      (VMS4)  Online               0
$1$DGA150:      (VMS4)  Online               0
$1$DGA151:      (VMS4)  Online               0
$1$DGA152:      (VMS4)  Online               0
$1$DGA153:      (VMS4)  Online               0
```

3.5.3 Start-up Procedures Using Detached Process on DCL

(1) Create the shareable Logical name for RAID if undefined initially.

CCI (RAID Manager) need to define the physical device (**1DGA145…**) as either DG* or DK* or GK* by using SHOW DEVICE command and **DEFINE/SYSTEM** command, but then does not need to be mounted in CCI version 01-12-03/03 or earlier.

```
$ show device
Device                  Device        Error    Volume         Free  Trans Mnt
Name                    Status        Count     Label        Blocks Count Cnt
$1$DGA145:      (VMS4)  Online          0
$1$DGA146:      (VMS4)  Online          0
:
:
$1$DGA153:      (VMS4)  Online          0
$
$ DEFINE/SYSTEM DKA145 $1$DGA145:
$ DEFINE/SYSTEM DKA146 $1$DGA146:
:
:
$ DEFINE/SYSTEM DKA153 $1$DGA153:
```

(2) Define the environment for RAID Manager in LOGIN.COM.

You need to define the Path for the RAID Manager commands to **DCL$PATH** as the foreign command. Refer to the section about Automatic Foreign Commands in the *OpenVMS User's Manual*.

```
$ DEFINE DCL$PATH SYS$POSIX_ROOT:[horcm.usr.bin],SYS$POSIX_ROOT:[horcm.etc]
```

If RAID Manager command and HORCM will be executing in different jobs (different terminal), then you must redefine **LNM$TEMPORARY_MAILBOX** in LNM$PROCESS_DIRECTORY table as follows:

```
$ DEFINE/TABLE=LNM$PROCESS_DIRECTORY LNM$TEMPORARY_MAILBOX LNM$GROUP
```

(3) Discover and describe the command device on SYS$POSIX_ROOT:[etc]horcm0.conf.

```
$ inqraid DKA145-151 -CLI
DEVICE_FILE     PORT    SERIAL  LDEV CTG  H/M/12  SSID R:Group  PRODUCT_ID
DKA145          CL1-H    30009   145   -       -     -       -  OPEN-9-CM
DKA146          CL1-H    30009   146   -  s/S/ss  0004 5:01-11  OPEN-9
DKA147          CL1-H    30009   147   -  s/P/ss  0004 5:01-11  OPEN-9
DKA148          CL1-H    30009   148   -  s/S/ss  0004 5:01-11  OPEN-9
DKA149          CL1-H    30009   149   -  s/P/ss  0004 5:01-11  OPEN-9
DKA150          CL1-H    30009   150   -  s/S/ss  0004 5:01-11  OPEN-9
DKA151          CL1-H    30009   151   -  s/P/ss  0004 5:01-11  OPEN-9

SYS$POSIX_ROOT:[etc]horcm0.conf
HORCM_MON
#ip_address        service         poll(10ms)     timeout(10ms)
127.0.0.1          30001           1000              3000

HORCM_CMD
#dev_name          dev_name        dev_name
DKA145
```

You will have to start HORCM without a description for HORCM_DEV and HORCM_INST because target ID & LUN are Unknown.

You will be able to know about a mapping of a physical device with a logical name easily by using the **raidscan -find** command option.

(4) Execute an ‘horcmstart 0’.

```
$ run /DETACHED SYS$SYSTEM:LOGINOUT.EXE /PROCESS_NAME=horcm0 -
_$ /INPUT=VMS4$DKB100:[SYS0.SYSMGR.][horcm]loginhorcm0.com -
_$ /OUTPUT=VMS4$DKB100:[SYS0.SYSMGR.][horcm]run0.out -
_$ /ERROR=VMS4$DKB100:[SYS0.SYSMGR.][horcm]run0.err
%RUN-S-PROC_ID, identification of created process is 00004160
```

(5) Verify a physical mapping of the logical device.

```
$ HORCMINST := 0
$ raidscan -pi DKA145-151 -find
DEVICE_FILE        UID  S/F PORT   TARG  LUN    SERIAL  LDEV  PRODUCT_ID
DKA145               0   F  CL1-H     0    1     30009   145  OPEN-9-CM
DKA146               0   F  CL1-H     0    2     30009   146  OPEN-9
DKA147               0   F  CL1-H     0    3     30009   147  OPEN-9
DKA148               0   F  CL1-H     0    4     30009   148  OPEN-9
DKA149               0   F  CL1-H     0    5     30009   149  OPEN-9
DKA150               0   F  CL1-H     0    6     30009   150  OPEN-9
DKA151               0   F  CL1-H     0    7     30009   151  OPEN-9

$ horcmshutdown 0
inst 0:
HORCM Shutdown inst 0 !!!
```

(6) Describe the known HORCM_DEV on SYS$POSIX_ROOT:[etc]horcm*.conf

For horcm0.conf

```
HORCM_DEV
#dev_group    dev_name     port#     TargetID        LU#     MU#
VG01          oradb1       CL1-H            0          2       0
VG01          oradb2       CL1-H            0          4       0
VG01          oradb3       CL1-H            0          6       0
HORCM_INST
#dev_group        ip_address      service
VG01              HOSTB           horcm1
```

For horcm1.conf

```
HORCM_DEV
#dev_group    dev_name     port#     TargetID        LU#     MU#
VG01          oradb1       CL1-H            0          3       0
VG01          oradb2       CL1-H            0          5       0
VG01          oradb3       CL1-H            0          7       0
HORCM_INST
#dev_group        ip_address      service
VG01              HOSTA           horcm0
```

Note: Defines the UDP port name for HORCM communication in the **SYS$SYSROOT:[000000.TCPIP$ETC]SERVICES.DAT** file, as in the example below.

```
horcm0     30001/udp
horcm1     30002/udp
```

(7) Start **horcm0** and **horcm1** as the Detached process.

```
$ run /DETACHED SYS$SYSTEM:LOGINOUT.EXE /PROCESS_NAME=horcm0 -
_$ /INPUT=VMS4$DKB100:[SYS0.SYSMGR.][horcm]loginhorcm0.com -
_$ /OUTPUT=VMS4$DKB100:[SYS0.SYSMGR.][horcm]run0.out -
_$ /ERROR=VMS4$DKB100:[SYS0.SYSMGR.][horcm]run0.err
%RUN-S-PROC_ID, identification of created process is 00004160
$
$
$ run /DETACHED SYS$SYSTEM:LOGINOUT.EXE /PROCESS_NAME=horcm1 -
_$ /INPUT=VMS4$DKB100:[SYS0.SYSMGR.][horcm]loginhorcm1.com -
_$ /OUTPUT=VMS4$DKB100:[SYS0.SYSMGR.][horcm]run1.out -
_$ /ERROR=VMS4$DKB100:[SYS0.SYSMGR.][horcm]run1.err
%RUN-S-PROC_ID, identification of created process is 00004166
```

You will be able to verify that HORCM daemon is running as Detached Process by using the **SHOW PROCESS** command.

```
$ show process horcm0
25-MAR-2003 23:27:27.72   User: SYSTEM          Process ID:   00004160
                          Node: VMS4            Process name: "HORCM0"
Terminal:
User Identifier:    [SYSTEM]
Base priority:      4
Default file spec:  Not available
Number of Kthreads: 1

Soft CPU Affinity: off
```

3.5.4 Command Examples in DCL

(1) Setting the environment variable by using Symbol.

```
$ HORCMINST := 0
$ HORCC_MRCF := 1
$ raidqry -l
No Group    Hostname            HORCM_ver  Uid  Serial#    Micro_ver Cache(MB)
1  ---      VMS4              01-22-03/02    0    30009  50-04-00/00     8192
$
$ pairdisplay -g VG01 -fdc
Group   PairVol(L/R) Device_File   M ,Seq#,LDEV#.P/S,Status,   % ,P-LDEV# M
VG01    oradb1(L)    DKA146        0 30009  146..S-VOL PAIR,  100    147  -
VG01    oradb1(R)    DKA147        0 30009  147..P-VOL PAIR,  100    146  -
VG01    oradb2(L)    DKA148        0 30009  148..S-VOL PAIR,  100    149  -
VG01    oradb2(R)    DKA149        0 30009  149..P-VOL PAIR,  100    148  -
VG01    oradb3(L)    DKA150        0 30009  150..S-VOL PAIR,  100    151  -
VG01    oradb3(R)    DKA151        0 30009  151..P-VOL PAIR,  100    150  -
$
```

(2) Removing the environment variable.

```
$ DELETE/SYMBOL HORCC_MRCF
$ pairdisplay -g VG01 -fdc
Group   PairVol(L/R) Device_File   ,Seq#,LDEV#.P/S,Status,Fence,   % ,P-LDEV# M
VG01    oradb1(L)    DKA146        30009  146..SMPL  ---- ------,-----  ----  -
VG01    oradb1(R)    DKA147        30009  147..SMPL  ---- ------,-----  ----  -
VG01    oradb2(L)    DKA148        30009  148..SMPL  ---- ------,-----  ----  -
VG01    oradb2(R)    DKA149        30009  149..SMPL  ---- ------,-----  ----  -
VG01    oradb3(L)    DKA150        30009  150..SMPL  ---- ------,-----  ----  -
VG01    oradb3(R)    DKA151        30009  151..SMPL  ---- ------,-----  ----  -
$
```

(3) Changing the default log directory.

```
$ HORCC_LOG := /horcm/horcm/TEST
$ pairdisplay
PAIRDISPLAY: requires '-x xxx' as argument
PAIRDISPLAY: [EX_REQARG] Required Arg list
Refer to the command log(SYS$POSIX_ROOT:[HORCM.HORCM.TEST]HORCC_VMS4.LOG (/HORCM
/HORCM/TEST/horcc_VMS4.log)) for details.
```

(4) Turning back to the default log directory.

```
$ DELETE/SYMBOL HORCC_LOG
```

(5) Specifying the device described in scandev.LIS.

```
$ define dev_file SYS$POSIX_ROOT:[etc]SCANDEV
$ type dev_file
DKA145-150
$
$ pipe type dev_file | inqraid -CLI
DEVICE_FILE     PORT    SERIAL  LDEV CTG  H/M/12  SSID R:Group PRODUCT_ID
DKA145          CL1-H    30009   145   -       -     -       - OPEN-9-CM
DKA146          CL1-H    30009   146   -  s/S/ss  0004 5:01-11 OPEN-9
DKA147          CL1-H    30009   147   -  s/P/ss  0004 5:01-11 OPEN-9
DKA148          CL1-H    30009   148   -  s/S/ss  0004 5:01-11 OPEN-9
DKA149          CL1-H    30009   149   -  s/P/ss  0004 5:01-11 OPEN-9
DKA150          CL1-H    30009   150   -  s/S/ss  0004 5:01-11 OPEN-9
```

(6) Making the configuration file automatically.

You will be able to omit the step from (3) to (6) on Start-up procedures by using mkconf command.

```
$ type dev_file
DKA145-150
$
$ pipe type dev_file | mkconf -g URA -i 9
starting HORCM inst 9
HORCM Shutdown inst 9 !!!
A CONFIG file was successfully completed.
HORCM inst 9 finished successfully.
starting HORCM inst 9
DEVICE_FILE             Group    PairVol     PORT   TARG  LUN M   SERIAL  LDEV
DKA145                  -        -           -         -    - -    30009   145
DKA146                  URA      URA_000     CL1-H     0    2 0    30009   146
DKA147                  URA      URA_001     CL1-H     0    3 0    30009   147
DKA148                  URA      URA_002     CL1-H     0    4 0    30009   148
DKA149                  URA      URA_003     CL1-H     0    5 0    30009   149
DKA150                  URA      URA_004     CL1-H     0    6 0    30009   150
HORCM Shutdown inst 9 !!!
Please check 'SYS$SYSROOT:[SYSMGR]HORCM9.CONF','SYS$SYSROOT:[SYSMGR.LOG9.CURLOG]
HORCM_*.LOG', and modify 'ip_address & service'.
HORCM inst 9 finished successfully.
$

SYS$SYSROOT:[SYSMGR]horcm9.conf (/sys$sysroot/sysmgr/horcm9.conf)

# Created by mkconf on Thu Mar 13 20:08:41

HORCM_MON
#ip_address        service         poll(10ms)     timeout(10ms)
127.0.0.1          52323                 1000              3000

HORCM_CMD
#dev_name               dev_name                dev_name
#UnitID 0 (Serial# 30009)
DKA145

# ERROR [CMDDEV] DKA145               SER =    30009  LDEV =  145 [ OPEN-9-CM  `
HORCM_DEV
#dev_group         dev_name        port#     TargetID     LU#     MU#
# DKA146               SER =    30009  LDEV =  146 [ FIBRE FCTBL = 3 ]
URA                URA_000         CL1-H            0       2       0
# DKA147               SER =    30009  LDEV =  147 [ FIBRE FCTBL = 3 ]
URA                URA_001         CL1-H            0       3       0
# DKA148               SER =    30009  LDEV =  148 [ FIBRE FCTBL = 3 ]
URA                URA_002         CL1-H            0       4       0
# DKA149               SER =    30009  LDEV =  149 [ FIBRE FCTBL = 3 ]
URA                URA_003         CL1-H            0       5       0
# DKA150               SER =    30009  LDEV =  150 [ FIBRE FCTBL = 3 ]
URA                URA_004         CL1-H            0       6       0

HORCM_INST
#dev_group        ip_address      service
URA               127.0.0.1       52323
```

(7) Using **1*** naming as native device name.

You are able to use the native device without DEFINE/SYSTEM command by specifying **1*** naming directly.

```
$ inqraid $1$DGA145-155 -CLI
DEVICE_FILE     PORT    SERIAL  LDEV CTG  H/M/12  SSID R:Group PRODUCT_ID
$1$DGA145       CL2-H    30009   145   -       -     -       - OPEN-9-CM
$1$DGA146       CL2-H    30009   146   -  s/P/ss  0004 5:01-11 OPEN-9
$1$DGA147       CL2-H    30009   147   -  s/S/ss  0004 5:01-11 OPEN-9
$1$DGA148       CL2-H    30009   148   0  P/s/ss  0004 5:01-11 OPEN-9


$ pipe show device   | INQRAID -CLI
DEVICE_FILE     PORT    SERIAL  LDEV CTG  H/M/12  SSID R:Group PRODUCT_ID
$1$DGA145       CL2-H    30009   145   -       -     -       - OPEN-9-CM
$1$DGA146       CL2-H    30009   146   -  s/P/ss  0004 5:01-11 OPEN-9
$1$DGA147       CL2-H    30009   147   -  s/S/ss  0004 5:01-11 OPEN-9
$1$DGA148       CL2-H    30009   148   0  P/s/ss  0004 5:01-11 OPEN-9


$ pipe show device   | MKCONF -g URA -i 9
starting HORCM inst 9
HORCM Shutdown inst 9 !!!
A CONFIG file was successfully completed.
HORCM inst 9 finished successfully.
starting HORCM inst 9
DEVICE_FILE             Group    PairVol     PORT   TARG  LUN M   SERIAL  LDEV
$1$DGA145               -        -           -          -    - -    30009   145
$1$DGA146               URA      URA_000     CL2-H     0    2 0    30009   146
$1$DGA147               URA      URA_001     CL2-H     0    3 0    30009   147
$1$DGA148               URA      URA_002     CL2-H     0    4 0    30009   148
HORCM Shutdown inst 9 !!!
Please check 'SYS$SYSROOT:[SYSMGR]HORCM9.CONF','SYS$SYSROOT:[SYSMGR.LOG9.CURLOG]
HORCM_*.LOG', and modify 'ip_address & service'.
HORCM inst 9 finished successfully.
$

$ pipe show device   | RAIDSCAN -find
DEVICE_FILE         UID  S/F PORT   TARG  LUN    SERIAL  LDEV  PRODUCT_ID
$1$DGA145             0   F  CL2-H     0    1     30009   145  OPEN-9-CM
$1$DGA146             0   F  CL2-H     0    2     30009   146  OPEN-9
$1$DGA147             0   F  CL2-H     0    3     30009   147  OPEN-9
$1$DGA148             0   F  CL2-H     0    4     30009   148  OPEN-9


$ pairdisplay -g BCVG -fdc
Group   PairVol(L/R) Device_File    M  ,Seq#,LDEV#..P/S,Status,   % ,P-LDEV# M
BCVG    oradb1(L)    $1$DGA146      0  30009   146..P-VOL PAIR,  100     147 -
BCVG    oradb1(R)    $1$DGA147      0  30009   147..S-VOL PAIR,  100     146 -
$
$ pairdisplay -dg $1$DGA146
Group   PairVol(L/R) (Port#,TID, LU-M) ,Seq#,LDEV#..P/S,Status, Seq#,P-LDEV# M
BCVG    oradb1(L)   (CL1-H , 0,   2-0) 30009   146..P-VOL PAIR,30009     147 -
BCVG    oradb1(R)   (CL1-H , 0,   3-0) 30009   147..S-VOL PAIR,-----     146 -
$
```

3.5.5 Start-up Procedures in Bash

CCI (RAID Manager) does not recommend to be used through the bash, because the bash will not be provided as official release in OpenVMS 7.3-1.

(1) Create the shareable Logical name for RAID if undefined initially.

You need to define the Physical device (**1DGA145…**) as either DG* or DK* or GK* by using SHOW DEVICE command and **DEFINE/SYSTEM** command, but then does not need to be mounted.

```
$ show device
Device                  Device        Error    Volume         Free  Trans Mnt
Name                    Status        Count     Label       Blocks Count Cnt
$1$DGA145:      (VMS4)  Online          0
$1$DGA146:      (VMS4)  Online          0
:
:
$1$DGA153:      (VMS4)  Online          0
$
$ DEFINE/SYSTEM DKA145 $1$DGA145:
$ DEFINE/SYSTEM DKA146 $1$DGA146:
:
:
$ DEFINE/SYSTEM DKA153 $1$DGA153:
```

(2) Define the environment for RAID Manager in LOGIN.COM.

If Raid Manager command and HORCM will be executing in different jobs (different terminal), then you must redefine **LNM$TEMPORARY_MAILBOX** in LNM$PROCESS_DIRECTORY table as follows:

```
$ DEFINE/TABLE=LNM$PROCESS_DIRECTORY LNM$TEMPORARY_MAILBOX LNM$GROUP
```

(3) Discover and describe the command device on /etc/horcm0.conf.

```
bash$ inqraid DKA145-151 -CLI
DEVICE_FILE     PORT    SERIAL  LDEV CTG  H/M/12  SSID R:Group PRODUCT_ID
DKA145          CL1-H    30009   145   -       -     -       - OPEN-9-CM
DKA146          CL1-H    30009   146   -  s/S/ss  0004 5:01-11 OPEN-9
DKA147          CL1-H    30009   147   -  s/P/ss  0004 5:01-11 OPEN-9
DKA148          CL1-H    30009   148   -  s/S/ss  0004 5:01-11 OPEN-9
DKA149          CL1-H    30009   149   -  s/P/ss  0004 5:01-11 OPEN-9
DKA150          CL1-H    30009   150   -  s/S/ss  0004 5:01-11 OPEN-9
DKA151          CL1-H    30009   151   -  s/P/ss  0004 5:01-11 OPEN-9
```

/etc/horcm0.conf

```
HORCM_MON
#ip_address        service         poll(10ms)     timeout(10ms)
127.0.0.1          52000           1000              3000

HORCM_CMD
#dev_name          dev_name        dev_name
DKA145

HORCM_DEV
#dev_group         dev_name        port#     TargetID   LU#   MU#

HORCM_INST
#dev_group         ip_address      service
```

You will have to start HORCM without a description for HORCM_DEV and HORCM_INST **because target ID & Lun are Unknown**.

You will be able to know about a mapping of a physical device with a logical name easily by using the **raidscan -find** command option.

(4) Execute an ‘horcmstart 0’ as background.

```
bash$ horcmstart 0 &
18
bash$
      starting HORCM inst 0
```

(5) Verify a physical mapping of the logical device.

```
bash$ export HORCMINST=0
bash$ raidscan -pi DKA145-151 -find
DEVICE_FILE         UID  S/F PORT   TARG  LUN    SERIAL  LDEV  PRODUCT_ID
DKA145                0   F  CL1-H     0    1     30009   145  OPEN-9-CM
DKA146                0   F  CL1-H     0    2     30009   146  OPEN-9
DKA147                0   F  CL1-H     0    3     30009   147  OPEN-9
DKA148                0   F  CL1-H     0    4     30009   148  OPEN-9
DKA149                0   F  CL1-H     0    5     30009   149  OPEN-9
DKA150                0   F  CL1-H     0    6     30009   150  OPEN-9
DKA151                0   F  CL1-H     0    7     30009   151  OPEN-9
```

(6) Describe the known HORCM_DEV on /etc/horcm*.conf.

FOR horcm0.conf

```
HORCM_DEV
#dev_group    dev_name     port#     TargetID        LU#     MU#
VG01          oradb1       CL1-H            0          2       0
VG01          oradb2       CL1-H            0          4       0
VG01          oradb3       CL1-H            0          6       0
HORCM_INST
#dev_group        ip_address      service
VG01              HOSTB           horcm1
```

FOR horcm1.conf

```
HORCM_DEV
#dev_group    dev_name     port#     TargetID        LU#     MU#
VG01          oradb1       CL1-H            0          3       0
VG01          oradb2       CL1-H            0          5       0
VG01          oradb3       CL1-H            0          7       0
HORCM_INST
#dev_group        ip_address      service
VG01              HOSTA           horcm0
```

(7) Start ‘horcmstart 0 1’.

Note: The subprocess(HORCM) created by bash will be terminated when the bash is EXIT.

```
bash$ horcmstart 0 &
19
bash$
      starting HORCM inst 0
bash$ horcmstart 1 &
20
bash$
      starting HORCM inst 1
```

3.6 CCI Startup

After you have installed the CCI software (see section 3.3), set the configuration definition file(s) (see section 3.4), and (for OpenVMS only) followed the porting requirements and restrictions (see section 3.5), you can begin using the CCI software (HORCM) to perform Hitachi TrueCopy and/or ShadowImage operations on the attached storage systems.

3.6.1 Startup for UNIX Systems

One Instance. To start up one instance of CCI on a UNIX system:

1. Modify **/etc/services** to register the port name/number (service) of the configuration definition file. Make the port name/number the same on all servers.
   horcm xxxxx/udp xxxxx **=** the port name/number of horcm.conf
2. If you want HORCM to start automatically each time the system starts up, add **/etc/horcmstart.sh** to the system automatic start-up file (e.g., **/sbin/rc**).
3. Execute the **horcmstart.sh** script manually to start the CCI instance:
   # horcmstart.sh
4. Set the log directory (**HORCC_LOG**) in the command execution environment as needed.
5. If you want to perform Hitachi TrueCopy operations, do not set the **HORCC_MRCF** environment variable. If you want to perform ShadowImage operations, set the **HORCC_MRCF** environment variable for the HORCM execution environment.

   For B shell:

   ```
   # HORCC_MRCF=1
   # export HORCC_MRCF
   ```

   For C shell:

   ```
   # setenv HORCC_MRCF  1

   # pairdisplay -g xxxx
   ```

   xxxx = group name

Two Instances. To start up two instances of CCI on a UNIX system:

1. Modify **/etc/services** to register the port name/number (service) of each configuration definition file. The port name/number must be different for each CCI instance.
   horcm0 xxxxx/udp xxxxx = the port name/number for horcm0.conf
   horcm1 yyyyy/udp yyyyy = the port name/number for horcm1.conf
2. If you want HORCM to start automatically each time the system starts up, add **/etc/horcmstart.sh 0 1** to the system automatic start-up file (e.g., **/sbin/rc**).
3. Execute the **horcmstart.sh** script manually to start the CCI instances:
   # horcmstart.sh 0 1
4. Set an instance number to the environment which executes a command:

   For B shell:
   # HORCMINST=X X = instance number = 0 or 1
   # export HORCMINST

   For C shell:
   # setenv HORCMINST X
5. Set the log directory (**HORCC_LOG**) in the command execution environment as needed.
6. If you want to perform Hitachi TrueCopy operations, do not set the **HORCC_MRCF** environment variable. If you want to perform ShadowImage operations, set the **HORCC_MRCF** environment variable for the HORCM execution environment.

   For B shell:
   # HORCC_MRCF=1
   # export HORCC_MRCF

   For C shell:
   # setenv HORCC_MRCF 1

   # pairdisplay -g xxxx xxxx = group name

3.6.2 Startup for Windows Systems

One Instance. To start up one instance of CCI on a Windows system:

1. Modify **\WINNT\system32\drivers\etc\services** to register the port name/number (service) of the configuration definition file. Make the port name/number the same on all servers: **horcm** **xxxxx/udp** xxxxx **=** the port name/number of horcm.conf
2. If you want HORCM to start automatically each time the system starts up, add **\HORCM\etc\horcmstart** to the system automatic start-up file (e.g., **\autoexec.bat**).
3. Execute the **horcmstart** script manually to start CCI: **D:\HORCM\etc> horcmstart**
4. Set the log directory (**HORCC_LOG**) in the command execution environment as needed.
5. If you want to perform Hitachi TrueCopy operations, do not set the **HORCC_MRCF** environment variable. If you want to perform ShadowImage operations, set the **HORCC_MRCF** environment variable for the HORCM execution environment:

   D:\HORCM\etc> set HORCC_MRCF=1

   D:\HORCM\etc> pairdisplay -g xxxx xxxx = group name

Two Instances. To start up two instances of CCI on a Windows system:

1. Modify **\WINNT\system32\drivers\etc\services** to register the port name/number (service) of the configuration definition files. Make sure that the port name/number is different for each instance:
   horcm0 **xxxxx/udp** xxxxx **=** the port name/number of horcm0.conf
   horcm1 **xxxxx/udp** xxxxx **=** the port name/number of horcm1.conf
2. If you want HORCM to start automatically each time the system starts up, add **\HORCM\etc\horcmstart 0 1** to the system automatic start-up file (e.g., **\autoexec.bat**).
3. Execute the **horcmstart** script manually to start CCI: **D:\HORCM\etc> horcmstart 0 1**
4. Set an instance number to the environment which executes a command:
   D:\HORCM\etc> set HORCMINST=X X = instance number = 0 or 1
5. Set the log directory (**HORCC_LOG**) in the command execution environment as needed.
6. If you want to perform Hitachi TrueCopy operations, do not set the **HORCC_MRCF** environment variable. If you want to perform ShadowImage operations, set the **HORCC_MRCF** environment variable for the HORCM execution environment:

   D:\HORCM\etc> set HORCC_MRCF=1

   D:\HORCM\etc> pairdisplay -g xxxx xxxx = group name

3.6.3 Startup for OpenVMS® Systems

One Instance. To start up one instance of CCI on an OpenVMS® system:

1. Create the configuration definition file (see section 3.4).

   For a new installation, the configuration definition sample file is supplied (SYS$POSIX_ROOT:[HORCM.etc]horcm.conf). Make a copy of the file:
   $ COPY SYS$POSIX_ROOT:[HORCM.etc]horcm.conf   SYS$POSIX_ROOT:[etc]

   Edit this file according to the system configuration using a text editor (e.g., eve).

   Register the port name (service) of the configuration definition file in “SYS$SYSROOT:[000000.TCPIP$ETC]SERVICES.DAT “.

   ```
        [horcm  xxxxx/udp.            where "xxxxx" denotes a port number]
   ```

   Use the same port number in all servers. The port number can be directly specified without registering it in “SYS$SYSROOT:[000000.TCPIP$ETC]SERVICES.DAT”.

2. Manually execute the HORCM startup command.

   $ spawn /nowait /process=horcm horcmstart

   Note: The subprocess(HORCM) created by SPAWN will be terminated when the terminal will be LOGOFF or the session will be terminated. If you want independence Process to the terminal LOGOFF, then use “RUN /DETACHED” command (Refer to item (4) in section 3.5.1).

3. Confirm the configuration.

   Set the log directory (HORCC_LOG) in the command execution environment as required.

   > *Note:* If the log directory under SYS$POSIX_ROOT is shared with other nodes, the log directory of Horc Manager must be set for each node. The log directory of Horc Manager can be changed by setting the parameter of horcmstart (see Table 4.35).

   When the command issued is for HOMRCF, set the environment variable (HORCC_MRCF).
   $ HORCC_MRCF:=1
   $ pairdisplay -g xxxx   Where “xxxx” denotes a group name.

Note: If a system configuration change or a RAID configuration change causes this file to change, (e.g., cache size change or microcode change), these changes will not take effect until you stop HORCM (horcmshutdown) and restart HORCM (horcmstart). Use the “-c” option of the pairdisplay command to verify that there are no configuration errors.

Two Instances. To start up two instances of CCI on a OpenVMS® system:

1. Create the configuration definition files (see section 3.4).

   For a new installation, the configuration definition sample file is supplied (SYS$POSIX_ROOT:[HORCM.etc]horcm.conf). Copy the file twice, once for each instance.

   $ COPY SYS$POSIX_ROOT:[HORCM.etc]horcm.conf SYS$POSIX_ROOT:[etc] horcm0.conf

   $ COPY SYS$POSIX_ROOT:[HORCM.etc]horcm.conf SYS$POSIX_ROOT:[etc] horcm1.conf

   Edit these two files according to the system configuration using a text editor (e.g., eve).

   Register the port name (service) of the configuration definition file in "SYS$SYSROOT:[000000.TCPIP$ETC]SERVICES.DAT".

```
     horcm0  xxxxx/udp.  Where "xxxxx" denotes a port number.
     horcm1  yyyyy/udp.   Where "xxxxx" denotes a port number.
```

   Each instance should have a unique port number.

   The port number can be directly specified without registering it in "SYS$SYSROOT:[000000.TCPIP$ETC]SERVICES.DAT".

2. Execute the HORCM startup command.

```
$ spawn /nowait  /process=horcm0  horcmstart 0
$ spawn /nowait  /process=horcm1  horcmstart 1
```

   Note: The subprocess(HORCM) created by SPAWN will be terminated when the terminal will be LOGOFF or the session will be terminated. If you want independence Process to the terminal LOGOFF, then use "RUN /DETACHED" command (Refer to item (4) in section 3.5.1).

3. Set the HORCM instance numbers in the environment in which the command is to be executed:
   $ HORCMINST:=X where "X" denotes an instance number (0 or 1)

4. Confirm the configuration using a RAID Manager command.

   Set the log directory (**HORCC_LOG**) in the command execution environment as required.

   > *Note:* If the log directory under SYS$POSIX_ROOT is shared with other nodes, the log directory of Horc Manager must be set for each node. The log directory of Horc Manager can be changed by setting the parameter of horcmstart (see Table 4.35).

   When the command issued is for HOMRCF, set the environment variable (**HORCC_MRCF**).
   $ HORCC_MRCF:=1
   $ pairdisplay -g xxxx Where "xxxx" denotes a group name.

Note: If a system configuration change or a RAID configuration change causes this file to change (e.g., cache size change, microcode change), these changes will not take effect until you stop HORCM (horcmshutdown 0 1) and restart HORCM (horcmstart 0 and horcmstart 1). Use the "-c" option to pairdisplay command to verify that there are no configuration errors.

3.7 Starting CCI as a Service (Windows Systems)

Usually, CCI (HORCM) is started by executing the start-up script from the Windows services. However, in the VSS environment, there is no interface to automatically start CCI. As a result, CCI provides the following `svcexe.exe` command and a sample script (HORCM0_run.txt) file so that CCI can be started automatically from the services:

```
C:\HORCM\tool\>svcexe
```

- Usage for adding [HORCM_START_SVC]: svcexe /A=command_path
  - for deleting [HORCM_START_SVC]: svcexe /D
  - for specifying a service: svcexe /S=service_name
  - for dependent services: svcexe /C=service_name,service_name

This command example uses HORCM0 for the registration of the service name for HORCM instance#0:

- Example for adding [HORCM0]: svcexe /S=HORCM0 “/A=C:\HORCM\tool\svcexe.exe”
  - for deleting [HORCM0]: svcexe /S=HORCM0 /D
  - for starting [HORCM0] :[1] make a C:\HORCM\tool\HORCM0_run.txt file.
    - :[2] set a user account to this service.
    - :[3] confirm to start by ‘horcmstart 0’.
    - :[4] confirm to stop by ‘horcmshutdown 0’.
    - :[5] start from a service by ‘net start HORCM0’.

Performing Additional Configuration Tasks

1. Registering the HORCM instance as a service.
   The system administrator must add the HORCM instance using the following command:

   ```
   C:\HORCM\tool\>svcexe /S=HORCM0 “/A=C:\HORCM\tool\svcexe.exe”
   ```

2. Customizing a sample script file.
   The system administrator must customize the sample script file (HORCM0_run.txt) according to the HORCM instance. For details, please refer to the descriptions in the HORCM0_run.txt file.

3. Setting the user account.
   The system administrator must set the user account for the CCI administrator as needed.

   In case of using GUI, use “Administrative Tools→Services→Select HORCM0→Logon”.

   In case of using CUI, use “sc config” command as follows:

   ```
    C:\HORCM\tool\>sc config HORCM0 obj= AccountName password= password
   ```

   If the system administrator uses default account (LocalSystem), add “HORCM_EVERYCLI=1”:

   ```
   #  ****  For INSTANCE# X, change to HORCMINST=X as needed  ****
   START:
    set HORCM_EVERYCLI=1
    set HORCMINST=0
   set HORCC_LOG=STDERROUT
    C:\HORCM\etc\horcmstart.exe
    exit 0
   ```

4. Starting the HORCM instance from the service.
   After you have confirmed starting and stopping using “horcmstart 0” and “horcmshutdown 0”, you must verify that HORCM0 starts from the service and that HORCM0 started automatically from REBOOT, using the following command:

   ```
   C:\HORCM\tool\>net start HORCM0
   ```

5. Stopping HORCM instance as a service.
   Instead of using the “horcmshutdown 0” command, you must use the following command to stop HORCM0:

   ```
   C:\HORCM\tool\>net stop HORCM0
   ```

   (By using the “horcmshutdown 0” command, the script written into HORCM0_run.txt will automatically restart HORCM0).

Chapter 4 Performing CCI Operations

This chapter covers the following topics:

- Environmental variables (section 4.1)
- Creating pairs (paircreate) (section 4.2)
- Splitting and deleting pairs (pairsplit) (section 4.3)
- Resynchronizing pairs (pairresync) (section 4.4)
- Confirming pair operations (pairevtwait) (section 4.5)
- Monitoring pair activity (pairmon) (section 4.6)
- Checking attribute and status (pairvolchk) (section 4.7)
- Displaying pair status (pairdisplay) (section 4.8)
- Checking Hitachi TrueCopy pair currency (paircurchk) (section 4.9)
- Performing Hitachi TrueCopy takeover operations (horctakeover) (section 4.10)
- Displaying configuration information (raidscan, raidar, raidqry) (section 4.11)
- Performing data protection operations (raidvchkset, raidvchkdsp, raidvchkscan) (section 4.12)
- Controlling CCI activity (hormstart, horcmshutdown, horcctl) (section 4.13)
- CCI command tools (inqraid, mkconf) (section 4.14)
- Synchronous waiting command (pairsyncwait) for Hitachi TrueCopy Async (section 4.15)
- Protection facility (section 4.16)
- Group version control for mixed storage system configurations (section 4.17)
- LDM volume discovery and flushing for Windows (section 4.18)
- Special facilities for Windows systems (section 4.19)
- Host group control (section 4.20)
- Using CCI SLPR Security (section 4.21)

4.1 Environmental Variables

When activating HORCM or initiating a command, users can specify any of the environmental variables that are listed in Table 4.1.

Table 4.1 HORCM, Hitachi TrueCopy, and ShadowImage Variables

Variable	Functions
HORCM (**/etc/horcmgr**) environmental variables	$HORCM_CONF: Names the HORCM configuration file, default = /etc/horcm.conf. $HORCM_LOG: Names the HORCM log directory, default = /HORCM/log/curlog. $HORCM_TRCSZ: Specifies the size of the HORCM trace file in KB, default = 1 MB. The trace file size cannot be changed using the **horcctl** command. $HORCM_TRCLVL: Specifies the HORCM trace level (0 - 15), default = 4. If a negative value is specified, trace mode is canceled. The trace level can be changed using **horcctl -c -l** command. $HORCM_TRCBUF: Specifies the HORCM trace mode. If this variable is specified, data is written in the trace file in the non-buffer mode. If not, data is written in the buffer mode. The trace mode can be changed using the **horcctl -c -b** command. $HORCM_TRCUENV: Specifies whether or not to succeed the trace control parameters (TRCLVL and TRCBUF) as they are when a command is issued. When this variable is specified, the Hitachi TrueCopy default trace control parameters are used to the trace control parameters of HORCM as global parameters. If not, the default trace control parameters for Hitachi TrueCopy commands are used and tracing level = 4, trace mode = buffer mode. $HORCMFCTBL: Changes the fibre address conversion table number, used when the target ID indicated by the **raidscan** command is different than the TID on the system. $HORCMPROMOD: Turns ON protection mode for the command device (see section 4.16.7). $HORCMPERM: Specifies the HORCM permission file name (see section4.16.7).
Hitachi TrueCopy command environmental variables	$HORCC_LOG: Specifies the command log directory name, default = /HORCM/log* (* = instance number). If this variable has "STDERROUT" as magic strings, then the command will change an output of the logging to STDERR. This strings is used to inhibit an output of the logging when the user script does handle in prospect of an error code for the command. $HORCC_TRCSZ: Specifies the size of the command trace file in KB, default = HORCM trace file size. The default Hitachi TrueCopy trace file size can be changed using **horcctl -d -s**, and it becomes effective from later executing a command. $HORCC_TRCLVL: Specifies the command trace level (0 = 15), default = 4 or the specified HORCM trace level. If a negative value is specified, trace mode is canceled. The default trace level for Hitachi TrueCopy commands can be changed using the **horcctl -d -l**, and it becomes effective from later executing a command. $HORCC_TRCBUF: Specifies the command trace mode. If specified, data is written in the trace file in the non-buffer mode. If not, the HORCM trace mode is used. The default trace mode for Hitachi TrueCopy commands can be changed using the **horcctl -d -b**, and it becomes effective from later executing a command. $HORCC_LOGSZ: This variable is used to specify a maximum size (in units of KB) and normal logging for the current command. "/HORCM/log*/horcc_HOST.log" file is moved to "/HORCM/log*/horcc_HOST.oldlog" file when reaching in the specified maximum size. If this variable is not specified or specified as '0', it is same as the current logging for only command error.
HORCM instance environmental variable	$HORCMINST: Specifies the instance number when using two or more CCI instances on the same server. The command execution environment and the HORCM activation environment require an instance number to be specified. Set the configuration definition file (HORCM_CONF) and log directories (HORCM_LOG and HORCC_LOG) for each instance.

Variable	Functions
ShadowImage command environmental variables	$ HORCC_MRCF: Sets the execution environment of the ShadowImage commands. The selection whether the command functions as that of Hitachi TrueCopy or ShadowImage is made according to this variable. The HORCM is not affected by this variable. When issuing a Hitachi TrueCopy command, do not set the HORCC_MRCF variable for the execution environment of the command. When issuing a ShadowImage command, set the environmental variable HORCC_MRCF=1 for the execution environment of the command. *Note:* The following environment variables are validated for USP V/VM and USP/NSC only, and are also validated on TC-TC/SI cascading operation using "-FHOMRCF [MU#]" option. To maintain compatibility across RAID storage systems, these environment variables are ignored by 9900V/9900, which enables you to use a script with "$HORCC_SPLT, $HORCC_RSYN, $HORCC_REST" for USP/NSC on the 9900V/9900 storage systems. $ HORCC_SPLT: =NORMAL The "pairsplit" and "paircreate -split" will be performed as Non quick mode regardless of setting of the system option mode 122 via SVP. =QUICK The "pairsplit" and "paircreate -split" will be performed as Quick Split regardless of setting of the system option mode 122 via SVP. $ HORCC_RSYN: =NORMAL The "pairresync" will be performed as Non quick mode regardless of setting of the system option mode 87 via SVP. =QUICK The "pairresync" will be performed as Quick Resync regardless of setting of the system option mode 87 via SVP. $ HORCC_REST: =NORMAL The "pairresync -restore" will be performed as Non quick mode regardless of setting of the system option mode 80 via SVP. =QUICK The "pairresync -restore" will be performed as Quick Restore regardless of setting of the system option mode 80 via SVP.

4.1.1 $HORCMINST and $HORCC_MRCF Supported Options

The CCI command has depended on the `$HORCMINST,HORCC_MRCF` environment variable as described in the table above. However CCI also supports the following options that do not depend on the `$HORCMINST,HORCC_MRCF` environment variable.

4.1.1.1 Specifying Options

- **-I[instance#]** This option used for specifying Instance# of HORCM. For example to set HORCMINST=5:
  # pairdisplay -g <group> -I5 …
  For example to set without HORCMINST:
  # pairdisplay -g <group> -I …
- **-IH[instance#] or -ITC[instance#]** This option used for specifying the command as HORC, and used for specifying Instance# of HORCM. For example to set HORC(TC) mode:
  # pairdisplay -g <group> -IH …
  For example to set HORC(TC) mode and HORCMINST=5 :
  # pairdisplay -g <group> -IH5 …
- **-IM[instance#] or -ISI[instance#]** This option used for specifying the command as HOMRCF, and used for specifying Instance# of HORCM. For example to set HOMRCF(SI) mode:
  # pairdisplay -g <group> -IM …
  For example to set HOMRCF(SI) mode and HORCMINST=5 :
  # pairdisplay -g <group> -IM5 …

  Note: In interactive mode (-z option), the HORCM Instance# cannot be changed due to be attaching to the Log directory for its instance# at that time.

4.1.1.2 Relationship between -I[H][M][inst#] option and $HORCMINST,HORCC_MRCF

If this option will not be specified, then the performing of the command has being depended on $HORCMINST,HORCC_MRCF environment variable. Table 4.2 shows the relationship between "-I[inst#]" option and $HORCMINST and HORCC_MRCF.

Table 4.2 Relationship Between -I[inst#] Option and $HORCMINST and HORCC_MRCF

-I[inst#] option	$HORCMINST	Behavior
-I	Don't care	Attaching w/o HORCMINST
-IX		Attaching to HORCMINST=X
Unspecified	HORCMINST=X	Attaching to HORCMINST=X
	Unspecified	Attaching w/o HORCMINST

-IH, -IM or -ITC, -ISI option	$HORCC_MRCF	Behavior
-IH or -ITC	Don't care	Executing as HORC(TC) mode
-IM or -ISI		Executing as HOMRCF(SI) mode
Unspecified	HORCC_MRCF=1	Executing as HOMRCF(SI) mode
	Unspecified	Executing as HORC(TC) mode

X: this shows the Instance Number

4.1.2 Verifying $HORCC_MRCF,HORCMINST

RAID Manager provides a way to verify "$HORCC_MRCF" and "$HORCMINST" environment variable so that a user can confirm RM instance number and Copy mode they are setting.

```
# pairdisplay -h
Model  : RAID-Manager/Solaris
Ver&Rev: 01-22-03/02
Usage  : pairdisplay [options] for HORC[5]
-h     Help/Usage
-I[#]  Set to the instance# of HORCM
 -IH[#] Set to HORC   mode [and the instance# of HORCM]
 -IM[#] Set to HOMRCF mode [and the instance# of HORCM]
 -z     Set to the interactive mode
 -zx    Set to the interactive mode and HORCM monitoring
 -q     Quit(Return to main())
 -g <group>    Specify the group_name
```

- Interactive mode

```
# pairdisplay -z
pairdisplay[HORC[5]]: -IM
pairdisplay[HOMRCF[5]]: -q
#
```

4.2 Creating Pairs (Paircreate)

WARNING: Use the paircreate command with caution. The paircreate command starts the Hitachi TrueCopy/ShadowImage initial copy operation, which overwrites all data on the secondary/target volume. If the primary and secondary volumes are not identified correctly, or if the wrong options are specified (e.g., **vl** instead of **vr**), data will be transferred in the wrong direction.

The paircreate command generates a new volume pair from two unpaired volumes. The paircreate command can create either a paired logical volume or a group of paired volumes. The paircreate command allows you to specify the direction (local or remote) of the pair generation (see Figure 4.1). If local (**vl** option) is specified, the server issuing the paircreate command has the primary volume. If remote (**vr** option) is specified, the remote server has the primary volume. The **-split** option of the paircreate command (ShadowImage only) allows you to simultaneously create and split pairs using a single CCI command. When **-split** is used, the pair status changes from COPY to PSUS (instead of PAIR) when the initial copy operation is complete. Table 4.3 lists and describes the paircreate command parameters and returned values. Table 4.4 lists and describes the error codes for the paircreate command.

Note: Snapshot support for the TagmaStore USP/NSC depends on the microcode version.

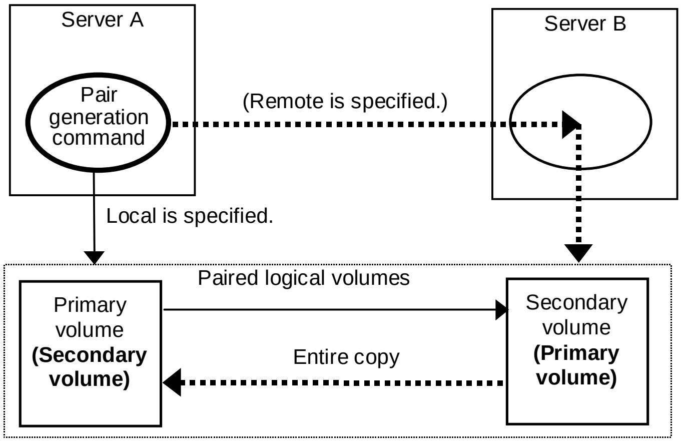


Figure 4.1 Pair Creation

Before issuing the paircreate command, make sure that the secondary volume is not mounted on any system. If the secondary volume is found to be mounted after paircreate, delete the pair (pairsplit -S), unmount the secondary volume, and then reissue the paircreate command.

Note: The paircreate command terminates before the initial copy operation is complete (except when the **nocopy** option is specified). Use the pair event waiting or pair display command to verify that the initial copy operation completed successfully (status changes from COPY to PAIR, or from COPY to PSUS if the **-split** option was specified). The execution log file also shows completion of the initial copy operation.

Hitachi TrueCopy only: The paircreate command cannot execute copy rejection in case of an error condition which made the target volume is accompanied by maintenance work.

Table 4.3 Paircreate Command Parameters

<table>
<tr><th>Parameter</th><th>Value</th></tr>
<tr><td>Command Name</td><td>paircreate</td></tr>
<tr><td>Format</td><td>paircreate { -h | -q | -z | -g <group> | -d <pair Vol> | -d[g] <raw_device> [MU#] | |-FHORC [MU#] -d[g] <seq#> <LDEV#> [MU#] | -f[g] <fence> [CTGID] | -v | -c <size> | -nocopy | -nomsg | -split | [-m <mode>] | -jp <id> | -js <id> | -pid <PID> |-fq <mode> | -cto <o-time> <c-time> <r-time> \ -nocsus }</td></tr>
</table>

Parameter	Value
Options	**-h**: Displays Help/Usage and version information. **-q**: Terminates the interactive mode and exits the command. **-z** or **-zx** (OpenVMS cannot use the -zx option): Makes the paircreate command enter interactive mode. The **-zx** option guards performing of the HORCM in interactive mode. When this option detects a HORCM shut down, interactive mode terminates. **-I[H][M][instance#] or -I[TC][SI][instance#]** Specifies the command as [HORC]/[HOMRCF], and used for specifying Instance# of HORCM **-g <group>**: Specifies a group name defined in the configuration definition file. The command is executed for the specified group unless the -d <pair Vol> option is specified. **-d <pair Vol>**: Specifies paired logical volume name defined in the configuration definition file. When this option is specified, the command is executed for the specified paired logical volume. **-d[g] <raw_device> [MU#]**: Searches a group on the configuration definition file (local instance) for the specified raw_device, and if the specified raw_device is contained in the group, the target volume is executed as the paired logical volume (-d) or group (-dg). This option is effective without specification of “-g <group>“ option. If the specified the raw_device is contained in two or more groups, the command is executed on the first group. **-d[g] <seq#> <LDEV#> [MU#]**: Searches a group on the configuration definition file (local instance) for the specified LDEV, and if the specified LDEV is in the group, the target volume is executed as the paired logical volume (-d) or group (-dg). This option is effective without specification of “-g <group>“ option. If the specified LDEV is contained in two or more groups, the command is executed on the first group. The **<seq #> <LDEV #>** values can be specified in hexadecimal (by addition of “0x “) or decimal notation. **-f[g] <fence> [CTGID]** (Hitachi TrueCopy or UR only): Specifies the fence level for assuring the consistency of paired volume data. A fence level of “data”, “status”, “never”, or “async” must be specified. Fence level "-f async" can be specified only for TC Async/UR. The “-fg” option is used to make TC Sync CTG volume, and fence level must be specified as "-fg data", "-fg status", or "-fg never". A CTGID (CT Group ID) is assigned automatically if you do not specify the “CTGID” option in this command (and define it in the config file). If “CTGID” is not specified (with “-f async” or “-fg” option) and the maximum number of CT groups already exists (e.g., 256 for USP/NSC, 128 for 9900V), an EX_ENOCTG error will be returned. Therefore, the “CTGID” option can forcibly assign a volume group to an existing CTGID (0-15/63/127/255) on the Hitachi RAID storage systems. The CTGID option is ignored unless you specify the “-f async” or “-fg” option. **-vl** or **-vr**: Specifies the data flow direction and must always be specified. The -vl option specifies “local” and the host which issues the command possesses the primary volume. The -vr option specifies “remote” and the remote host possesses the primary volume while the local host possesses the secondary volume. **-c <size>**: Specifies the number of extents (1 - 15) to be used for the initial data copy. If this option is not specified a default value is used. **-nocopy**: Creates paired volumes without copying data in the case in which the data consistency of simplex volumes is assured by the user. **-nomsg**: Suppresses messages to be displayed when this command is executed. It is used to execute this command from a user program. This option must be specified at the beginning of a command argument. The command execution log is not affected by this option. **-split** (ShadowImage only): Splits the paired volume after the initial copy operation is complete. This option will return after changed the state in PVOL_PSUS & SVOL_COPY immediately, and SVOL state will be changed to “SVOL_SSUS” after all data is copied. (See *Note 2* under Table 2.3 for details.) **-m <mode>**: **mode = noread** (ShadowImage only): Specifies the noread mode for hiding the secondary volume. The secondary volume becomes read-disabled when this mode option is specified. The secondary volume is read-enabled when this mode option is omitted. *Note:* The primary volume becomes read-disabled during a reverse resync operation (**restore** option of pairresync command). **mode = cyl** (9900V only): sets TrueCopy bitmap difference management to cylinder. **mode = trk** (9900V only): sets TrueCopy bitmap difference management to track. *Note:* If the mode (cyl or track) is not specified, the default values are used: default is track for OPEN-3 and OPEN-9; default is cylinder for OPEN-E and OPEN-L. *Note:* For TrueCopy volumes paired between 9900V and 9900 storage systems, the bitmap tables will be managed at the Cylinder level, even if Track is specified. **mode=grp** [CTGID] (9900V ShadowImage only). Makes a group for splitting all ShadowImage pairs specified in a group. Like a TrueCopy Async/UR consistency group, ShadowImage guarantees data consistency among multiple LUNs in a group at a single point in time when doing a split using the “pairsplit -g <group>“ command (except “-S” or “-E” option). A CTGID (CT Group ID) is assigned automatically if you do not specify the “CTGID” option in this command. If “CTGID” is not specified and the maximum number of CT groups already exists, an EX_ENOCTG error will be returned. Therefore, the “CTGID” option can forcibly assign a volume group to an existing CTGID (e.g., 0-127 on 9900V).

Parameter	Value
Returned values	This command sets the following returned values during exit allowing the user to check the execution results. Normal termination: 0. When creating groups, 0 = normal termination for all pairs. Abnormal termination: other than 0, refer to the execution logs for error details.

Table 4.4 Specific Error Codes for Paircreate

Category	Error Code	Error Message	Recommended Action	Value
Volume status	EX_ENQVOL	Unmatched volume status within the group	Confirm status using the pairdisplay command. Make sure all volumes in the group have the same fence level and volume attributes.	236
	EX_INCSTG	Inconsistent status in group	Confirm pair status using pairdisplay.	229
	EX_INVVOL	Invalid volume status	Confirm pair status using pairdisplay -l.	222
	EX_INVSTP	Invalid pair status	Confirm pair status using pairdisplay.	228
Unrecoverable	EX_ENQSIZ	Unmatched volume size for pairing	Confirm volume size or number of LUSE volume using **raidscan -f**, and make sure volume sizes are identical.	212
Resource	EX_ENOCTG	Not enough CT groups in the RAID	Choose an existing CTGID (pairvolchk displays CTGIDs). Use '-f async <CTGID>' or '-m grp <CTGID>' option of paircreate to force the pair into a pre-existing CTGID.	217
	EX_ENXCTG	No CT groups left for OPEN Vol use.	Confirm whether all CT groups are already used by TC/TC390 Async or SI/SI390.	215
Unrecoverable	EX_ENOPOL	Not enough Pool in RAID	Could not retain the pool for executing a command due to be exceeded the threshold rate. Delete unnecessary/earlier generations paired volume, or re-synchronize unnecessary/earlier generations split volume.	206

Note: Unrecoverable errors are fixed and will not be resolved, even after re-executing the command. If the command failed, the detailed status will be logged in the CCI command log ($HORCC_LOG) (see Table A.2), even if the user script has no error handling.

4.3 Splitting and Deleting Pairs (Pairsplit)

The pairsplit command stops updates to the secondary volume of a pair and can either maintain (status = PSUS) or delete (status = SMPL) the pairing status of the volumes (see Table 4.3). The pairsplit command can be applied to a paired logical volume or a group of paired volumes. The pairsplit command allows read access or read/write access to the secondary volume, depending on the selected options. When the pairsplit command is specified, acceptance of write requests to the primary volume depends on the fence level of the pair (data, status, never, or async). Table 4.5 lists and describes the pairsplit command parameters and returned values. Table 4.6 lists and describes the error codes for the pairsplit command.

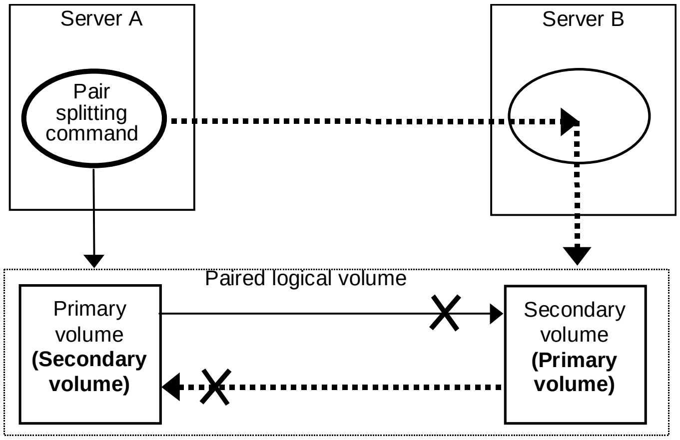


Figure 4.2 Pair Splitting

The primary volume's server is automatically detected by the pairsplit command, so the server does not need to be specified in the pairsplit command parameters. If the -S option (simplex) is used, the volume pair is deleted, the volumes are returned to the simplex state, and the primary and secondary volume status is lost. Paired volumes are split as soon as the pairsplit command is issued. If you want to synchronize the volumes, the pairsplit command must be issued after write I/Os to the paired volume have completed (see section 4.3.1 for examples).

Note: You can create and split ShadowImage pairs simultaneously using the **-split** option of the paircreate command (refer to section 4.2).

Note on Quick Split: If "$HORCC_SPLT=QUICK" environment variable is set (USP V/VM or USP/NSC), the "pairsplit" and "paircreate -split" operations will be performed as Quick Split regardless of the system option mode 122 setting on the SVP. The $HORCC_SPLT environment variable is ignored by 9900V/9900.

Table 4.5 Pairsplit Command Parameters

Parameter	Value
Command Name	pairsplit
Format	pairsplit {-h | -q | -z | -g <group> | -d <pair Vol> | -d[g] <raw_device> [MU#] | -FHORC [MU#] | -FMRCF [MU#] | -d[g] <seq#> <LDEV#> [MU#] | -r | -rw | -S | -R[S][B] | -P | -l | -nomsg | -C <size> | -E | -fq <mode>}

Options *Note:* Only one pairsplit option (-r, -rw, -S, -R, or -P) can be specified. If more than one option is specified, only the last option will be executed.	-h: Displays Help/Usage and version information. -q: Terminates the interactive mode and exits this command. -z or -zx (OpenVMS cannot use the -zx option): Makes the pairsplit command enter the interactive mode. The -zx option guards performing of the HORCM in the interactive mode. When this option detects a HORCM shut down, interactive mode terminates. -I[H][M][instance#] or -I[TC][SI][instance#] Specifies the command as [HORC]/[HOMRCF], and used for specifying instance# of HORCM. -g <group>: Specifies a group name defined in the configuration definition file. This option must always be specified. The command is executed for the specified group unless the -d <pair Vol> option is specified. -d <pair Vol>: Specifies the paired logical volume name defined in the configuration definition file. When this option is specified, the command is executed for the specified paired logical volumes. -d[g] <raw_device> [MU#]: Searches a group on the configuration definition file (local instance) for the specified raw_device, and if the specified raw_device is contained in the group, the target volume is executed as the paired logical volume (-d) or group (-dg). This option is effective without specification of "-g <group>" option. If the specified the raw_device is contained in two or more groups, the command is executed on the first group. -d[g] <seq#> <LDEV#> [MU#]: Searches a group on the configuration definition file (local instance) for the specified LDEV, and if the specified LDEV is in the group, the target volume is executed as the paired logical volume (-d) or group (-dg). This option is effective without specification of "-g <group>" option. If the specified LDEV is contained in two or more groups, the command is executed on the first group. The <seq #> <LDEV #> values can be specified in hexadecimal (by addition of "0x ") or decimal notation. -r or -rw (TrueCopy only): Specifies a mode of access to the SVOL after paired volumes are split. The -r option (default) allows read-only to the SVOL. The -rw option enables read and write access to the SVOL. -S: Selects simplex mode (deletes the pair). When the pairing direction is reversed among the hosts (e.g., disaster recovery), this mode is established once, and then the paircreate command is issued. When splitting a pair, whether or not you can change the pair status of S-VOL, changing the pair status of P-VOL to SMPL takes priority. Therefore, if the pair status of S-VOL cannot be changed to SMPL, the pair status of P-VOL might not correspond with that of S-VOL. When a path failure has occurred, the pair status of S-VOL cannot be changed to SMPL. -R: Brings the secondary volume into the simplex mode forcibly. It is issued by the secondary host, if the host possessing the primary volume is down or has failed. -R[S][B] (Specifiable for HORC only): This option is used to bring the secondary volume forcibly into simplex mode. It is issued by the secondary host if the host possessing the primary volume goes down due to a failure. -RS option is used to bring the secondary volume forcibly into SSWS mode. -RB option is used to back the secondary volume forcibly from SSWS into PSUS(PSUE)(SSUS) mode. This makes to be able to back to the primary volume if the user wants to back from the secondary host in SSWS state on Link failure to the primary host. -P (Specifiable for TC/UR only): For TrueCopy Sync, this option is used to bring the primary volume forcibly into write disabled mode like PSUE with "fence=data". It is issued by the secondary host to disable PVOL data changes by the host possessing the primary volume. For TrueCopy Async/JNL, this option is used to suspend and purge the remaining data into SideFile/Journal like link failure (PSUE) without updating SVOL. This enables the user to stop journal operations forcibly when the journal utilization traffic becomes high. This is the same for the case of disaster that S-vol data is not up to date, but it allows to specify "-rw –P" for writing enable. In that situation, if the user will use the SVOL as file system (i.e. UFS, NTFS, HANFS), then an FSCK(CHKDSK) is necessary before mounting the volume even after the PVOL is unmounted. -l: When this command cannot utilize the remote host for host down, this option enables a pairsplit operation by a local host only. Except the -R option, the target volume of a local host must be P-VOL. (ShadowImage volumes are able to split only SVOL.) -nomsg: Suppresses messages to be displayed when this command is executed. It is used to execute a command from a user program. This option must be specified at the beginning of a command argument. The command execution log is not affected by this option. -C <size> (ShadowImage/Snapshot only): Copies difference data retained in the primary volume into the secondary volume, then enables reading and writing from/to the secondary volume after completion of the copying. (This is the default option.) For <size>, specify the copy pace for the pairsplit (range = 1 to 15 track extents). If not specified, the value used for paircreate is used. -E (ShadowImage only): Suspends a paired volume forcibly when a failure occurs. Not normally used. -FHORC [MU#] or -FCA [MU#]: Forcibly specifies a cascading Hitachi TrueCopy volume for specified volume pair on ShadowImage environment (see example in Figure 4.3). If the -l option is specified, a cascading TrueCopy volume is split on a local host (near site). If the -l option is not specified, a cascading

Returned values	Normal termination: 0. When splitting groups, 0 = normal termination for all pairs. Abnormal termination: other than 0, refer to the execution logs for error details.

Table 4.6 Specific Error Codes for Pairsplit

Category	Error Code	Error Message	Recommended Action	Value
Volume status	EX_ENQVOL	Unmatched volume status within the group	Confirm status using the pairdisplay command. Make sure all volumes in the group have the same fence level and volume attributes.	236
	EX_INCSTG	Inconsistent status in group	Confirm pair status using pairdisplay.	229
	EX_INVVOL	Invalid volume status	Confirm pair status using pairdisplay -l.	222
	EX_EVOLCE	Pair Volume combination error	Confirm pair status using pairdisplay, and change combination of volumes.	235
	EX_INVSTP	Invalid pair status	Confirm pair status using pairdisplay.	228
Unrecoverable	EX_EWSUSE	Pair suspended at WAIT state	Issue pairresync manually to the identified failed paired volume to try to recover it. If the trouble persists, call the Hitachi Data Systems Support Center.	234

Note: Unrecoverable errors are fixed and will not be resolved, even after re-executing the command. If the command failed, the detailed status will be logged in the CCI command log ($HORCC_LOG) (see Table A.2), even if the user script has no error handling.

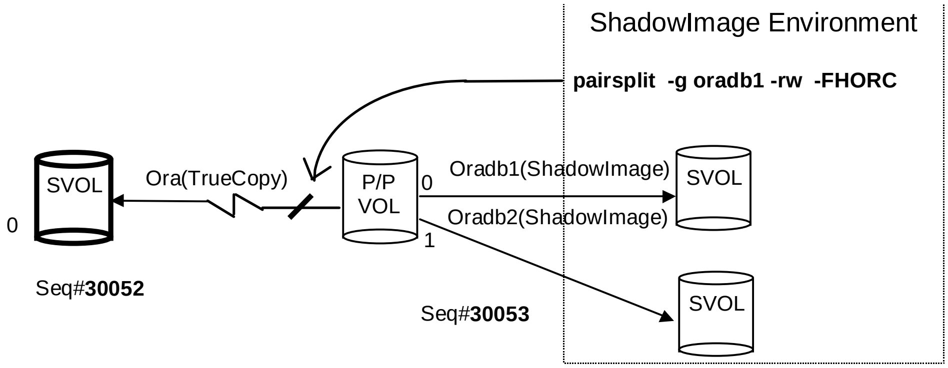


Figure 4.3 Example of -FHORC Option for Pairsplit

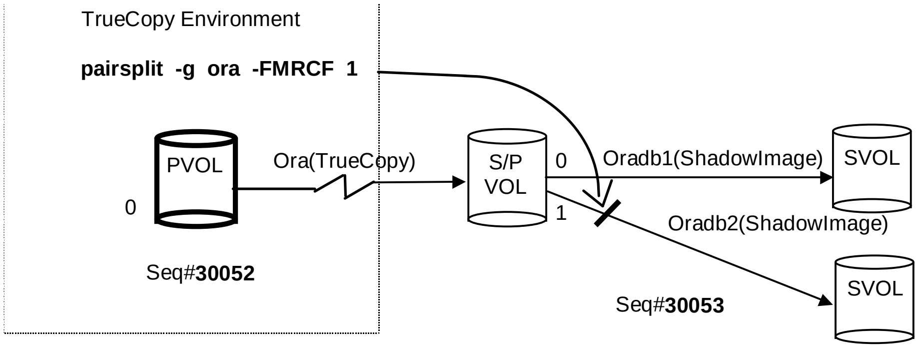


Figure 4.4 Example of -FMRCF Option for Pairsplit

4.3.1 Timing Pairsplit Operations

The pairsplit command terminates after verifying that the status has changed according to the pairsplit command options (to PSUS or SMPL). If you want to synchronize the volume pair, the non-written data (in the host buffer) must be written before you issue the pairsplit command. When the pairsplit command is specified, acceptance of write requests to the primary volume depends on the fence level of the pair (data, status, never, or async). Some examples are shown below.

Instantaneous offline backup of UNIX file system:

- Unmount the primary volume, and then split the volume pair.
- Mount the primary volume (**mount -rw**).
- Verify that the pairsplit is complete, and mount the secondary volume (**mount -r**).
- Execute the backup.
- Restore the volumes to their previous state, and resynchronize the volume pair.

Online backup of UNIX file system:

- Issue the **sync** command to a mounted primary volume to flush the file system buffer, and then split the volume pair using the **-rw** option.
- Verify that the pairsplit is complete, and then use the **fsck** command to check the consistency of the secondary volume file system.
- Mount (**mount -r**) the secondary volume.
- Execute the backup.
- Restore the volumes to their previous state, and resynchronize the volume pair.

Instantaneous offline backup of Windows file system:

- Execute **-x umount** on the PVOL, then split the volume pair with the **-rw** option.
- Execute x-mount on the primary volume.
- Make sure that the paired volume is split, then execute **-x mount** on the SVOL.
- Execute backup, and unmount the SVOL (**-x umount**).
- Resynchronize the volume pair and restore the previous state.

Online backup of Windows file system:

- Issue **-x sync** in the state the primary volume is mounted, then flush only the file system buffer. Then, split the paired volume with the **-rw** option.
- Make sure that the paired volume is split, then execute **-x mount** on the SVOL.
- Execute backup, and unmount the SVOL (**-x umount**).
- Resynchronize the volume pair.

Note: If the primary volume is divided by LVM or partition, the control information of LVM or partition on the primary volume is also copied to the secondary volume. In case of executing the backup from the secondary volume, it is required to import this control information, and to execute pairsplit with the **-rw** option when activating the secondary volume.

4.3.2 Deleting Pairs (Pairsplit -S)

The pair delete operation is executed by using the **-S** option of the pairsplit command. When the **pairsplit -S** command is issued, the specified Hitachi TrueCopy or ShadowImage pair is deleted, and each volume is changed to SMPL (simplex) mode. If you want to re-establish a pair which has been deleted, you must use the paircreate command (not pairresync).

4.4 Resynchronizing Pairs (Pairresync)

The pairresync command re-establishes a split pair and then restarts the update copy operations to the secondary volume (see Figure 4.5). The pairresync command can resynchronize either a paired logical volume or a group of paired volumes. The normal direction of resynchronization is from the primary volume to the secondary volume. If the **--restore** option is specified (ShadowImage only), the pair is resynchronized in the reverse direction (i.e., secondary volume to primary volume). Figure 4.6 shows the normal and restore resync operations. The primary volume remains accessible during pairresync, except when the **-restore** option is specified. The secondary volume becomes write-disabled when the pairresync command is issued. Table 4.7 lists and describes the pairresync command parameters and returned values. The primary volume's server is automatically detected by the pairresync command, so the server does not need to be specified in the pairresync command parameters. Table 4.8 lists the error codes for `pairresync`.

`Pairresync` terminates before resynchronization of the secondary (or primary) volume is complete. Use the pair event waiting or pair display command to verify that the resync operation completed successfully (status changes from COPY to PAIR). The execution log file also shows completion of the resync operation. The status transition of the paired volume is judged by the status of the primary volume. The fence level is not changed (only for TrueCopy, TrueCopy Async, or UR).

If no data was written to the secondary volume while the pair was split, the differential data on the primary volume is copied. If data was written to the secondary volume, the differential data on the primary volume and secondary volume is copied. This process is reversed when the ShadowImage **-restore** option is specified.

Before issuing the pairresync command (normal or reverse direction), make sure that the secondary volume is not mounted on any UNIX system. Before issuing a reverse pairresync command, make sure that the primary volume is not mounted on any UNIX system.

Note on Quick Resync/Restore: If the "$HORCC_RSYN=QUICK" /"$HORCC_REST=QUICK" environment variable is set (USP V/VM or USP/NSC), the "pairresync" operation will be performed as **Quick Resync** regardless of the system option mode 87/80 setting via SVP. The $HORCC_RSYN and $HORCC_REST environment variables are ignored by 9900V/9900.

Hitachi TrueCopy only: The **swaps(p)** option is used to swap volume from the SVOL(PVOL) to PVOL(SVOL) at suspending state on the SVOL(PVOL) side, and resynchronize the NEW_SVOL based on the NEW_PVOL. At the result of this operation, the volume attributes of own host (local host) become the attributes for the NEW_PVOL(SVOL). The paircreate command cannot execute copy rejection in case of an error condition which made the target volume is accompanied by maintenance work. The **swaps(p)** option will:

- Ignore the **-l** option.
- Use a default of **three** for number of copy tracks (-c size) when **-c size** option is omitted.
- Execute at PAIR state as well as PSUS/PSUE state (not applicable to COPY and SMPL).
- Since the target volume of the local host has been already the PVOL(SVOL), this target volume is skipped an operation.

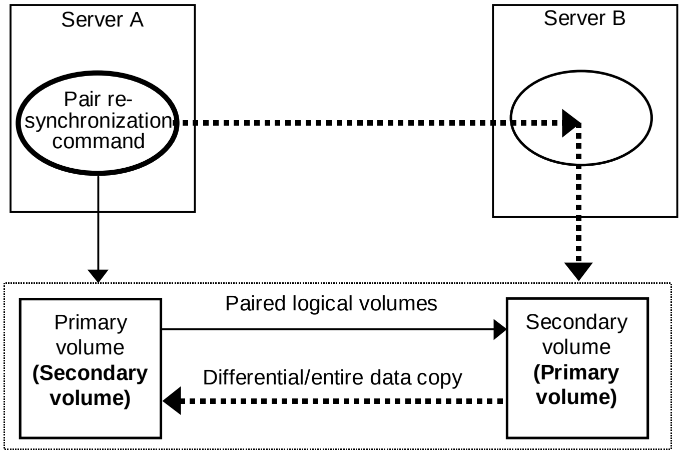


Figure 4.5 Pair Resynchronization

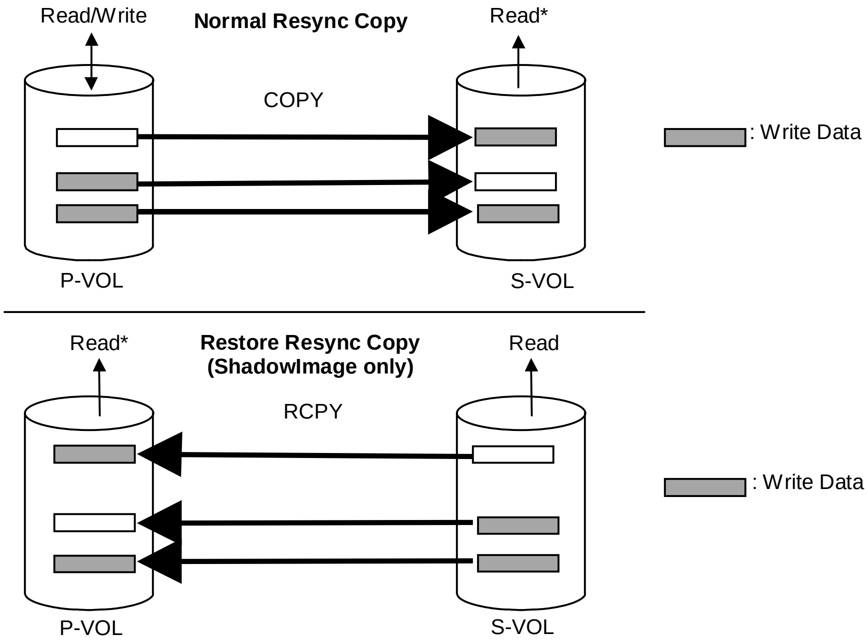


Figure 4.6 Normal Resync and ShadowImage Restore Resync

Table 4.7 Pairresync Command Parameters

<table>
<tr><th>Parameter</th><th>Value</th></tr>
<tr><td>Command Name</td><td>pairresync</td></tr>
<tr><td>Format</td><td>pairresync{ -h | -q | -z | -g <group> | -d <pair Vol> | -d[g] <raw_device> [MU#] | -FHORC [MU#] | -FMRCF [MU#] | -d[g] <seq#> <LDEV#> [MU#] |-c <size> | -nomsg | -l | -restore | -swaps | -swapp |-fq <mode>| -cto <o-time> <c-time> <r-time> | -f[g] <fence> [CTGID]}</td></tr>
</table>

Parameter	Value
Options	-h: Displays Help/Usage and version information. -q: Terminates the interactive mode and exits this command. -z or -zx (OpenVMS cannot use the -zx option): Makes the pairresync command enter the interactive mode. The -zx option guards performing of the HORCM in the interactive mode. When this option detects a HORCM shut down, interactive mode terminates. -I[H][M][instance#] or -I[TC][SI][instance#] Specifies the command as [HORC]/[HOMRCF], and used for specifying instance# of HORCM. -g <group>: This option is used to specify a group name defined in the configuration definition file. This option must always be specified. The command is executed for the specified group unless the -d <pair Vol> option is specified. -d <pair Vol>: Specifies a paired logical volume name defined in the configuration definition file. When this option is specified, the command is executed for the specified paired logical volumes. -d[g] <raw_device> [MU#]: Searches a group on the configuration definition file (local instance) for the specified raw_device, and if the specified raw_device is contained in the group, the target volume is executed as the paired logical volume (-d) or group (-dg). This option is effective without specification of “-g <group>“ option. If the specified the raw_device is contained in two or more groups, the command is executed on the first group. -d[g] <seq#> <LDEV#> [MU#]: Searches a group on the configuration definition file (local instance) for the specified LDEV, and if the specified LDEV is contained in the group, the target volume is executed as the paired logical volume (-d) or group (-dg). This option is effective without specification of “-g <group>“ option. If the specified LDEV is contained in two or more groups, the command is executed on the first group. The <seq #> <LDEV #> values can be specified in hexadecimal (by addition of “0x “) or decimal notation. -FHORC [MU#] or -FCA [MU#]: Forcibly specifies a cascading Hitachi TrueCopy volume for specified pair logical volumes on ShadowImage environment (see example in Figure 4.7). If the -l option is specified, this option resyncs a cascading TrueCopy volume on a local host (near site). If no -l option is specified, this option resyncs a cascading TrueCopy volume on a remote host (far site). The target TrueCopy volume must be a P-VOL, the -swapp option cannot be specified. -FMRCF [MU#] or -FBC [MU#]: Forcibly specifies a cascading ShadowImage volume for specified pair logical volumes on TrueCopy environment (see example in Figure 4.8). If the -l option is specified, this option resyncs a cascading ShadowImage volume on a local host (near site). If no -l option is specified, this option resyncs a cascading ShadowImage volume on a remote host (far site). The target ShadowImage volume must be a P-VOL. -swaps with -FHORC [MU#] This option is used to swap the cascading UR volume from the primary node for failback. In failback operation from 3DC Cascade Site Failure, If a user want to failback to DC1 from DC3 directly, it will be needed to operate all cascading volume from DC1. In order to make this operation possible, RAID Manager supports “pairresync -swaps -FHORC” option that swaps UR volume on the cascading CA-Sync/UR volume. -c <size>: Specify the copy pace for the resync operation (range = 1 to 15 track extents). If not specified, the value used for paircreate is used. -nomsg: Suppresses messages to be displayed when this command is executed. It is used to execute this command from a user program. This option must be specified at the beginning of a command argument. The command execution log is not affected by this option. -l: When this option cannot utilize the remote host for host down, this option enables a pairresync operation by the local host only. The target volume of the local host must be P-VOL. (ShadowImage volumes are able to resync only SVOL.) -restore (ShadowImage only): Performs reverse resync (from secondary volume to primary volume). swaps (TrueCopy only): Executed from the SVOL side when there is no host on the PVOL side to help. Typically executed in PSUS state to facilitate “fast failback” without requiring a full copy. In Figure 4.9, the left side shows T0 for both the PVOL and SVOL (before command execution), and the right side shows T1, after the command has executed. For both -swaps and -swapp, the delta data from the original SVOL becomes dominant and is copied to the original PVOL, then the S/PVOL designations are swapped. swapp (TrueCopy only): Executes the equivalent of a -swaps from the original PVOL side. Unlike -swaps, -swapp does require the cooperation of hosts at both sides. -fq <mode> (9900V ShadowImage only) This option is used to specify the mode whether “pairresync” is performed or not as “QUICK”. mode = normal pairresync will be performed as Non-quick mode regardless of setting of $HORCC_RSYN environment variable and/or the system option mode 87 via SVP. mode = quick pairresync will be performed as Quick Resync regardless of setting of $HORCC_RSYN environment

Parameter	Value
Returned values	Normal termination: 0. When resynching groups, 0 = normal termination for all pairs. Abnormal termination: other than 0, refer to the execution logs for error details.

Table 4.8 Specific Error Codes for Pairresync

Category	Error Code	Error Message	Recommended Action	Value
Volume status	EX_ENQVOL	Unmatched volume status within the group	Confirm status using the pairdisplay command. Make sure all volumes in the group have the same fence level and volume attributes.	236
	EX_INCSTG	Inconsistent status in group	Confirm pair status using pairdisplay.	229
	EX_INVVOL	Invalid volume status	Confirm pair status using pairdisplay -l.	222
Unrecoverable	EX_INVSTP	Invalid pair status	Confirm pair status using pairdisplay.	228

Note: Unrecoverable errors are fixed and will not be resolved, even after re-executing the command. If the command failed, the detailed status will be logged in the CCI command log ($HORCC_LOG) (see Table A.2), even if the user script has no error handling.

The primary and secondary volumes must not be mounted on any UNIX system because this command renews data on both the primary and secondary volumes. This command cannot execute copy rejection in case of the trouble (single error in cash memory, etc...) which made the target volume is accompanied by maintenance work.(HORC only)

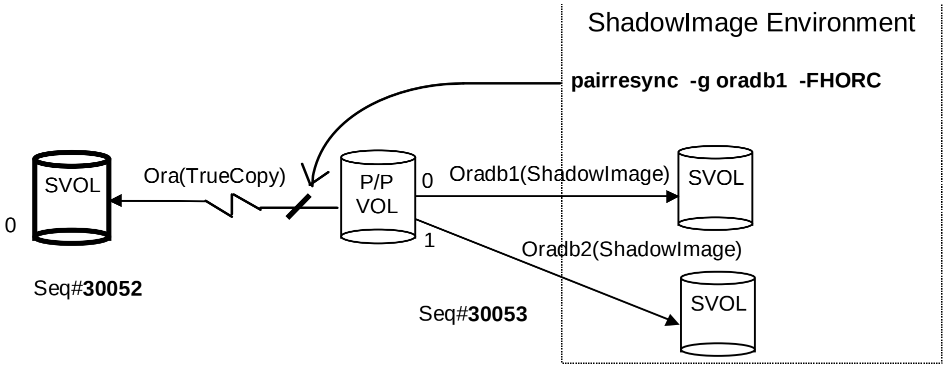


Figure 4.7 Example of -FHORC Option for Pairresync

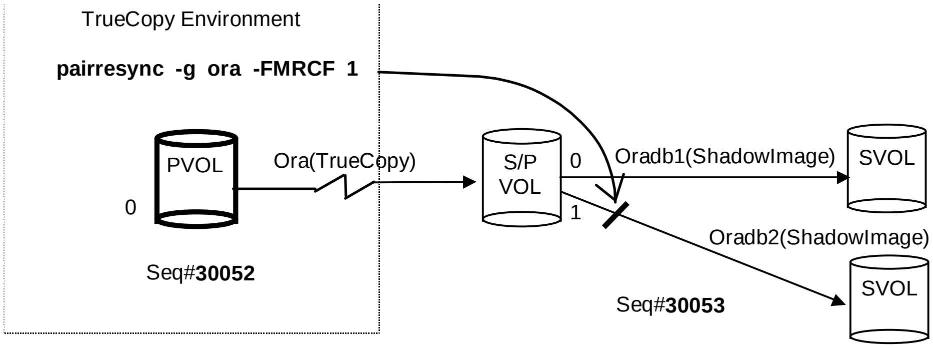


Figure 4.8 Example of -FMRCF Option for Pairresync

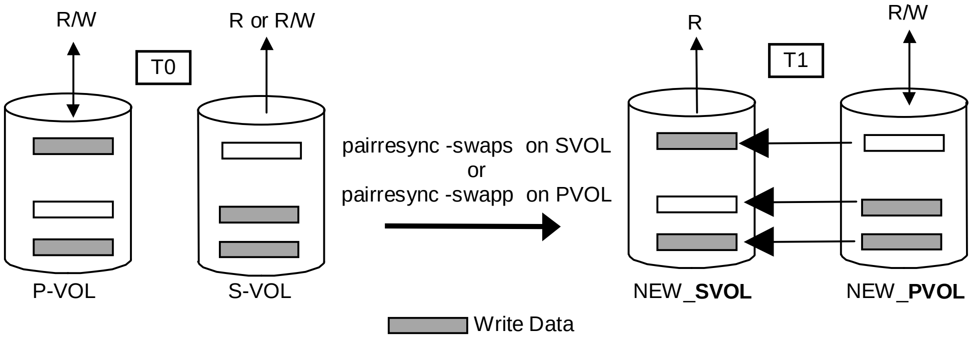


Figure 4.9 Swap Operation

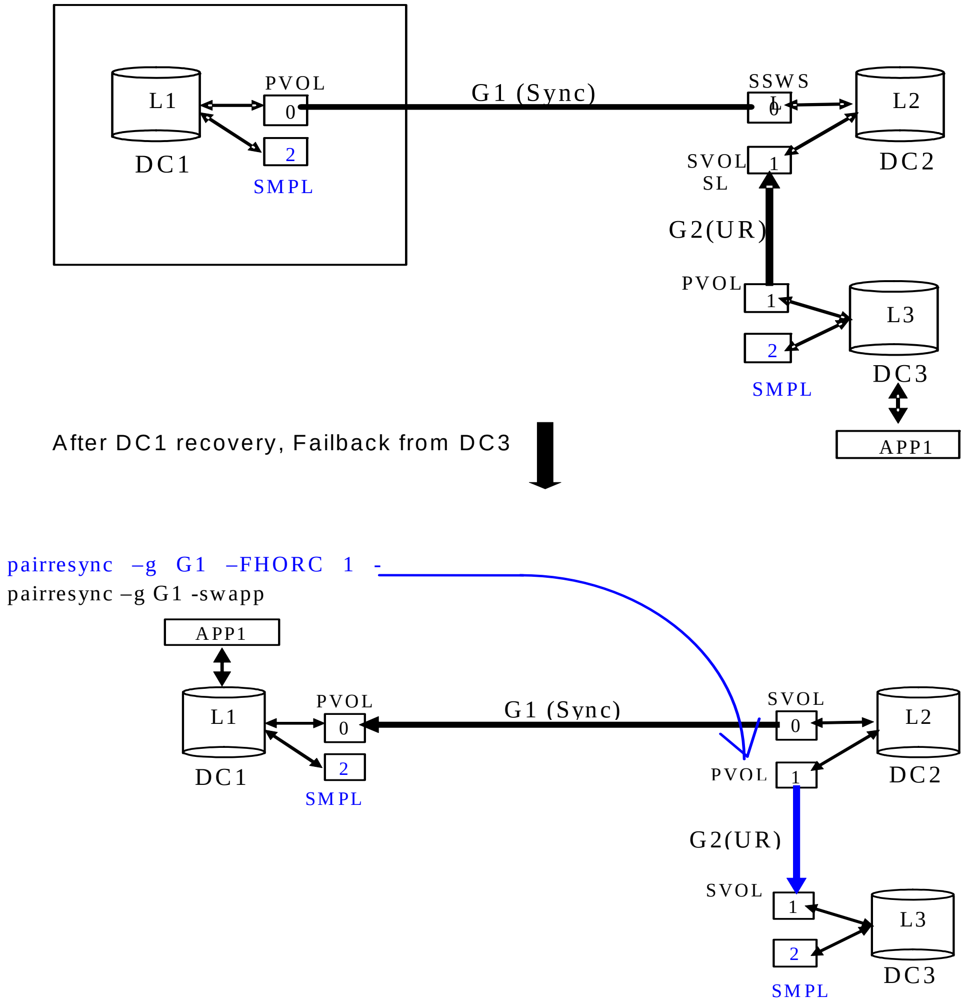


Figure 4.10 Example swaps option with -FHORC [MU#]

4.5 Confirming Pair Operations (Pairevtwait)

The pair event waiting (**pairevtwait**) command is used to wait for completion of pair creation and pair resynchronization and to check the status (see Figure 4.11). It waits (“sleeps”) until the paired volume status becomes identical to a specified status and then completes. The pairevtwait command can be used for a paired logical volume or a group of paired volumes. The primary volume’s server is automatically detected by the pair event waiting command, so the server does not need to be specified in the pair event waiting command parameters. Table 4.9 lists and describes the pair event waiting command parameters and returned values. Table 4.10 lists and describes the error codes for the pairevtwait command.

The pair event waiting command waits until the specified status is established, and terminates abnormally if an abnormal status is detected. The transition of the paired volume status is judged by the status of the primary volume. If the event waiting command is issued for a group, the command waits until the status of each volume in the group changes to the specified status. When the event waiting command with the **-nowait** option is issued for a group, the status is returned if the status of each volume in the group is identical. For ShadowImage pairs, this command must be used to confirm a pair status transition.

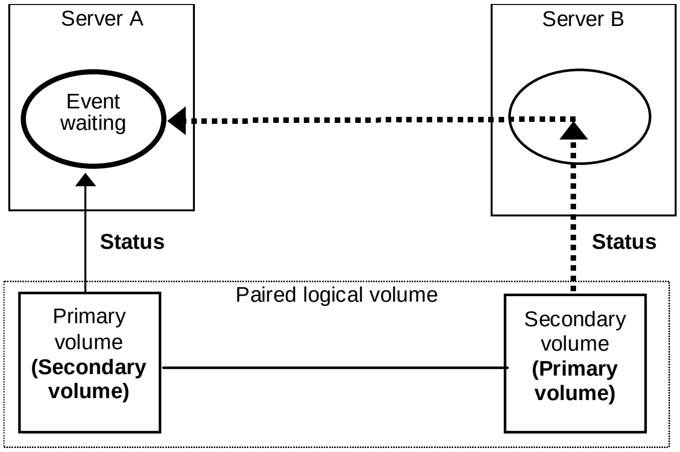


Figure 4.11 Pair Event Waiting

Table 4.9 Pairevtwait Command Parameters

Parameter	Value
Command Name	pairevtwait
Format	pairevtwait{ -h │ -q │ -z │ -g <group> │ -d <pair Vol> │ -d[g] <raw_device> [MU#] │ -FHORC [MU#] │ -FMRCF [MU#] │ -d[g] <seq#> <LDEV#> [MU#] │ -s [s] <status> ...│ -t <timeout>[intervall] │ -nowait[s] │ -l │ -nomsg }

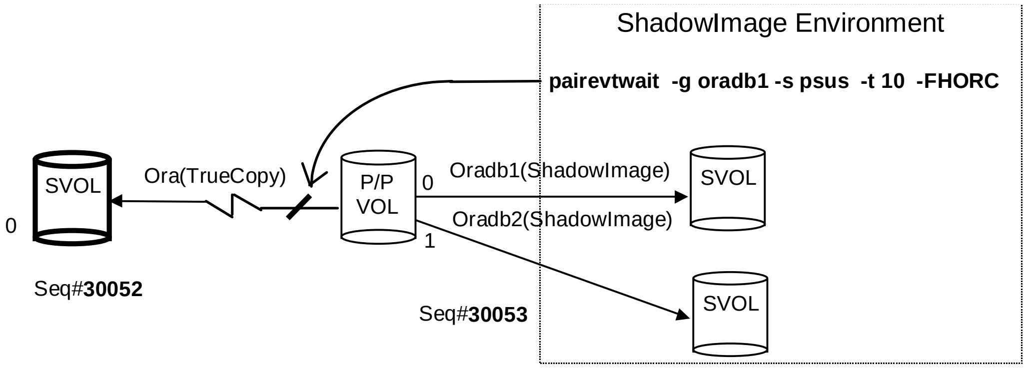
Parameter	Value
Options	-h: Displays Help/Usage and version information. -q: Terminates the interactive mode and exits this command. -z or -zx (OpenVMS cannot use the -zx option): Makes the pairevtwait command enter the interactive mode. The -zx option guards performing of the HORCM in the interactive mode. When this option detects a HORCM shut down, interactive mode terminates. -I[H][M][instance#] or -I[TC][SI][instance#] Specifies the command as [HORC]/[HOMRCF], and used for specifying instance# of HORCM. -g <group>: Specifies a group name defined in the configuration definition file. This option must always be specified. The command is executed for the specified group unless the -d <pair Vol> option is specified. -d <pair Vol>: Specifies a paired logical volume name defined in the configuration definition file. When this option is specified, the command is executed for the specified paired logical volumes. -d[g] <raw_device> [MU#]: Searches a group on the configuration definition file (local instance) for the specified raw_device, and if the specified raw_device is contained in the group, the target volume is executed as the paired logical volume (-d) or group (-dg). This option is effective without specification of "-g <group>" option. If the specified the raw_device is contained in two or more groups, the command is executed on the first group. -FHORC [MU#] or -FCA [MU#]: Forcibly specifies a cascading TrueCopy volume for specified pair logical volumes on ShadowImage environment (see example in Figure 4.12). If the -l option is specified, this option tests status of a cascading TrueCopy volume on a local host (near site). If no -l option is specified, this option tests status of a cascading TrueCopy volume on a remote host (far site). The target TrueCopy volume must be P-VOL or SMPL. -FMRCF [MU#] or -FBC [MU#]: Forcibly specifies a cascading ShadowImage volume for specified pair logical volumes on TrueCopy environment (see example in Figure 4.13). If the -l option is specified, this option tests status of a cascading ShadowImage volume on a local host (near site). If no -l option is specified, this option tests status of a cascading ShadowImage volume on a remote host (far site). The target ShadowImage volume must be P-VOL or SMPL. -d[g] <seq#> <LDEV#> [MU#]: Searches a group on the configuration definition file (local instance) for the specified LDEV, and if the specified LDEV is contained in the group, the target volume is executed as the paired logical volume (-d) or group (-dg). This option is effective without specification of "-g <group>" option. If the specified LDEV is contained in two or more groups, the command is executed on the first group. The <seq #> <LDEV #> values can be specified in hexadecimal (by addition of "0x ") or decimal notation. -s <status>: ..Specifies the waiting status, which is "smpl", "copy/rcpy", "pair", "psus", or "psue/pdub". If two or more statuses are specified following -s, waiting is done according to the logical OR of the specified statuses. This option is valid when the -nowait option is not specified. -ss <status>: Specifies the waiting status, which is "smpl", "copy"("RCPY" is included), "pair", "ssus","psue" on SVOL. If two or more statuses are specified following -s, waiting is done according to the logical OR of the specified statuses. This option is valid when the -nowait option is not specified. -t <timeout> [interval]: Specifies the interval of monitoring a status specified using the -s option and the time-out period in units of 1 sec. Unless [interval] is specified, the default value is used. This option is valid when the -nowait option is not specified. If <timeout> is specified more than 1999999, then "WARNING" message will be displayed. -nowait: When this option is specified, the pair status at that time is reported without waiting. The pair status is set as a returned value for this command. When this option is specified, the -t and -s options are not needed. -nowait[s] When this option is specified, the pairing status on SVOL at that time is reported without waiting. The pairing status is set as a returned value for this command. When this option is specified, the -t and -s options are not needed. -l: When this command cannot utilize a remote host for host down, this option executes this command by a local host only. The target volume of a local host must be SMPL or P-VOL. (ShadowImage volumes are able to specify from SVOL.) -nomsg: Suppresses messages to be displayed when this command is executed. It is used to execute a command from a user program. This option must be specified at the beginning of a command argument. The command execution log is not affected by this option.

Parameter	Value
Returned values	When the **-nowait** option is specified: Normal termination: 1: The status is SMPL 2: The status is COPY or RCPY 3: The status is PAIR 4: The status is PSUS 5: The status is PSUE When monitoring groups, 1/2/3/4/5 = normal termination for all pairs. Abnormal termination: other than 0 to 127, refer to the execution logs for error details. When the **-nowaits** option is specified: Normal termination: 1: The status is SMPL 2: The status is COPY or RCPY 3: The status is PAIR 4: The status is SSUS ((Note that SVOL_PSUS will be displayed as SSUS) 5: The status is PSUE When the -nowait and/or -nowaits option is not specified. When the **-nowait and or nowaits** option is not specified: Normal termination: 0. When monitoring groups, 0 = normal termination for all pairs. Abnormal termination: other than 0 to 127, refer to the execution logs for error details.

Table 4.10 Specific Error Codes for Pairevtwait

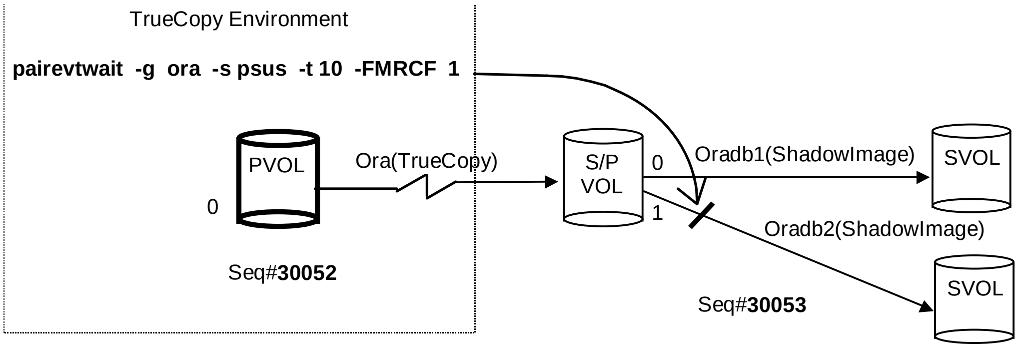
Category	Error Code	Error Message	Recommended Action	Value
Volume status Unrecoverable	EX_ENQVOL	Unmatched volume status within the group	Confirm status using the pairdisplay command. Make sure all volumes in the group have the same fence level and volume attributes.	236
	EX_INCSTG	Inconsistent status in group	Confirm pair status using pairdisplay.	229
	EX_INVVOL	Invalid volume status	Confirm pair status using pairdisplay -l.	222
	EX_EVOLCE	Pair Volume combination error	Confirm pair status using pairdisplay, and change combination of volumes.	235
	EX_EWSUSE	Pair suspended at WAIT state	Issue pairresync manually to the identified failed paired volume to try to recover it. If the trouble persists, call the Hitachi Data Systems Support Center.	234
Timer	EX_EWSTOT	Timeout waiting for specified status	Increase timeout value using -t option.	233
Recoverable	EX_EWSLTO	Timeout waiting for specified status on the local host	Confirm that CCI (HORCM) on the remote host is running.	232

Note: Unrecoverable errors are fixed and will not be resolved, even after re-executing the command. If the command failed, the detailed status will be logged in the CCI command log ($HORCC_LOG) (see Table A.2), even if the user script has no error handling.



pairevtwait -g oradb1 -s psus -t 10 -FHORC

Figure 4.12 Example of -FHORC Option for Pairevtwait



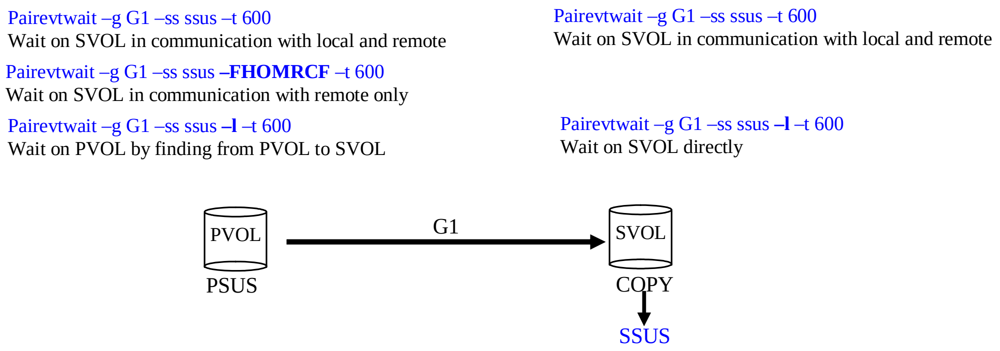
pairevtwait -g ora -s psus -t 10 -FMRCF 1

Figure 4.13 Example of -FMRCF Option for Pairevtwait

Using **-ss <status>** ... and **-nowaits option**

In PVOL_PSUS & SVOL_COPY state of HOMRCF quick mode, pairevtwait will return immediately even if the S-VOL is still in SVOL_COPY state because PVOL is already in PVOL_PSUS state. If you want to wait the SVOL_SSUS state, then use **-ss <status>** and **-nowaits** option in order for waiting the pair status on SVOL side. This will be needed for operating **pairresync -restore** or **pairsplit -S**.

The figure below shows five examples of waiting until “PVOL_PSUS” & “SVOL_COPY” state will be changed to SVOL_SSUS.



Pairevtwait –g G1 –ss ssus –t 600
Wait on SVOL in communication with local and remote

Pairevtwait –g G1 –ss ssus **–FHOMRCF** –t 600
Wait on SVOL in communication with remote only

Pairevtwait –g G1 –ss ssus **–l** –t 600
Wait on PVOL by finding from PVOL to SVOL

Pairevtwait –g G1 –ss ssus –t 600
Wait on SVOL in communication with local and remote

Pairevtwait –g G1 –ss ssus **–l** –t 600
Wait on SVOL directly

Figure 4.14 Example for waiting on HOMRCF

The horctakeover will suspend G2(CA-Jnl) automatically if horctakeover will return “Swap-takeover” as exit code. In DC1 host failure, if APP1 want to wait until DC3 become the suspend state, then they can verify “SSUS” state by using the pairevtwait command as shown below.

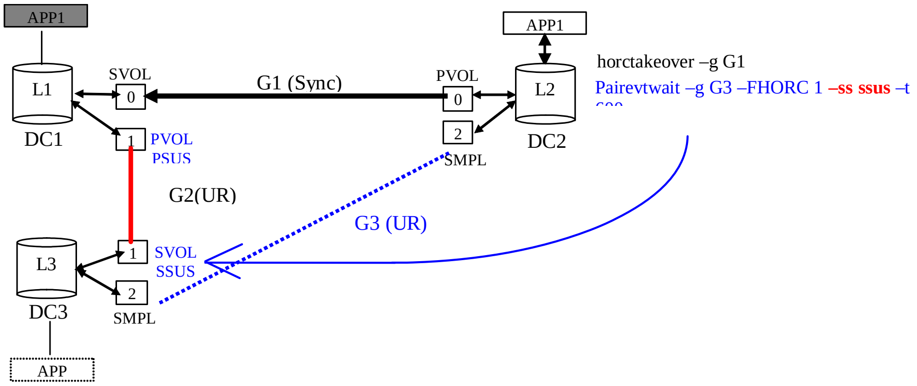


Figure 4.15 Example for waiting “SSUS” on 3DC using TC/UR

4.6 Monitoring Pair Activity (Pairmon)

The pairmon command, which is connected to the HORCM daemon, obtains the pair status transition of each volume pair and reports it. If the pair status changes (due to an error or a user-specified command), the pairmon command issues a message. Table 4.11 lists and describes the pairmon command parameters. Figure 4.16 shows an example of the pairmon command and its output. Table 4.12 specifies the results of the command options.

The pair status transition events exist in the HORCM pair state transfer queue. The **-resevt** option (reset event) deletes one/all events from the HORCM pair state transfer queue. If reset event is not specified, the pair state transfer queue is maintained. If the **-s** option is not specified, pairmon displays all events for which it receives information from HORCM. If the **-s** option is specified, only the specified status transitions are displayed.

The CCI software supports the error monitoring and configuration confirmation commands for linkage with the system operation management of the UNIX server.

Table 4.11 Pairmon Command Parameters

Parameter	Value
Command Name	pairmon
Format	pairmon { -h | -q | -z | -D | -allsnd | -resevt | -nowait | -s <status> ... }
Options	-h: Displays Help/Usage and version information. -q: Terminates the interactive mode and exits this command. -z or -zx (OpenVMS cannot use the -zx option): Makes the pairmon command enter the interactive mode. The -zx option guards performing of the HORCM in the interactive mode. When this option detects a HORCM shut down, interactive mode terminates. -I[H][M][instance#] or -I[TC][SI][instance#] Specifies the command as [HORC]/[HOMRCF], and used for specifying instance# of HORCM. -D: Selects the default report mode. In the default mode, if there is pair status transition information to be reported, one event is reported and the event is reset. If there is no pair status transition information to be reported, the command waits. The report mode consists of the three flags: -allsnd, - resevt, and -nowait options. -allsnd: Reports all events if there is pair status transition information. -resevt: Reports events if there is pair status transition information, and then resets all events. -nowait: When this option is specified, the command does not wait when there is no pair status transition information. -s <status> ...: Specifies the pair status transition to be reported: smpl, copy (includes rcpy), pair, psus, psue. If two or more statuses are specified following -s, masking is done according to the logical OR of the specified statuses. If this option is not specified, pairmon displays all events which received information from HORCM.

```
# pairmon  -allsnd   -nowait
Group Pair vol       Port    targ#   lun#    LDEV#…  Oldstat code -> Newstat code
oradb oradb1 CL1-A   1       5       145…    SMPL    0x00 -> COPY    0x01
oradb oradb2 CL1-A   1       6       146…    PAIR    0x02 -> PSUS    0x04
```

Figure 4.16 Pairmon Command Example

Output of the pairmon command:

- **Group**: This column shows the group name (dev_group) which is described in the configuration definition file.
- **Pair vol**: This column shows the paired volume name (dev_name) in the specified group which is described in the configuration definition file.
- **Port targ# lun#**: These columns show the port ID, TID, and LUN which is described in the configuration definition file. For further information on fibre-to-SCSI address conversion, see Appendix C.
- **LDEV#**: This column shows the LDEV ID for the specified device.
- **Oldstat**: This column shows the old pair status when the status of the volume is changed.
- **Newstat**: This column shows the new pair status when the status of the volume is changed.
- **code**: This column shows the storage system-internal code for the specified status.

Table 4.12 Results of Pairmon Command Options

-D	-nowait	-resevt	-allsnd	Actions
-D				When HORCM does not have an event, this option waits until an event occurs. If one or more events exist, then it reports one event and resets the event which it reported.
Invalid			-allsnd	When HORCM does not have an event, this option waits until an event occurs. If one or more events exist, then it reports all events.
Invalid		-resevt		When HORCM does not have an event, this option waits until an event occurs. If one or more events exist, then it reports one event and resets all events.
Invalid		-resevt	-allsnd	When HORCM does not have an event, this option waits until an event occurs. If one or more events exist, then it reports all events and resets all events.
Invalid	-nowait			When HORCM does not have an event, this option reports event nothing. If one or more events exist, then it reports one event and resets the event which it reported.
Invalid	-nowait		-allsnd	When HORCM does not have an event, this option reports event nothing. If one or more events exist, then it reports all events.
Invalid	-nowait	-resevt		When HORCM does not have an event, this option reports event nothing. If one or more events exist, then it reports one event and resets all events.
Invalid	-nowait	-resevt	-allsnd	When HORCM does not have an event, this option reports event nothing. If one or more events exist, then it reports all events and resets all events.

4.7 Checking Attribute and Status (Pairvolchk)

The pairvolchk command acquires and reports the attribute of a volume or group connected to the local host (issuing the command) or remote host. The volume attribute is SMPL (simplex), P-VOL (primary volume), or S-VOL (secondary volume). The **-s[s]** option reports the pair status in addition to the attribute. Figure 4.17 shows examples of the pairvolchk command and its output. lists and describes the pairvolchk command parameters and returned values. Table 4.14 lists and describes the error codes for the pairvolchk command. Table 4.15 shows the truth table for pairvolchk group status display. Table 4.16 provides the state transition table for an HA control script using the pairvolchk and horctakeover commands.

```
# pairvolchk  -g   oradb
pairvolchk : Volstat is P-VOL.[status = PAIR fence = ASYNC CTGID = 2]        ← TC Async
# pairvolchk  -g   oradb
pairvolchk : Volstat is P-VOL.[status = PAIR fence = DATA ]          ← TrueCopy Sync
# pairvolchk -g oradb
pairvolchk : Volstat is P-VOL.[status = PAIR ]                           ← ShadowImage
# pairvolchk -g oradb
pairvolchk : Volstat is P-VOL.[status = PAIR CTGID = 1]      ← ShadowImage at-time split
```

Figure 4.17 Pairvolchk Command Examples

Table 4.13 Pairvolchk Command Parameters

Parameter	Value
Command Name	pairvolchk
Format	pairvolchk{ -h ｜ -q ｜ -z ｜ -g <group> ｜ -d <pair Vol> ｜ -d[g] <raw_device> [MU#] ｜ -FHORC [MU#] ｜ -FMRCF [MU#] ｜ -d[g] <seq#> <LDEV#> [MU#] ｜ -c ｜ -ss ｜-nomsg }

Parameter	Value
Options	-h: Displays Help/Usage and version information. -q: Terminates the interactive mode and exits the pair volume check command. -z or -zx (OpenVMS cannot use the -zx option): Makes the pairvolchk command enter the interactive mode. The -zx option guards performing of the HORCM in the interactive mode. When this option detects a HORCM shut down, interactive mode terminates. -I[H][M][instance#] or -I[TC][SI][instance#] Specifies the command as [HORC]/[HOMRCF], and used for specifying instance# of HORCM. -g <group>: Specifies the group name defined in the configuration definition file. This option must always be specified. The command is executed for the specified group unless the -d <pair Vol> option is specified. -d <pair Vol>: Specifies the paired logical volume name defined in the configuration definition file. When this option is specified, the command is executed for the specified paired logical volumes. -d[g] <raw_device> [MU#]: Searches a group on the configuration definition file (local instance) for the specified raw_device, and if the specified raw_device is contained in the group, the target volume is executed as the paired logical volume (-d) or group (-dg). This option is effective without specification of "-g <group>" option. If the specified the raw_device is contained in two or more groups, the command is executed on the first group. -d[g] <seq#> <LDEV#> [MU#]: Searches a group on the configuration definition file (local instance) for the specified LDEV. If specified LDEV is contained in the group, the target volume is executed as the paired logical volume (-d) or group (-dg). This option is effective without specification of "-g <group>" option. If the specified LDEV is contained in two or more groups, the command is executed on the first group. The <seq #> <LDEV #> values can be specified in hexadecimal (by addition of "0x ") or decimal notation. -c: Checks the conformability of the paired volumes of the local and remote hosts and reports the volume attribute of the remote host. If this option is not specified, the volume attribute of the local host is reported. -ss: Used to acquire the attribute of a volume and the pair status of a volume. If this option is not specified, the volume attribute is reported. -nomsg: Suppresses messages to be displayed when this command is executed. It is used to execute a command from a user program. This option must be specified at the beginning of a command argument. The command execution log is not affected by this option. -FHORC [MU#] or -FCA [MU#]: Forcibly specifies a cascading TrueCopy volume for specified pair logical volumes on ShadowImage environment (see example in Figure 4.18). If no -c option is specified, this option acquires the attributes of a cascading TrueCopy volume on a local host (near site). If the -c option is specified, this option acquires the attributes of a cascading TrueCopy volume on a remote host (far site). -FMRCF [MU#] or -FBC [MU#]: Forcibly specifies a cascading ShadowImage volume for specified pair logical volumes on TrueCopy environment (see example in Figure 4.19). If no -c option is specified, acquires the attributes of a cascading ShadowImage volume on a local host (near site). If the -c option is specified, acquires the attributes of a cascading ShadowImage volume on a remote host (far site). -MINAP: Shows the minimum active paths on specified group in HORC/HORCAsync on PVOL. *Note*: If RAID F/W will not be supporting the number of active path, then "MINAP" item will not be displayed as follows. `pairvolchk : Volstat is P-VOL.[status = PAIR fence = ASYNC CTGID = 2]`

Display example for ShadowImage/Snapshot:

```
# pairvolchk -g oradb
pairvolchk : Volstat is P-VOL.[status = PAIR ]
```

Display example for ShadowImage (specified with "-m grp" option):

```
# pairvolchk -g oradb
pairvolchk : Volstat is P-VOL.[status = PAIR CTGID = 1]
```

Display example for TrueCopy:

```
# pairvolchk -g oradb
pairvolchk : Volstat is P-VOL.[status = PAIR fence = DATA  MINAP = 2 ]
```

Display example for TrueCopy Sync CTG:

```
# pairvolchk -g oradb
pairvolchk : Volstat is P-VOL.[status = PAIR fence = DATA CTGID = 2 MINAP
= 2 ]
```

Display example for TrueCopy Async:

```
# pairvolchk -g oradb
pairvolchk : Volstat is P-VOL.[status = PAIR fence = ASYNC CTGID = 2 MINAP
= 2 ]
```

MINAP displays the following two conditions (status) according to the pair status:

PVOL: This shows the minimum in Active Paths on specified group in TrueCopy/TrueCopy Async

Parameter	Value
Returned values	**When the -ss option is not specified**: ▪ Normal termination: 1: The volume attribute is SMPL. 2: The volume attribute is P-VOL. 3: The volume attribute is S-VOL. ▪ Abnormal termination: Other than 0 to 127, refer to the execution log files for error details. **When the -ss option is specified**: ▪ Abnormal termination: specific error codes (Table 4.14) and generic error (Table 5.3). ▪ Normal termination: 11: The status is SMPL. **For Hitachi TrueCopy Sync/ShadowImage**: 22: The status is PVOL_COPY or PVOL_RCPY. 23: The status is PVOL_PAIR. 24: The status is PVOL_PSUS. 25: The status is PVOL_PSUE. 26: The status is PVOL_PDUB (TrueCopy & LUSE volume only). 29: The status is PVOL_INCSTG (inconsistent status in group). Not returned. 32: The status is SVOL_COPY or SVOL_RCPY. 33: The status is SVOL_PAIR. 34: The status is SVOL_PSUS. 35: The status is SVOL_PSUE. 36: The status is SVOL_PDUB (TrueCopy & LUSE volume only). 39: The status is SVOL_INCSTG (inconsistent status in group). Not returned. To identify TrueCopy Async/UR, the pairvolchk command returns a value which is 20 more than the TrueCopy Sync status code and adds PFUL and PFUS states to return code to identify sidefile status of TrueCopy Async or UR journal file. **For Hitachi TrueCopy Async and Universal Replicator**: 42: The status is PVOL_COPY. 43: The status is PVOL_PAIR. 44: The status is PVOL_PSUS. 45: The status is PVOL_PSUE. 46: The status is PVOL_PDUB. (TrueCopy & LUSE volume only) 47: The status is PVOL_PFUL. 48: The status is PVOL_PFUS. 52: The status is SVOL_COPY or SVOL_RCPY. 53: The status is SVOL_PAIR. 54: The status is SVOL_PSUS. 55: The status is SVOL_PSUE. 56: The status is SVOL_PDUB. (TrueCopy & LUSE volume only) 57: The status is SVOL_PFUL. 58: The status is SVOL_PFUS. For group status, see: 214: EX_EXQCTG 216: EX_EXTCTG 236: EX_ENQVOL 237: EX_CMDIOE 235: EX_EVOLCE ... When the -c option is specified only. 242: EX_ENORMT... When the -c option is specified only. **For a SnapShot Volume**: The SnapShot needs to show the status of Full of the SnapShot Pool as snapshot condition. For this purpose, SnapShot also uses PFUL and PFUS status which is the status of Full of the sidefile for TrueCopy Async. The APP can refer this status as the return value. 22: The status is PVOL_COPY or PVOL_RCPY. 23: The status is PVOL_PAIR. 24: The status is PVOL_PSUS. 25: The status is PVOL_PSUE. 26: The status is PVOL_PDUB. (HORC && LUSE volumes only) 27: The status is PVOL_PFUL. (PAIR closing Full status of the SnapShot Pool) 28: The status is PVOL_PFUS. (PSUS closing Full status of the SnapShot Pool) 29: The status is PVOL_INCSTG. (Inconsistent status in group) ... Not returned 32: The status is SVOL_COPY or SVOL_RCPY. 33: The status is SVOL_PAIR.

Table 4.14 Specific Error Codes for Pairvolchk

Category	Error Code	Error Message	Recommended Action	Value
Volume status	EX_ENQVOL	Unmatched volume status within the group	Confirm status using the pairdisplay command. Make sure all volumes in the group have the same fence level and volume attributes.	236
Unrecoverable	EX_EVOLCE	Pair Volume combination error	Confirm pair status using pairdisplay, and change combination of volumes.	235

Note: Unrecoverable errors are fixed and will not be resolved, even after re-executing the command. If the command failed, the detailed status will be logged in the CCI command log ($HORCC_LOG) (see Table A.2), even if the user script has no error handling.

Figure 4.18 shows a **pairvolchk** example that acquires the status (PVOL_PSUS) of the intermediate P/Pvol through specified pair group on ShadowImage environment. Figure 4.19 shows a **pairvolchk** example that acquires the status (PVOL_PSUS) of the intermediate S/Pvol (MU#1) through specified pair group on Hitachi TrueCopy environment.

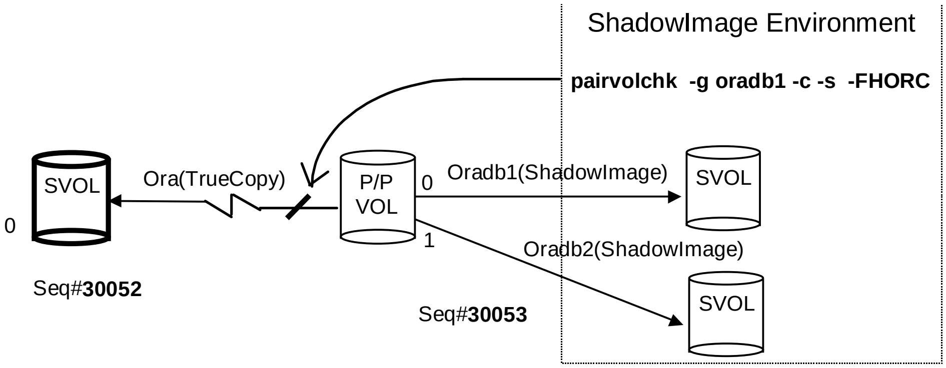


Figure 4.18 Example of -FHORC Option for Pairvolchk

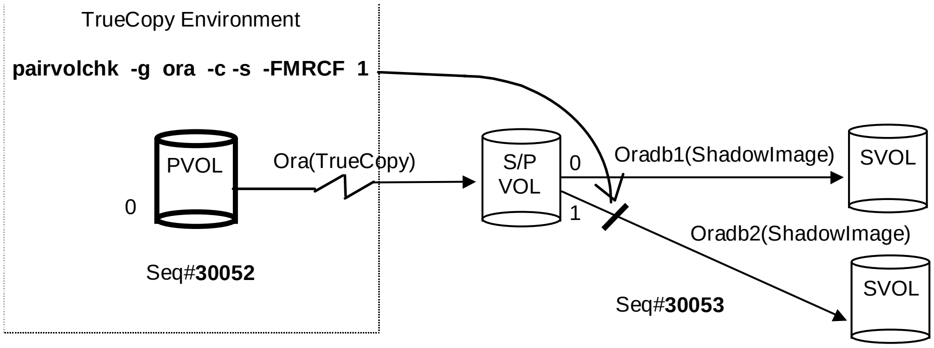


Figure 4.19 Example of -FMRCF Option for Pairvolchk

Table 4.15 Truth Table for Pairvolchk Group Status Display

	Status of Each Volume in the Group							
Option	COPY*	PSUE	PDUB	PFUS	PSUS	PFUL	PAIR	Group Status
See *Notes* below	TRUE	x	x	x	x	x	x	COPY*
	false	TRUE	x	x	x	x	x	PSUE
	false	false	TRUE	x	x	x	x	PDUB
	false	false	false	TRUE	x	x	x	PFUS
	false	false	false	false	TRUE	x	x	PSUS
	false	false	false	false	false	TRUE	x	PFUL
	false	false	false	false	false	false	TRUE	PAIR
-ss	TRUE	x	x	x	x	x	x	COPY*
	false	TRUE	x	x	x	x	x	PSUE
	false	false	TRUE	x	x	x	x	PDUB
	false	false	false	x	x	TRUE	x	PFUL
	false	false	false	x	x	false	TRUE	PAIR
	false	false	false	TRUE	false	false	false	PFUS
	false	false	false	false	TRUE	false	false	PSUS

*COPY = COPY or RCPY
x = true or false (does not matter).

Notes:

- The PFUL state is displayed as PAIR by all commands (except the **-fc** option of the pairdisplay command), since PFUL indicates PAIR state with sidefile at the HWM.
- The PFUS state is displayed as PSUS by all commands (except the **-fc** option of the pairdisplay command), since PFUS indicates SUSPENDED state due to sidefile full.
- The SVOL_PSUS state is displayed as SSUS by the pairdisplay command and other commands.
- This option will be able to use under condition when ‘pairvolchk -s’ has “USE_OLD_VCHK” variable.

Table 4.16 State Transition Table for HA Control Script

State No.	Volume Attributes and Pair Status			Results Executing pairvolchk and horctakeover from DC1(DC2)			
	DC1(DC2)	DC2(DC1)		pairvolchk -s (local volume)	pairvolchk -s -c (remote volume)	Pair Status	Horctakeover result
1	SMPL or SVOL-PSUS (SSWS)	SMPL		SMPL or SVOL-PSUS	SMPL	SMPL	EX_VOLCRE
2		P-VOL	COPY		PVOL_XXX	XXX	Nop
3			PAIR/PFUL				
4			PSUS				
4-1			PFUS				
5			PSUE				
6			PDUB				
8		S-VOL			EX_EVOLCE		EX_EVOLCE
9		Unknown			EX_ENORMT or EX_CMDIOE		(EX_ENORMT) (EX_CMDIOE)
10	P-VOL	SMPL		PVOL_XXX	SMPL	XXX	EX_VOLCRE
11		P-VOL			EX_EVOLCE		EX_EVOLCE
12	data or status & PSUE or PDUB	S-VOL			SVOL_YYY	XXX	PVOL-PSUE →12 or PVOL-SMPL →8
	Other						Nop
13	data or status & PSUE or PDUB	Unknown			EX_ENORMT or EX_CMDIOE	XXX	PVOL-PSUE →13 or PVOL-SMPL →9
	Other						Nop
14	S-VOL	SMPL		SVOL_YYY	EX_EVOLCE		EX_EVOLCE
15		P-VOL	COPY		PVOL_XXX	XXX	SVOL_E* → 4,5 SVOL_E*
16			PAIR/ PFUL				Swap →12
17			PSUS				SVOL_E → 4
			PFUS				SVOL → 4-1
18			PSUE	data			SVOL → 5,6

			PDUB	status				SVOL_E → 5,6
				never				SVOL_E → 5,6
				async				SVOL → 5,6
21		S-VOL				EX_EVOLCE		EX_EVOLCE
22	COPY	Unknown				EX_ENORMT or EX_CMDIOE	YYY	SVOL_E * → 4,5 SVOL_E*
23	PAIR/ PFUL	data						SVOL → 4
		status						SVOL → 4
		never						SVOL_E → 4
		async						SVOL → 4
24	PSUS							SVOL_E → 4
	PFUS							SVOL → 4-1
25	PSUE PDUB	data						SVOL → 5,6
		status						SVOL_E → 5,6
		never						SVOL_E → 5,6
		async						SVOL → 5,6

Explanation of terms in Table 4.16:

XXX = Pair status of P-VOL returned by “pairvolchk -s” or “pairvolchk -s -c” command

YYY = Pair status of S-VOL returned by “pairvolchk -s” or “pairvolchk -s -c” command

PAIR STATUS = Since the P-VOL controls status, PAIR STATUS is reported as PVOL_XXX (except when the P-VOL’s status is Unknown).

PVOL-PSUE = PVOL-PSUE-takeover

PVOL-SMPL = PVOL-SMPL-takeover

Nop = Nop-takeover

Swap = Swap-takeover. When the horctakeover command execution succeeds, the state transitions to the indicated (→) state number.

SVOL = **SVOL-SSUS** takeover or **Swap**-takeover. In case of a host failure, this function executes Swap-takeover. In case of an ESCON/fibre-channel or P-VOL site failure, this function executes SVOL-SSUS-takeover.

SVOL_E = Execute **SVOL-SSUS** takeover and return **EX_VOLCUR**.

SVOL_E* = Return **EX_VOLCUR**.

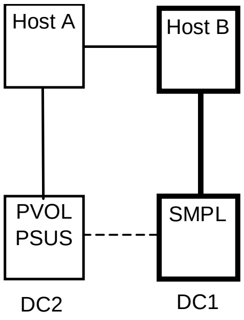
When the horctakeover command execution succeeds, the state transitions to the indicated (→) state number. For example, if the HA control script sees SVOL_PAIR at the local (near) volume and PVOL_PAIR at the remote (far) volume (like state 16 above), it will perform a swap takeover which will result in a state 12 situation.

4.7.1 Recovery in Case of SVOL-Takeover

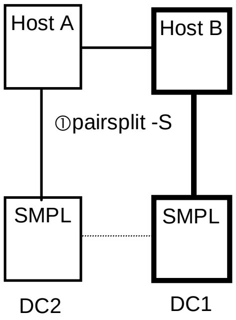
While the DC1 is conducting processing (normally state = 4), and when the DC2 has recovered from the failure, the following commands must be issued to make PVOL on the DC1 side:

In case of operations on the DC1 side:
① pairsplit -S
② paircreate **-vl**
③ pairevtwait (wait for PAIR)

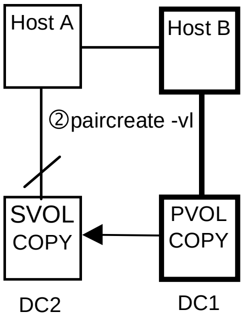
In case of operations on the DC2 side:
① pairsplit -S
② paircreate **-vr**
③ pairevtwait (wait for PAIR)



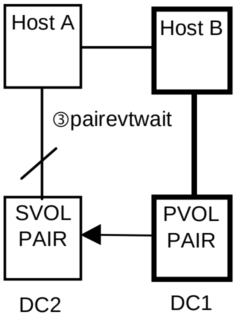
State No. 4



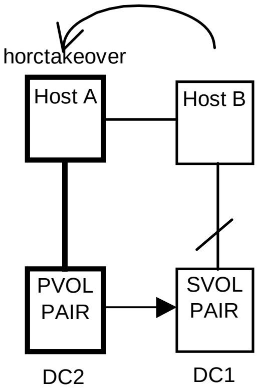
State No. 1



State No. 15



State No. 16

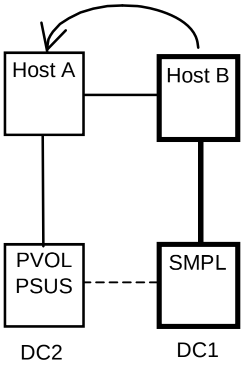


State No. 16

After operations (state is No.16), when the DC2 takes over processing from the DC1, the horctakeover command will execute a swap-takeover operation due to (DC2)SVOL & (DC1)PVOL_PAIR on the (DC2) side.

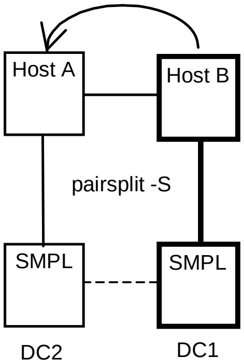
If the DC1 side has NO this operation, and when the DC2 takes over processing from the DC1, horctakeover command will be returned with **EX_VOLCRE** due to (DC2)PVOL & (DC1)SMPL on the (DC2) side.
→ state is No. 10.

In this case, pairvolchk (-s) command will be returned with **PVOL_PSUS** on the (DC2) side, and pairvolchk (-s -c) command will be returned with **SMPL** on the (DC2) side.



State No. 10

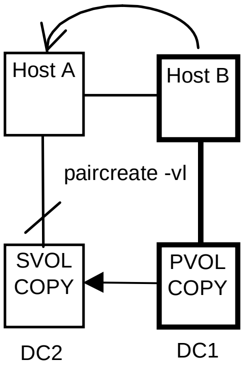
If after pairsplit operation, and when the DC2 takes over processing from the DC1, the horctakeover command will be returned with **EX_VOLCRE** due to (DC2)SMPL & (DC1)SMPL on the (DC2) side.
→ state is No. 1.



State No. 1

As for other case:
If the DC2 takes over processing from the DC1 on processing pairsplit operation, horctakeover command will be returned with **EX_ENQVOL (Unmatch volume status on the group)** due to the group's volume attribute is not the same on each volume ((DC2)SMPL & (DC2)PVOL) on the (DC2) side. In this case, pairvolchk (-s) command will be returned with **EX_ENQVOL** on the (DC2) side.

When the DC1 side has this operation and while the DC1 has COPY state DC1 (PVOL-COPY) & DC2(SVOL-COPY), if the DC2 takes over processing from the DC1, and then it will be needed that ask operator for decision, and/or pairevtwait (wait for PAIR) on the (DC2) side.
→ state is No. 15.



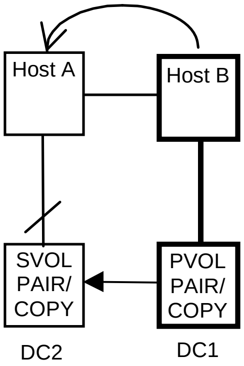
State No. 15

If the DC2 takes over processing from the DC1 without their confirmation operations, horctakeover command will be returned with **SVOL_E** (execute SVOL-takeover and return **EX_VOLCUR)** on the (DC2) side.
→ state is No. 15.

As for other case:
If the DC2 takes over processing from the DC1 on processing paircreate operation, horctakeover command will be returned with **EX_ENQVOL (Unmatch volume status on the group)** due to the group's volume attribute is not the same on each volume ((DC2)SMPL & (DC2)SVOL) on the (DC2) side.

In this case, pairvolchk (-s) command will be returned with **EX_ENQVOL** on the (DC2) side.

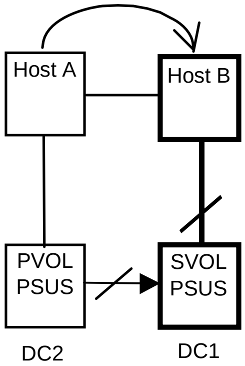
As for other case in state No. 16:
If the DC2 takes over processing from the DC1 without pairevtwait (-s pair) operations, horctakeover command will be returned with **SVOL_E** (execute SVOL-takeover and return **EX_VOLCUR)** due to the group's volume attribute is not the same on each volume ((DC2)SVOL_PAIR & (DC2)SVOL_COPY) on the (DC2) side.



State No. 16

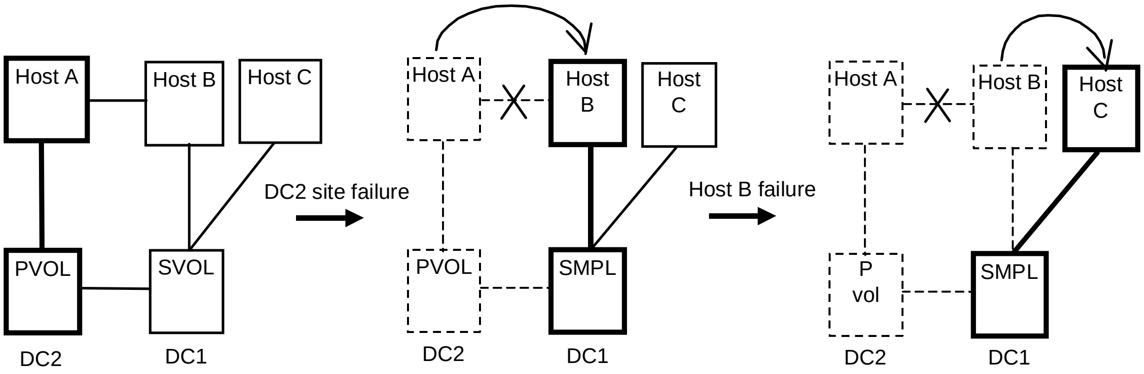
In this case, pairvolchk (-s) command will be returned with **SVOL_COPY** on the (DC2) side.

In case of state No. 17:
This case is pair suspend (using pairsplit command) by operator. The DC1 takes over processing from the DC2, when the DC2 has PSUS state DC1(SVOL-PSUS) & DC2(PVOL-PSUS) that will be needed that ask operator for decision, and/or pairresync on the DC1 side. If the DC1 takes over processing from the DC2 without their confirmation operations, horctakeover command will be returned with **SVOL_E** (execute SVOL-takeover and return **EX_VOLCUR**) on the (DC1) side.
→ state is No. 17.



State No. 17

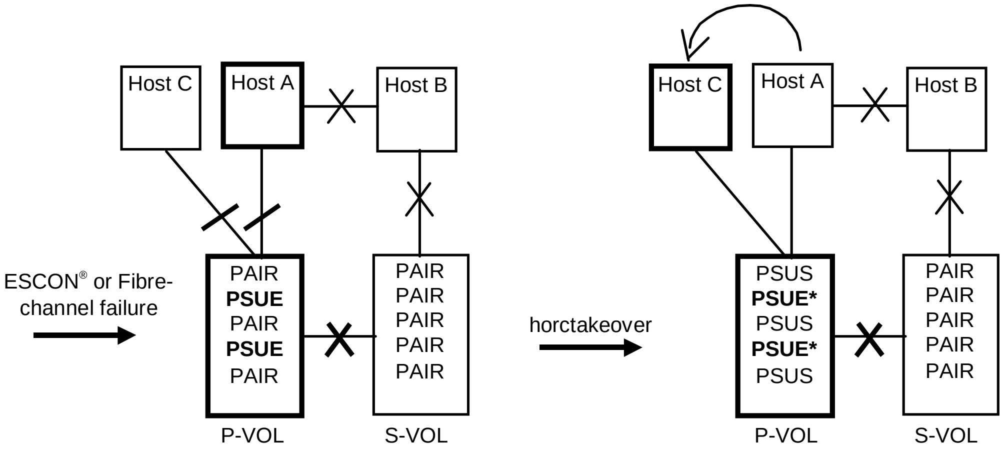
Consideration as for state No. 9
The horctakeover command will be failed with **EX_ENORMT** on the following nested failure case (state No. 4→9). Therefore, **HA Control Script** will be needed that ask operator for decision, and do nothing on the DC1 side.



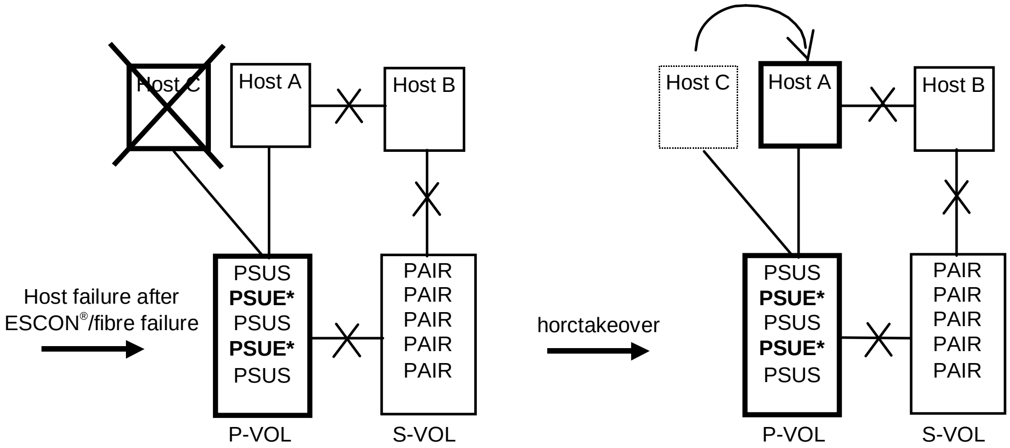
State No. 16 **State No. 23→4** **State No. 4→9**

4.7.2 PVOL-PSUE-Takeover

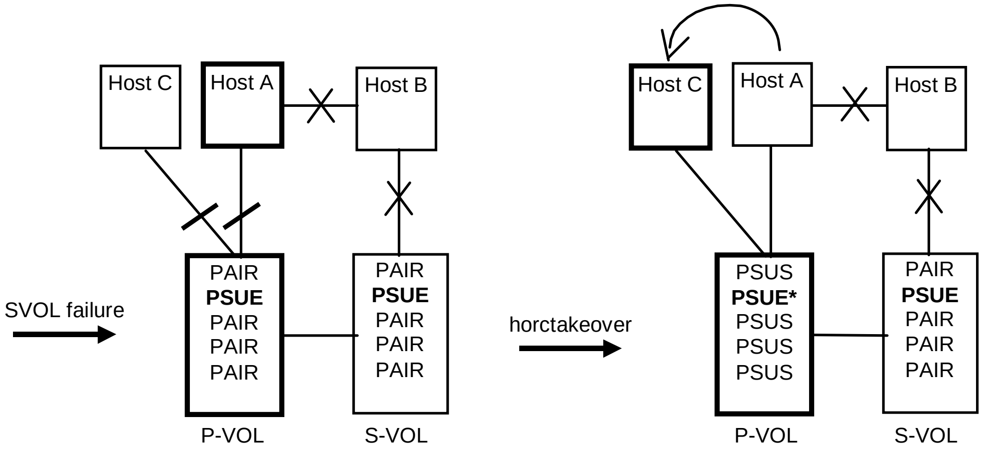
The horctakeover command executes PVOL-PSUE-takeover when the primary volume cannot be used (PSUE or PDUB volume is contained in the group, or the link down that the pair status is PVOL_PAIR/SVOL_PAIR and the AP (active path) value is 0), and will be returned with “PVOL-PSUE-takeover” as the return value. PVOL-PSUE-takeover changes the primary volume to the suspend state (PSUE or PDUB → **PSUE***, PAIR → PSUS) which permits WRITE to all primary volumes of the group.



The horctakeover command will be returned with PVOL-PSUE-takeover also on the following nested failure case.



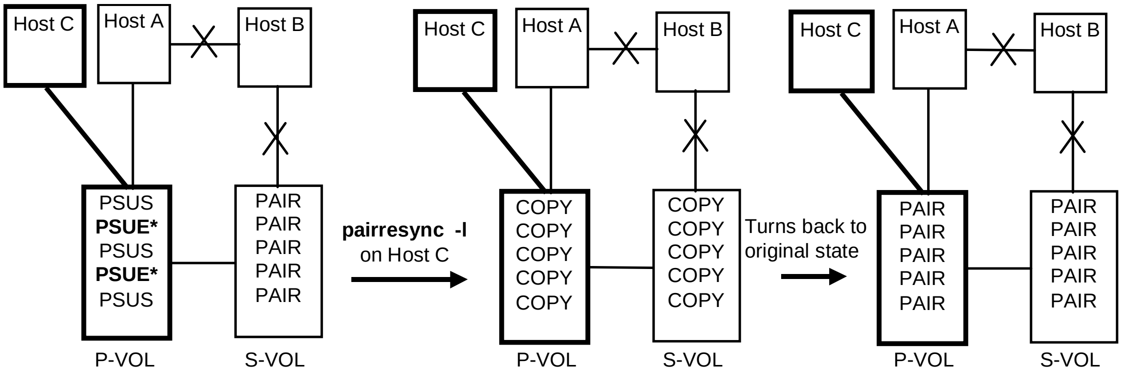
Even though ESCON or FC has been connected to S-VOL, PVOL-PSUE-takeover is changed to the suspend state with the primary volume only **(SVOL's state is not changed)**, since that maintains consistence of the secondary volume at having accepted horctakeover command.



Group STATUS of the P-VOL. The PSUE and/or PSUS status is intermingled in the group through action of this PVOL-PSUE-takeover. This intermingled pair status is PSUE as the group status, therefore the pairvolchk command returned give priority PSUE(PDUB) instead of PSUS as the group status. Therefore, the group status of the PVOL is also continued after the PVOL-PSUE-takeover.

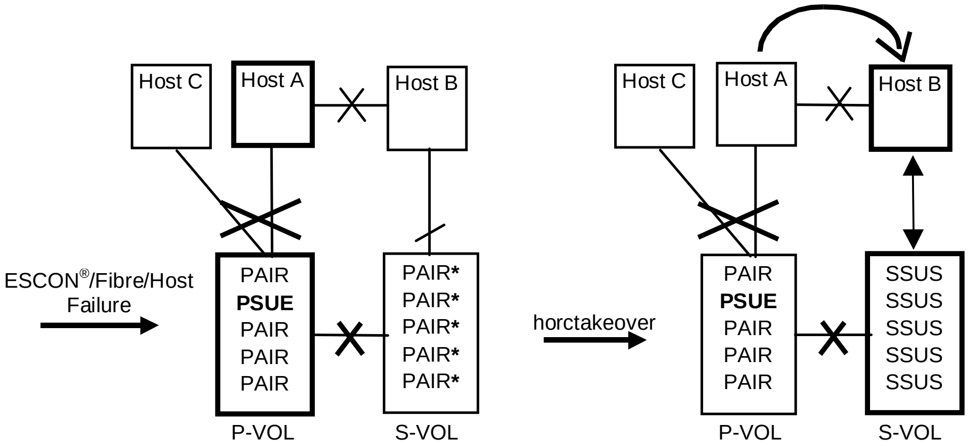
4.7.3 Recovery in Case of PVOL-PSUE-Takeover

This special state (**PSUE***) turns back to original state after the successful execution of the pairresync command (after the recovery of ESCON/fibre-channel link). If the pairresync command has been failed at the ESCON or fibre-channel link is not restored, then this special state (**PSUE***) is NOT changed.



4.7.4 SVOL-SSUS Takeover in Case of ESCON/Fibre/Host Failure

The SVOL-Takeover executes **SVOL-SSUS-takeover** to enable writing without changing the SVOL to SMPL. SVOL-SSUS-takeover changes the SVOL to the suspend state (PAIR, PSUE → **SSUS**) which permits write and maintains delta data (bitmap) for all SVOLs of the group.



PAIR* = PAIR for CA Sync., PAIR→PSUE for Hitachi TrueCopy Async/UR.
SSUS = SVOL_PSUS

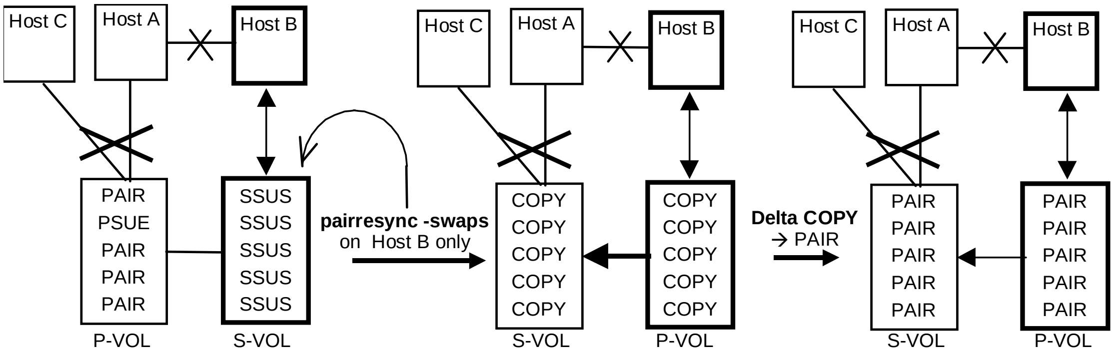
Group status of SVOL-SSUS-takeover: After SVOL-SSUS-takeover completes, the SVOL status is displayed as SSUS by pairdisplay command, and pairvolchk command will return SVOL status as SVOL_PSUS. Also this special state is displayed as SSWS using the **-fc** option of the pairdisplay command. This special state (PVOL_PSUE and SVOL_PSUS) between PVOL and SVOL may be needed that is handled by HA Control Script.

Hitachi TrueCopy Async/UR: Before the SVOL is changed to SSUS, the SVOL-takeover will try to copy non-transmitted data (which remains in the FIFO queue (sidefile) of the PVOL) to the SVOL. In case of an ESCON/FC failure, this data synchronize operation may fail. Even so, the SVOL-takeover function will execute the force split to SSUS, enabling the SVOL to be used.

Note: Non-transmitted data (which remains in the FIFO queue (sidefile) of the PVOL) will be reflected to the bitmap to empty the FIFO queue, and the pair state will be set to PSUE. This non-transmitted data which is reflected to the bitmap **will be lost** (resynchronized as NEW_SVOL) by issuing of the pairresync-swaps command for recovery from SVOL-SSUS-takeover on takeover site (Host B) (see next section).

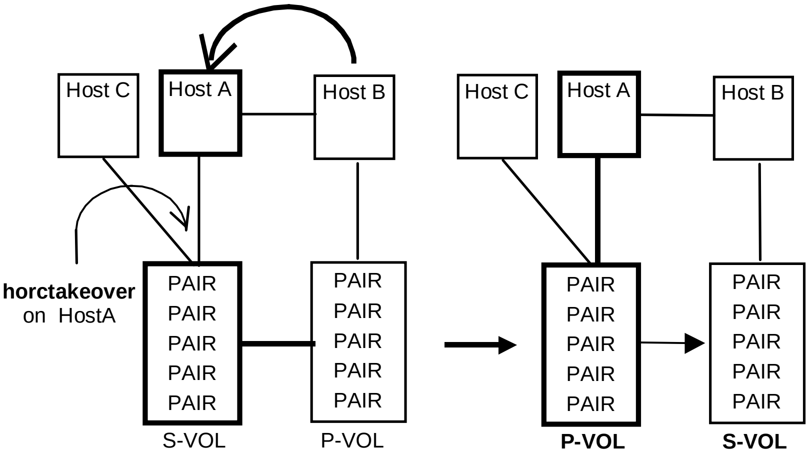
4.7.5 Recovery from SVOL-SSUS-Takeover

After recovery of the ESCON/FC link, this special state (PVOL_PSUE and SVOL_PSUS) will be changed to COPY state that original SVOL is swapped as the NEW_PVOL and resynchronizes (cast off original PVOL) the NEW_SVOL based on the NEW_PVOL by issuing of the **pairresync -swaps** command on takeover site (Host B).

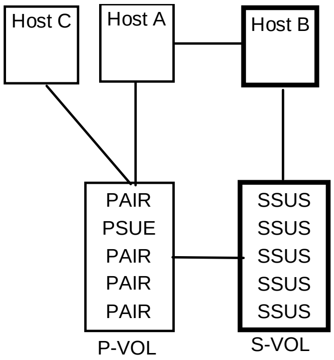


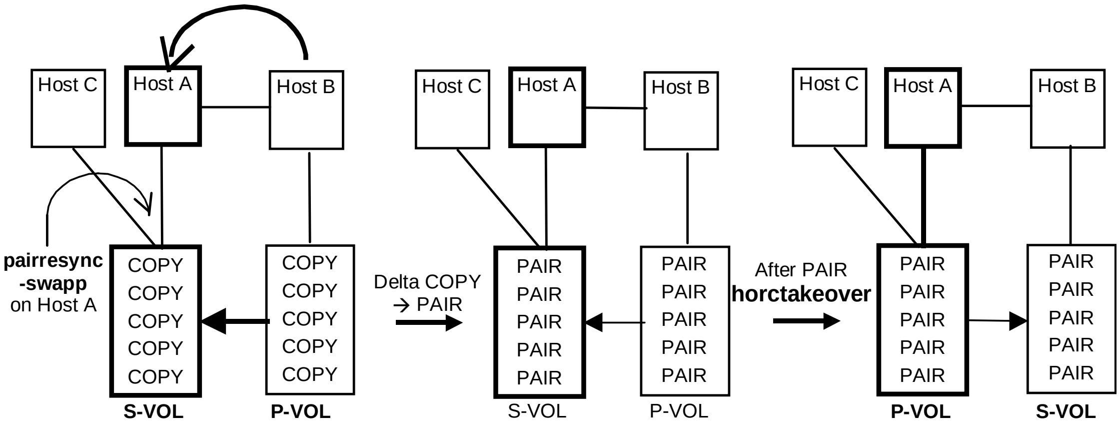
If the pairresync -swaps command has been failed at the ESCON/FC link is not restored, then this special state (PVOL_PSUE and SVOL_PSUS) is NOT changed.

Failback after recovery on Host B. After recovery with execution of the pairresync -swaps command on Host B, if you stop the applications on Host B and restart the applications on Host A, then horctakeover will execute Swap-Takeover, even though Host A cannot communicate with remote Host B.



Failback without recovery on Host B. After recovery of the ESCON/FC link and hosts, if you stopped the applications without executing the pairresync -swaps command on Host B and restarted the applications on Host A, you must use the following procedure for recovery. At this time, pairvolchk command on Host A will be returned **PVOL_PSUE & SVOL_PSUS** as state combination.



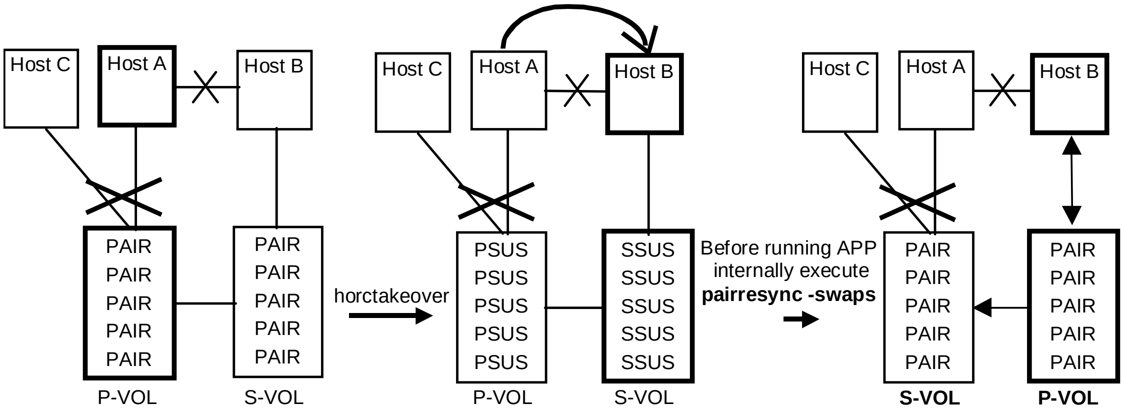


Note: The pairresync -swapp option is used to be swapped volume from the PVOL to SVOL at suspending state on the **PVOL side** and resynchronizes (cast off original PVOL) the NEW_SVOL based on the NEW_PVOL. At the result of this operation, the volume attributes of own host (local host) becomes for the NEW_SVOL. **The target volume of the local host must have the P-VOL, and needs to the remote host for this operation.**

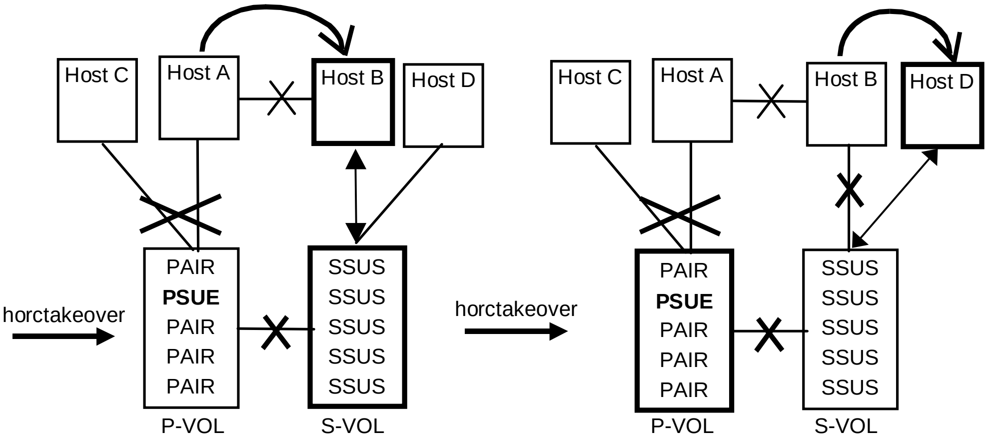
4.7.6 SVOL-Takeover in Case of Host Failure

After SVOL-takeover changed to the suspend (PAIR, PSUE → SSUS) state with the SVOL only, internal operation of SVOL-takeover will be executed **pairresync -swaps** command for maintaining mirror consistency between NEW_PVOL and NEW_SVOL, and then will be returned with Swap-takeover as the return value of horctakeover command.

Hitachi TrueCopy Async/UR. Before the SVOL is changed to SSUS, the SVOL-takeover will copy non-transmitted data (which remains in the FIFO queue (sidefile) of the PVOL) to the SVOL side. The SVOL-takeover operation is waited to copy non-transmitted data of the PVOL before a timeout value (that is specified by -t <timeout> option). After the completion of a synchronous state between the PVOL and SVOL, the SVOL-takeover will be split and the state will be changed to SSUS, and the operation of after that is same.



Since the SVOL has been the **SSWS** already as state of the SVOL_SSUS takeover after, the horctakeover command will do nothing in this nested failure case.



4.8 Displaying Pair Status (Pairdisplay)

The pairdisplay command displays the pair status allowing you to verify completion of pair operations (e.g., paircreate, pairresync). The pairdisplay command is also used to confirm the configuration of the pair connection path (the physical link of paired volumes and servers). The pairdisplay command can be used for a paired volume or a group of paired volumes. Table 4.17 lists and describes the pairdisplay command parameters and returned values. Figure 4.20 and Figure 4.21 show examples of the pairdisplay command and its output. Figure 4.22 shows examples of the **-m** option of the pairdisplay command.

Table 4.17 Pairdisplay Command Parameters

Parameter	Value
Command name	pairdisplay
Format	pairdisplay{ -h | -q | -z | -g <group> | -d <pair Vol> | -d[g] <raw_device> [MU#] | -FHORC [MU#]| -FMRCF [MU#]| -d[g] <seq#> <LDEV#> [MU#] | -c | -l | -f[xcdm] | -CLI | -m <mode> | -v jnl[t] |-v ctg |-v pid }

Parameter	Value
Options	**-h**: Displays Help/Usage and version information. **-q**: Terminates the interactive mode and exits the pair volume check command. **-z** or **-zx** (OpenVMS cannot use the -zx option): Makes the pairdisplay command enter the interactive mode. The **-zx** option guards performing of the HORCM in the interactive mode. When this option detects a HORCM shut down, interactive mode terminates. **-I[H][M][instance#] or -I[TC][SI][instance#]** Specifies the command as [HORC]/[HOMRCF], and used for specifying instance# of HORCM. **-g <group>**: Specifies the group name defined in the configuration definition file. This option must always be specified. The command is executed for the specified group unless the -d <pair Vol> option is specified. **-d <pair Vol>**: This option is used to specify the paired logical volume name defined in the configuration definition file. When this option is specified, the command is executed for the specified paired logical volumes. **-d[g] <raw_device> [MU#]**: Searches a group on the configuration definition file (local instance) for the specified raw_device, and if the specified raw_device is contained in the group, the target volume is executed as the paired logical volume (-d) or group (-dg). This option is effective without specification of "-g <group>" option. If the specified the raw_device is contained in two or more groups, the command is executed on the first group. **- FHORC [MU#]** or **-FCA [MU#]:** Forcibly specifies a cascading TrueCopy volume for specified pair logical volumes on ShadowImage environment. If the **-l** option is specified, this option displays status of a cascading TrueCopy volume on a local host (near site). If no **-l** option is specified, this option displays status of a cascading TrueCopy volume on a remote host (far site). This option cannot be specified with **-m <mode>** option on the same command line. **-FMRCF [MU#]** or **-FBC [MU#]**: Forcibly specifies a cascading ShadowImage volume for specified pair logical volumes on TrueCopy environment. If the **-l** option is specified, this option displays status of a cascading ShadowImage volume on a local host (near site). If no **-l** option is specified, this option displays status of a cascading ShadowImage volume on a remote host (far site). This option cannot be specified with **-m <mode>** option on the same command line. **-d[g] <seq#> <LDEV#> [MU#]**: Searches a group on the configuration definition file (local instance) for the specified LDEV, and if the specified LDEV is contained in the group, the target volume is executed as the paired logical volume (-d) or group (-dg). This option is effective without specification of "-g <group>" option. If the specified LDEV is contained in two or more groups, the command is executed on the first group. The **<seq #> <LDEV #>** values can be specified in hexadecimal (by addition of "0x ") or decimal notation. **-c**: Checks the configuration of the paired volume connection path (physical link of paired volume among the servers) and displays illegal pair configurations. If this option is not specified, the status of the specified paired volume is displayed without checking the path configuration. **-l**: Displays the paired volume status of the local host (which issues this command). **-fx**: Displays the LDEV ID as a hexadecimal number. **-fc**: Displays copy operation progress, sidefile percentage, bitmap percentage, or UR journal percentage. Displays **PFUL/PFUS** forTrueCopy Async/UR. Used to confirm **SSWS** state as indication of SVOL_SSUS-takeover after. **-fd**: Displays the relation between the Device_File and the paired volumes, based on the group (as defined in the local instance configuration definition file). If Device_File column shows "**Unknown**" to either the local or the remote HOST (instance) then it shows a volume which is not recognized on own HOST, and pair operation are rejected (except the local option such as "-l") in protection mode. Display example:

```
# pairdisplay -g oradb -fd
Group   PairVol(L/R) Device_File  M ,Seq#,LDEV#.P/S,Status, Seq#,P-LDEV# M
oradb   oradev1(L)   c0t3d0       0 35013   17..P-VOL COPY, 35013    18  -
oradb   oradev1(R)   c0t3d1       0 35013   18..S-VOL COPY, 35013    17  -
```

	-fm: Displays the Bitmap mode to output of M column. **-fe**: Displays the serial# and LDEV# of the external LUNs mapped to the LDEV and additional information for the pair volume. This option displays the information above by adding to last column, and then ignores the format of 80 column. This option will be invalid if the cascade options (-m all,-m cas) are specified. Display example for TrueCopy:

```
# pairdisplay -g horc0 -fdxe

Group ... LDEV#.P/S,Status,Fence,Seq#,P-LDEV# M CTG  JID AP EM E-Seq# E-LDEV#

horc0 ...    41.P-VOL PAIR ASYNC ,63528    40 -   0   -  2  -      -       -

horc0 ...    40.S-VOL PAIR ASYNC ,-----    41 -   0   -  -  -      -       -
```

	Display example for ShadowImage/Snapshot:

```
# pairdisplay -g horc0 -fe

Group ...  Seq#,LDEV#.P/S,Status, Seq#,P-LDEV# M CTG CM EM E-Seq# E-LDEV#
```

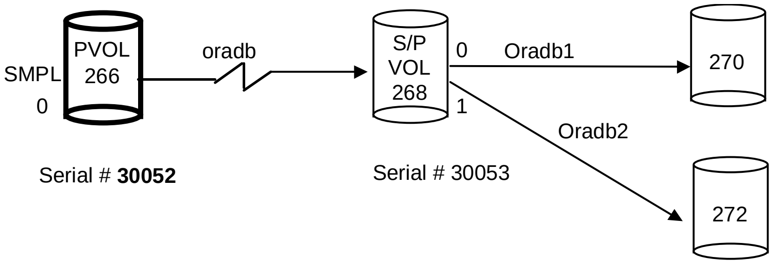
Parameter	Value
Returned values	1: The volume attribute is SMPL. 2: The volume attribute is P-VOL. 3: The volume attribute is S-VOL. When displaying groups, 1/2/3 = normal termination for all pairs. Abnormal termination (other than 0 to 127): refer to the execution log files for error details.

```
#  pairdisplay -g oradb -fcx
Group  Pair Vol(L/R)  (P,T#,L#),   Seq#,  LDEV#..P/S,  Status,  Fence, Copy%, P-LDEV#  M
oradb  oradb1(L)      (CL1-B, 1,0) 1234      64..P-VOL   PAIR   Never,    75       C8  -
oradb  oradb1(R)      (CL1-A, 1,0) 5678      C8..S-VOL   PAIR   Never,  ----       64  -
```

Figure 4.20 Hitachi TrueCopy Pairdisplay Command Example

```
#  pairdisplay  -g oradb
Group  Pair Vol(L/R) (Port#,TID,LU-M),  Seq#,  LDEV#..P/S, Status, Fence,  Seq#, P-LDEV# M
oradb      oradb1(L)     (CL1-A, 1,0)  30053      18..P-VOL  PAIR  Never, 30053      19  -
oradb      oradb1(R)     (CL1-D, 1,0)  30053      19..S-VOL  PAIR  Never,  ----      18  -
```

Figure 4.21 ShadowImage/Snapshot Pairdisplay Command Example



Display example for **-m cas**:

```
# pairdisplay -g oradb -m cas
Group   PairVol(L/R) (Port#,TID,LU-M), Seq#,  LDEV#..P/S,  Status, Seq#, P-LDEV# M
oradb   oradev1(L)   (CL1-D , 3,  0-0) 30052  266....SMPL  ----,   ----- ----    -
oradb   oradev1(L)   (CL1-D , 3,  0)   30052  266....P-VOL COPY,   30053 268     -
oradb1  oradev11(R)  (CL1-D , 3,  2-0) 30053  268....P-VOL COPY,   30053 270     -
oradb2  oradev21(R)  (CL1-D , 3,  2-1) 30053  268....P-VOL PSUS,   30053 272     W
oradb   oradev1(R)   (CL1-D , 3,  2)   30053  268....S-VOL COPY,   ----- 266     -
```

Display examples for **-m all**:

```
# pairdisplay -g oradb -m all
Group   PairVol(L/R) (Port#,TID,LU-M), Seq#,  LDEV#..P/S,  Status, Seq#, P-LDEV# M
oradb   oradev1(L)   (CL1-D , 3,  0-0) 30052  266....SMPL  ----,   ----  ----    -
-----   -----(L)     (CL1-D , 3,  0-1) 30052  266....SMPL  ----,   ----  ----    -
-----   -----(L)     (CL1-D , 3,  0-2) 30052  266....SMPL  ----,   ----  ----    -
oradb   oradev1(L)   (CL1-D , 3,  0)   30052  266....P-VOL PAIR,   30053 268     -
oradb1  oradev11(R)  (CL1-D , 3,  2-0) 30053  268....P-VOL COPY,   30053 270     -
oradb2  oradev21(R)  (CL1-D , 3,  2-1) 30053  268....P-VOL PSUS,   30053 272     W
-----   -----(R)     (CL1-D , 3,  2-1) 30053  268....SMPL  ----,   ----- ----    -
oradb   oradev1(R)   (CL1-D , 3,  2)   30053  268....S-VOL COPY,   ----- 266     -
# pairdisplay -d /dev/rdsk/c0t3d0 -l -m all
Group  PairVol(L/R) (Port#,TID,LU-M), Seq#,  LDEV#..P/S,  Status, Seq#, P-LDEV# M
oradb  oradev1(L)   (CL1-D , 3,  0-0) 30052  266....SMPL  ----,   ----   ----   -
-----  -----(L)     (CL1-D , 3,  0-1) 30052  266....SMPL  ----,   ----   ----   -
-----  -----(L)     (CL1-D , 3,  0-2) 30052  266....SMPL  ----,   ----   ----   -
oradb  oradev1(L)   (CL1-D , 3,  0)   30052  266....P-VOL PAIR,   30053  268    -
```

Figure 4.22 Pairdisplay -m Example

Output of the pairdisplay command:

- Group = group name (dev_group) as described in the configuration definition file
- Pair Vol(L/R) = paired volume name (dev_name) as described in the configuration definition file. (L) = local host; (R) = remote host

- (P,T#,L#) (TrueCopy) = port, TID, and LUN as described in the configuration definition file. For further information on fibre-to-SCSI address conversion, see Appendix C.
- (Port#,TID,LU-M) (ShadowImage) = port number, TID, LUN, and MU number as described in the configuration definition file
- Seq# = serial number of the RAID storage system
- LDEV# = logical device number
- P/S = volume attribute
- Status = status of the paired volume
- Fence (TrueCopy only) = fence level
- % (TrueCopy only) = copy operation completion, or percent pair synchronization

Vol.	Hitachi TrueCopy Async			Hitachi TrueCopy Sync			ShadowImage			
	COPY	PAIR	OTHER	COPY	PAIR	OTHER	COPY	PAIR	PVOL_PSUS SVOL_COPY	OTHER
PVOL	CR	SF	BMP	CR	BMP	BMP	CR	CR	BMP	CR
SVOL	-	SF	BMP	-	BMP	BMP	CR	CR	CR	CR

Volume	UR Status			
	COPY	PAIR	PSUS/SSUS (PJNS/SJNS)	OTHER
PVOL	CR	JF	JF	BMP
SVOL	-	JF	JF	BMP

CR: Shows the copy operation rate (identical rate of a pair).

BMP: Shows the identical percentage of BITMAP both PVOL and SVOL.

SF: Shows sidefile percentage of each CT group as sidefile 100% on cache of both PVOL and SVOL. Following is an arithmetic expression using the High Water Mark (HWM) as 100% of a sidefile space:
HWM(%) = High water mark(%)/Sidefile space(30 to 70) * 100

JF: Shows the usage rate of the current journal data as 100% of the journal data space.

- P-LDEV# = LDEV number of the partner volume of the pair
- M
  - For P-VOL and “PSUS” state:
    M=“W” shows that S-VOL is suspending with R/W enabled through the pairsplit.
    M=“-” shows that S-VOL is suspending with Read only through the pairsplit.
  - For S-VOL and “SSUS”state:
    M=“W” shows that S-VOL has been altered since entering SSUS state.
    M=“-” shows that S-VOL has NOT been altered since entering SSUS state.
  - For “COPY/RCPY/PAIR/PSUE” state:
    M=“N” shows that its volume are Read-disabled through the paircreate ‘-m noread’.

4.9 Checking Hitachi TrueCopy Pair Currency (Paircurchk)

The CCI paircurchk command checks the currency of the Hitachi TrueCopy secondary volume(s) by evaluating the data consistency based on pair status and fence level.

Table 4.18 specifies the data consistency for each possible state of a TrueCopy volume. A paired volume or group can be specified as the target of the paircurchk command. The paircurchk command assumes that the target is an S-VOL. If the paircurchk command is specified for a group, the data consistency of each volume in the group is checked, and all inconsistent volumes are found in the execution log file and displayed. Paircurchk is also executed as part of the TrueCopy takeover (horctakeover) command (see next section).

Table 4.18 Data Consistency Displayed by the Paircurchk Command

Object Volume			Currency	
Attribute	Status	Fence	Paircurchk	SVOL_takeover
SMPL	–	–	To be confirmed	–
P-VOL	–	–	To be confirmed	–
S-VOL	COPY	Data	Inconsistent	Inconsistent
		Status		
		Never		
		Async	Inconsistent	Inconsistent
	PAIR	Data	OK	OK
		Status	OK	OK
		Never	To be analyzed	To be analyzed
	PAIR	Async	To be analyzed	OK (assumption)
	PFUL		To be analyzed	OK (assumption)
	PSUS	Data	Suspected	Suspected
		Status	Suspected	Suspected
		Never	Suspected	Suspected
	PSUS	Async	Suspected	Suspected
	PFUS		Suspected	OK (assumption)
	PSUE PDUB	Data	OK	OK
		Status	Suspected	Suspected
		Never	Suspected	Suspected
		Async	Suspected	OK (assumption)
	SSWS	Data	Suspected	–
		Status	Suspected	
		Never	Suspected	
		Async	Suspected	

Notes:

1. To be confirmed = It is necessary to check the object volume, since it is not the secondary volume.
2. Inconsistent = Data in the volume is inconsistent because it was being copied.
3. OK (assumption) = Mirroring consistency is not assured, but as S-VOL of Hitachi TrueCopy Async/UR, the sequence of write data is ensured.

Figure 4.23 shows an example of the paircurchk command for a group and the resulting display of inconsistent volumes in the specified group. Table 4.19 lists and describes the paircurchk command parameters and returned values. Table 4.20 lists and describes the error codes for the paircurchk command.

```
# paircurchk  -g  oradb
Group  Pair vol  Port  targ# lun# LDEV#  Volstatus  Status  Fence   To be...
oradb  oradb1    CL1-A  1    5    145    S-VOL      PAIR    NEVER   Analyzed
oradb  oradb2    CL1-A  1    6    146    S-VOL      PSUS    STATUS  Suspected
```

Figure 4.23 Paircurchk Command Example

Table 4.19 Paircurchk Command Parameters

Parameter	Value
Command Name	paircurchk
Format	paircurchk { -h | -q | -z | -g <group> | -d <pair Vol> |-d[g] <raw_device> [MU#] | -d[g] <seq#> <LDEV#> [MU#] | -nomsg }
Options	-h: Displays Help/Usage and version information. -q: Terminates the interactive mode and exits the command. -z or -zx (OpenVMS cannot use the -zx option): Makes the paircurchk command enter the interactive mode. The -zx option guards performing of the HORCM in the interactive mode. When this option detects a HORCM shut down, interactive mode terminates. -I[H][M][instance#] or -I[TC][SI][instance#] Specifies the command as [HORC]/[HOMRCF], and used for specifying Instance# of HORCM -g <group>: Specifies a group name defined in the configuration definition file. The command is executed for the specified group unless the -d <pair Vol> option is specified. -d <pair Vol>: Specifies paired logical volume name defined in the configuration definition file. When this option is specified, the command is executed for the specified paired logical volume. -d[g] <raw_device> [MU#]: Searches a group on the configuration definition file (local instance) for the specified raw_device, and if the specified raw_device is contained in the group, the target volume is executed as the paired logical volume (-d) or group (-dg). This option is effective without specification of "-g <group>" option. If the specified the raw_device is contained in two or more groups, the command is executed on the first group. -d[g] <seq#> <LDEV#> [MU#]: Searches a group on the configuration definition file (local instance) for the specified LDEV, and if the specified LDEV is contained in the group, the target volume is executed as the paired logical volume (-d) or group (-dg). This option is effective without specification of "-g <group>" option. If the specified LDEV is contained in two or more groups, the command is executed on the first group. The <seq #> <LDEV #> values can be specified in hexadecimal (by addition of "0x ") or decimal notation. -nomsg: Suppresses messages to be displayed when this command is executed. This option must be specified at the beginning of a command argument. The command execution log is not affected by this option.
Returned values	Normal termination (data is consistent): 0 Abnormal termination: other than 0, refer to the execution logs for error details.

Table 4.20 Specific Error Code for Paircurchk

Category	Error Code	Error Message	Recommended Action	Value
Volume status Unrecoverable	EX_VOLCUR	S-VOL currency error	Check volume list to see if an operation was directed to the wrong S-VOL.	225

Note: Unrecoverable errors are fixed and will not be resolved, even after re-executing the command. If the command failed, the detailed status will be logged in the CCI command log ($HORCC_LOG) (see Table A.2), even if the user script has no error handling.

4.10 Performing Hitachi TrueCopy Takeover Operations

The Hitachi TrueCopy takeover command (horctakeover) is a scripted command for executing several Hitachi TrueCopy operations. The takeover command checks the specified volume's or group's attributes (paircurchk), decides the takeover function based on the attributes, executes the chosen takeover function, and returns the result. The four Hitachi TrueCopy takeover functions designed for HA software operation are (see section 4.10.1): takeover-switch, swap-takeover, PVOL-takeover, and SVOL-takeover. A paired volume or a group can be specified as the target of the TrueCopy takeover command. If SVOL-takeover is specified for a group, the data consistency check is executed for all volumes in the group, and all inconsistent volumes are found in the execution log file and displayed (same as paircurchk command).

The takeover command allows swapping of the primary and secondary volumes, so that if the primary or secondary volume is switched due to a server error or package transfer, duplex operations can be continued using the reversed volumes. When control is handed over to the current node, swapping the volumes again eliminates the need to copy them. The takeover command also allows the secondary volume to be separated for disaster recovery operations.

Table 4.21 lists and describes the horctakeover command parameters and returned values. Table 4.22 lists and describes the error codes for the horctakeover command.

Table 4.21 Horctakeover Command Parameters

Parameter	Value
Command Name	horctakeover
Format	horctakeover { -h ∣ -q ∣ -z ∣ -g <group> ∣ -d <pair Vol> ∣ -d[g] <raw_device> [MU#] ∣ -d[g] <seq#> <LDEV#> [MU#] ∣ -S ∣ -l ∣ -t <timeout> ∣ -nomsg }

Parameter	Value
Options	-h: Displays Help/Usage and version information. -q: Terminates the interactive mode and exits the command. -z or -zx (OpenVMS cannot use the -zx option): Makes the horctakeover command enter the interactive mode. The -zx option guards performing of the HORCM in the interactive mode. When this option detects a HORCM shutdown, interactive mode terminates. -I[H][M][instance#] or -I[TC][SI][instance#] Specifies the command as [HORC]/[HOMRCF], and used for specifying instance# of HORCM -g <group>: Specifies a group name defined in the configuration definition file. The command is executed for the specified group unless the -d <pair Vol> option is specified. -d <pair Vol>: Specifies paired logical volume name defined in the configuration definition file. When this option is specified, the command is executed for the specified paired logical volume. -d[g] <raw_device> [MU#]: Searches a group on the configuration definition file (local instance) for the specified raw_device, and if the specified raw_device is contained in the group, the target volume is executed as the paired logical volume (-d) or group (-dg). This option is effective without specification of "-g <group>" option. If the specified the raw_device is contained in two or more groups, the command is executed on the first group. -d[g] <seq#> <LDEV#> [MU#]: Searches a group on the configuration definition file (local instance) for the specified LDEV, and if the specified LDEV is contained in the group, the target volume is executed as the paired logical volume (-d) or group (-dg). This option is effective without specification of "-g <group>" option. If the specified LDEV is contained in two or more groups, the command is executed on the first group. The <seq #> <LDEV #> values can be specified in hex (by addition of "0x") or decimal notation. -S: Selects and executes SVOL-takeover. The target volume of the local host must be an S-VOL. If this option is specified, then the following "-l" option is invalid. -l: Enables read and write to the primary volume(s) by a local host only without a remote host, and executes PVOL-takeover when the primary volume cannot be used because it is fenced (fence = DATA or STATUS, state = PSUE or PDUB, or PSUE or PDUB volume is contained in the group). If the primary volume can be accessed, nop-takeover is executed. The target volume of the local host must be a P-VOL. -t <timeout>: Must be specified for async volumes only, ignored for sync. Specifies the maximum time to wait (in seconds) for swap-takeover and SVOL-takeover operation to synchronize the P-VOL and S-VOL. If this timeout occurs, the horctakeover command fails with EX_EWSTOT. To avoid timeout, set this value less than or equal to the start-up timeout value of the HA Control Script. -nomsg: Suppresses messages to be displayed when this command is executed. This option must be specified at beginning of a command argument. The command execution log is not affected by this option.
Returned values	Normal termination: 0: Nop-takeover (no operation). 1: Swap-takeover was successfully executed. 2: SVOL-takeover was successfully executed. 3: PVOL-SMPL-takeover was successfully executed. 4: PVOL-PSUE-takeover was successfully executed. (This value depends on the microcode level.) 5: SVOL-SSUS-takeover was successfully executed. (This value depends on the microcode level.) Abnormal termination: other than 0-5, refer to the execution logs for error details.

Table 4.22   Specific Error Codes for Horctakeover

Category	Error Code	Error Message	Recommended Action	Value
Volume status	EX_ENQVOL	Unmatched volume status within the group	Confirm status using pairdisplay command. Make sure all volumes in the group have the same fence level and volume attributes.	236
	EX_INCSTG	Inconsistent status in group	Confirm pair status using pairdisplay.	229

Category	Error Code	Error Message	Recommended Action	Value
	EX_EVOLCE	Pair Volume combination error	Confirm pair status using pairdisplay, and change combination of volumes.	235
	EX_VOLCUR	S-VOL currency error	Check volume list to see if an operation was directed to the wrong S-VOL.	225
	EX_VOLCUE	Local Volume currency error	Confirm pair status of the local volume.	224
Unrecoverable	EX_VOLCRE	Local and Remote Volume currency error	Confirm pair status of remote and local volumes using pairdisplay command.	223
Timer Recoverable	EX_EWSTOT	Timeout waiting for specified status	Increase timeout value using -t option.	233

Note: Unrecoverable errors are fixed and will not be resolved, even after re-executing the command. If the command failed, the detailed status will be logged in the CCI command log ($HORCC_LOG) (see Table A.2), even if the user script has no error handling.

Recovery from EX_EWSTOT: If horctakeover failed with [EX_EWSTOT], recover as follows:

1. Wait until the SVOL state becomes “SVOL_PSUS” by using the return code of “pairvolchk -g <group> -ss” command, and try to the start-up again for the HA Control Script.
2. Make an attempt to re-synchronize the original PVOL based on SVOL using “pairresync -g <group> -swaps -c <size>“ for a fast failback operation.
   If this pairresync operation fails with [EX_CMDRJE] or [EX_CMDIOE], there will be a cause of ESCON link down and/or site failure.

If this operation fails, then HA Control Script reports the following message: ”After a recovery from failure, please try ‘pairresync -g <group> -swaps -c <size>‘ command.”
To avoid above recovery steps, a timeout value should be a greater than (or equal) to the start-up timeout value for the HA control script.

4.10.1 Horctakeover Command Functions

4.10.1.1 Takeover-Switch Function

The control scripts activated by the HA software are used the same way by all nodes of a cluster; they do not discriminate between primary and secondary volumes. The takeover command, when activated by a control script, checks the combination of attributes of the local and remote volumes and determines the proper takeover action. Table 4.23 lists the volume attributes and specifies the TrueCopy takeover action for each combination of attributes.

Table 4.23 Volume Attributes and Takeover Actions

Local Node (Takeover Node)		Remote Node		
Volume Attribute	Fence Level and Status	Volume Attribute	P-VOL Status	Takeover Action
SMPL	-	SMPL	-	NG [1]
		P-VOL	-	Nop-Takeover [2]
		S-VOL	-	Volumes not conform [3]
		Unknown [4]	-	NG
P-VOL (primary)	Fence = Data or Status and Status = PSUE or PDUB or MINAP = 0	SMPL	-	NG
		P-VOL	-	Volumes not conform
		S-VOL	-	PVOL-Takeover
		Unknown Status (e.g., LAN down)	-	PVOL-Takeover
	Fence = Never Status = others	SMPL	-	NG
		P-VOL	-	Volumes not conform
		S-VOL	-	Nop-Takeover
		Unknown Status (e.g., LAN down)	-	Nop-Takeover
S-VOL (secondary)	Status = SSWS [5] After SVOL_SSUS-takeover	Any	-	Nop-Takeover
	Others	SMPL	-	Volumes not conform
		P-VOL	PAIR or PFUL	Swap-Takeover
			Others	SVOL-Takeover
		S-VOL	-	Volumes not conform
		Unknown	-	SVOL-Takeover

Notes:
1. NG = The takeover command is rejected, and the operation terminates abnormally.
2. Nop-Takeover = The takeover command is accepted, but no operation is performed.
3. Volumes not conform = The volumes are not in sync, and the takeover command terminates abnormally.
4. Unknown = The remote node attribute is unknown and cannot be identified. The remote node system is down or cannot communicate.
5. SSWS = Suspend for Swapping with SVOL side only. The SSWS state is displayed as SSUS (SVOL_PSUS) by ALL commands except the "-fc" option of the pairdisplay command.

4.10.1.2 Swap-Takeover Function

When the P-VOL status of the remote node is PAIR and the S-VOL data is consistent, it is possible to swap the primary and secondary volumes. The swap-takeover function is used by the HA control script when a package is manually moved to an alternate data center while all hardware is operational. Swap-takeover can be specified for a paired volume or a group.

The swap-takeover function internally executes the following commands to swap the primary and secondary volumes:

1. Execute **Suspend for Swapping** for the local volume (S-VOL). If this step fails, swap-takeover is disabled and an error is returned.
2. Execute **Resync for Swapping** for switch to the primary volume that the local volume (S-VOL) is swapped as the NEW_PVOL and resynchronizes the NEW_SVOL based on the NEW_PVOL. As for copy tracks, if the remote host is known, the command will use the value of PVOL specified at paircreate time. If the remote host is unknown, the command will use the default number of tracks (three). If this step fails, swap-takeover returns at **SVOL-SSUS-takeover**, and the local volume (S-VOL) is maintained in SSUS(PSUS) state which allows and keeps track of write I/Os using a bitmap for the S-VOL. This special state is displayed as **SSWS** using the **-fc** option of the pairdisplay command.

Note: The swap-takeover function does not use **SMPL** or **No Copy** mode for swapping to guarantee mirror consistence, and this is included as a function of SVOL-takeover.

Note for Hitachi TrueCopy Async: The CCI software on the S-VOL side will issue a **Suspend for Swapping** to the S-VOL side RAID storage system. Non-transmitted data which remains in the FIFO queue (sidefile) of the P-VOL will be copied to the S-VOL, and a **Resync for Swapping** operation will be performed (after the copy process). The swap operation is required to copy non-transmitted P-VOL data within a given timeout value (specified by the **-t <timeout>** option).

4.10.1.3 SVOL-Takeover Function

The SVOL-takeover function allows the takeover node to use the secondary volume (except in COPY state) in SSUS(PSUS) state (i.e., reading and writing are enabled), on the assumption that the remote node (possessing the primary volume) cannot be used. The data consistency of the Hitachi TrueCopy SVOL is evaluated by its pair status and fence level (same as paircurchk, refer to). If the primary and secondary volumes are not consistent, the SVOL-takeover function fails. If primary and secondary volumes are consistent, the SVOL-takeover function attempts to switch to the primary volume using **Resync for Swapping**. If successful, the SVOL-takeover function returns **Swap-takeover** as the return value of the horctakeover command. If not successful, the SVOL-takeover function returns **SVOL-SSUS-takeover** as the return value of the horctakeover command. In case of a host failure, **Swap-takeover** is returned. In case of an ESCON/FC or P-VOL site failure, **SVOL-SSUS-takeover** is returned.

SVOL-takeover can be specified for a paired volume or a group. If the SVOL-takeover is specified for a group, a data consistency check is executed for all volumes in the group, and all inconsistent volumes are displayed (see example in Figure 4.24).

```
Group  Pair vol        Port  targ# lun#  LDEV#  Volstatus Status Fence   To be...
oradb1 /dev/dsk/hd001  CL1-A  1     5    145     S-VOL    PAIR   NEVER   Analyzed
oradb1 /dev/dsk/hd002  CL1-A  1     6    146     S-VOL    PSUS   STATUS  Suspected
```

Figure 4.24 Display of Inconsistent Volumes for SVOL-Takeover of Group

Note for Hitachi TrueCopy Async/UR: The CCI software on the S-VOL side will issue a **Suspend for Swapping** to the S-VOL side RAID storage system. Non-transmitted data of the P-VOL will be copied to the S-VOL side, and a **Resync for Swapping** operation will be performed (after the copy process). In case of a host failure, this data synchronize operation will be accomplished and SVOL-takeover function will return **Swap-takeover** by attempting a **Resync for Swapping**. In case of an ESCON/FC or P-VOL site failure, this data synchronize operation may fail. Even so, the SVOL-takeover function will do **Suspend for Swapping**, and enable the S-VOL to be used. As result, this function will be returned as **SVOL-SSUS-takeover**. Through this behavior, you will be able to judge that the non-transmitted data of the P-VOL was not transmitted completely when SVOL-takeover returns **SVOL-SSUS-takeover**.

The SVOL-takeover operation is required to copy non-transmitted P-VOL data within a given timeout value (specified by the **-t <timeout>** option). If the timeout occurs (before SVOL takeover has completed all S-VOL changes to SSWS state), the horctakeover command will be failed with EX_EWSTOT. Therefore this timeout value should be a greater than (or equal to) the start-up timeout value for the HA Control Script.

If the horctakeover command failed due to timeout, then try to recover as follows:

1. Wait until SVOL state becomes SSWS (use **pairdisplay -g <group> -l -fc** command), and try to the start-up again for the HA Control Script.
2. Make an attempt at doing resynchronize original PVOL based on SVOL using **pairresync -g <group> -swaps -c <size>** for Fast Failback Performance. If this operation has been failed at [EX_CMDRJE] or [EX_CMDIOE], then the cause is ESCON/FC link down and/or site failure. After the recovery from failure, please try again this command.

4.10.1.4 PVOL-Takeover Function

The PVOL-takeover function releases the pair state as a group, since that maintains the consistency of the secondary volume at having accepted horctakeover command when the primary volume is fenced ("data or status" & "PSUE or PDUB" state, "PSUE or PDUB" volume are contained in the group). This function allows the takeover node to use the primary volume (i.e., reading and writing are enabled), on the assumption that the remote node (possessing the secondary volume) cannot be used. PVOL-takeover can be specified for a paired volume or a group.

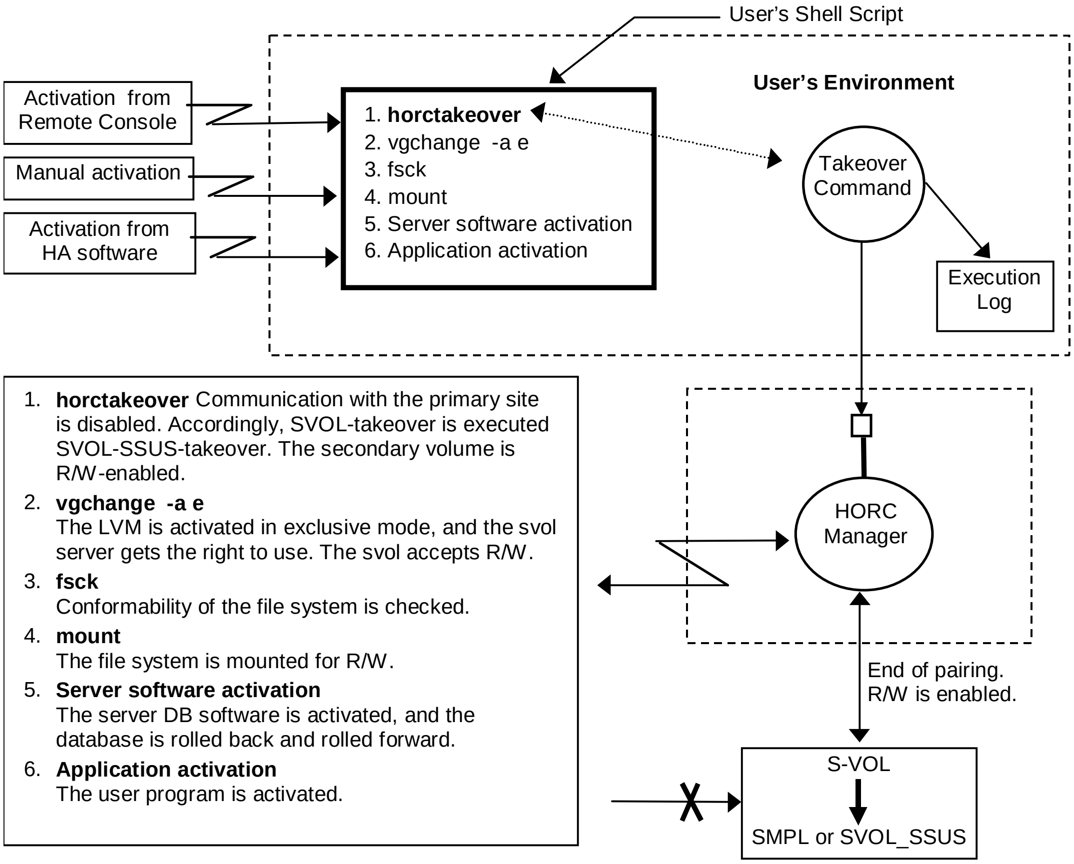
The PVOL-takeover function executes the following two commands:

- PVOL-PSUE-takeover: Changes the primary volume to the suspend (PSUE, PSUS) state which enables write I/Os to all primary volumes of the group. The action of the PVOL-PSUE-Takeover causes PSUE and/or PSUS to be intermingled in the group. This intermingled pair status is PSUE as the group status, therefore pairvolchk command returned give priority PSUE(PDUB) than PSUS as the group status. This special state turns back to the original state when the pairresync command is issued.
- PVOL-SMPL-takeover: Changes the primary volume to the simplex (SMPL) state. First, PVOL-takeover executes PVOL-PSUE-takeover further than PVOL-SMPL-takeover. If the PVOL-PSUE-takeover function fails, the PVOL-SMPL-takeover function is executed.

Note for Hitachi TrueCopy Async/UR: PVOL-Takeover will not be executed. It will be Nop-Takeover, since the fence level for TrueCopy Asynchronous is Async, which is the same as Never.

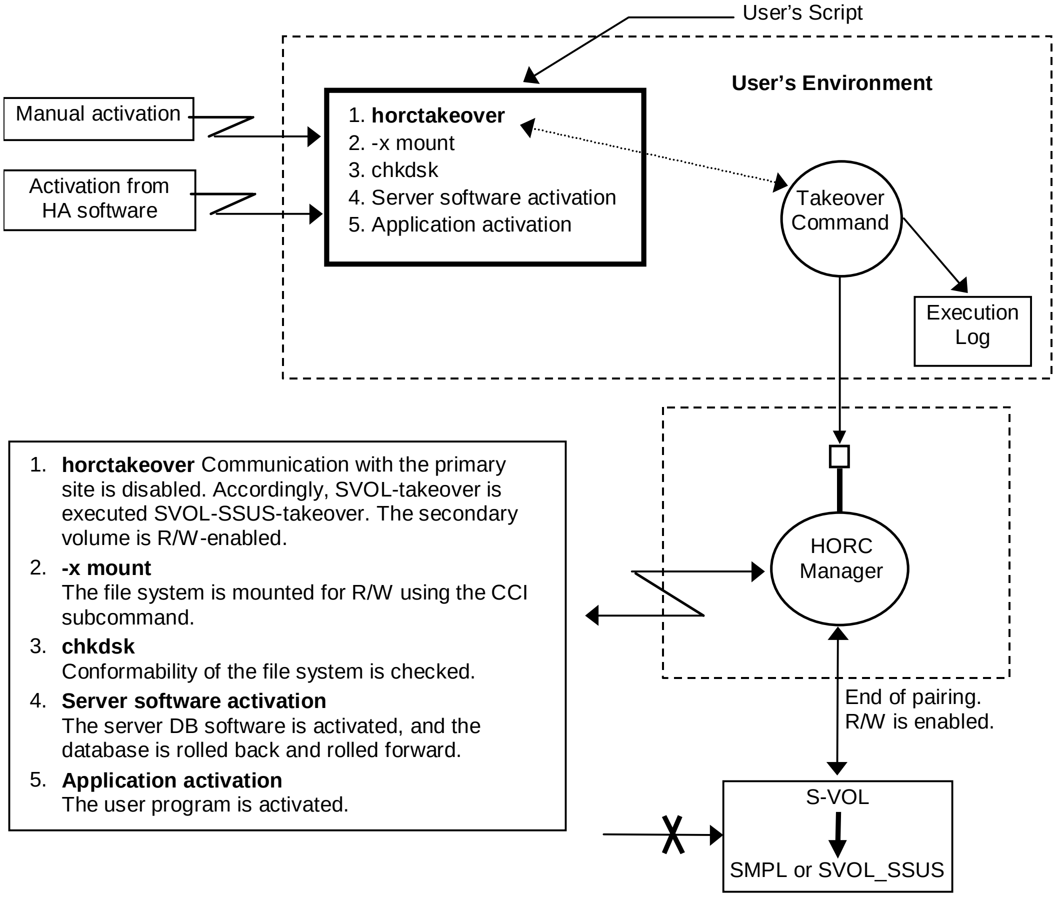
4.10.2 Applications of the Horctakeover Command

The basic Hitachi TrueCopy commands (takeover, pair creation, pair splitting, pair resynchronization, event waiting) can be combined to enable recovery from a disaster, backup of paired volumes, and many other operations (e.g., restoration of paired volumes based on the secondary volume, swapping of the paired volumes). Figure 4.25 illustrates the flow of starting operations on a UNIX server at the secondary site using the Hitachi TrueCopy horctakeover command. Figure 4.26 illustrates the flow of starting operations on a Windows server at the secondary site using the horctakeover command.



1. **horctakeover** Communication with the primary site is disabled. Accordingly, SVOL-takeover is executed SVOL-SSUS-takeover. The secondary volume is R/W-enabled.
2. **vgchange -a e**
   The LVM is activated in exclusive mode, and the svol server gets the right to use. The svol accepts R/W.
3. **fsck**
   Conformability of the file system is checked.
4. **mount**
   The file system is mounted for R/W.
5. **Server software activation**
   The server DB software is activated, and the database is rolled back and rolled forward.
6. **Application activation**
   The user program is activated.

Figure 4.25 Application/Example of TrueCopy Takeover (UNIX-based System)



1. **horctakeover** Communication with the primary site is disabled. Accordingly, SVOL-takeover is executed SVOL-SSUS-takeover. The secondary volume is R/W-enabled.
2. **-x mount**
   The file system is mounted for R/W using the CCI subcommand.
3. **chkdsk**
   Conformability of the file system is checked.
4. **Server software activation**
   The server DB software is activated, and the database is rolled back and rolled forward.
5. **Application activation**
   The user program is activated.

Figure 4.26 Application/Example of TrueCopy Takeover (Windows-based System)

4.11 Displaying Configuration Information

4.11.1 Raidscan Command

The **raidscan** command displays configuration and status information for the specified port/TID(s)/device(s). The information is acquired directly from the storage system (not the config. definition file). Table 4.24 lists and describes the **raidscan** command parameters. Figure 4.27 and Figure 4.28 provide examples of the **raidscan** command and its output.

Note: If Sync has failed, you need to confirm the following conditions:

- The logical and physical drives designated as the objects of the sync command are not opened to any applications. For example, confirm that Explore is not pointed on the target drive. If Explore is pointed on the target drive, the target drive will be opening.
- Sync command does not ignore the detected error on the NT file system, so sync executes successfully in normal case (NO ERROR case) only on NT file system. For example, confirm the target drive has no failure on the system for Event Viewer. In this case, you must reboot the system or delete the partition and reconfigure the target drive.

Table 4.24 Raidscan Command Parameters

Parameter	Value
Command Name	raidscan
Format	raidscan{ -h | -q | -z | -p <port> [hgrp]|-pd[g] <raw_device> |-s <Seq#> |-t <targ>| -l <lun> | [-f[xfgde]] | -CLI | -find[g] [op] [MU#] | -pi <strings> | -m <MU#> } }

Parameter	Value
Options	

-h: Displays Help/Usage and version information.

-q: Terminates the interactive mode and exits the command.

-z or **-zx** (OpenVMS cannot use the -zx option): Makes the **raidscan** command enter interactive mode. The **-zx** option guards performing of the HORCM in interactive mode. When this option detects a HORCM shut down, interactive mode terminates.

-I[H][M][instance#] or -I[TC][SI][instance#] Specifies the command as [HORC]/[HOMRCF], and used for specifying instance# of HORCM.

-p <port> [hgrp]: Specifies the port ID of the port to be scanned. Valid ports are CL1-A to CL1-R and CL2-A to CL2-R (excluding CL1-I, CL1-O, CL2-I, CL2-O)

For USP V/VM: CL3-a to CL3-r, or CLG-a to CLG-r for the expanded port.
For TagmaStore USP V/VM: CL3-a to CL3-r, or CLG-a to CLG-r for the expanded port.
For TagmaStore NSC: CL3-a to CL3-h, or CL8-a to CL8-h for the expanded port.
For 9900V: CL3-a to CL3-r, or CL4-a to CL4-r for the expanded port.

The port is not case sensitive (e.g. CL1-A= cl1-a= CL1-a= cl1-A, CL3-a= CL3-A= cl3-a= cl3-A).

This option must be specified if “-find” or “-pd <raw_device>“option will not be specified.

[hgrp] is specified to display only the LDEVs mapped to a host group on a port (9900V and later).

-pd[g] <raw_device>: Specifies the raw device name. This option finds Seq# and port_name of the storage system to which the specified device can be connected, and scans the port of the storage system which corresponds with the unit ID that searches the unit ID from Seq#. This option must be specified if the “-find” option will not be specified. If this option is specified, the following **-s <Seq#>** option is invalid.

-pdg option is used to show a LUN on the host view by finding a host group (9900V and later).

-s <Seq#>: Used to specify the Seq# (serial#) of the storage system when this option cannot specify the unit ID which is contained for “-p <port>“ option. This option scans the port specified by “-p <port>“ option of the storage system which corresponds with the unit ID that searches the unit ID from Seq#. If this option is specified, then the unit ID which is contained in “-p <port>“ option is invalid.

-t <targ>: Specifies a target ID (0 to 15) of the specified port. If this option is not specified, the command applies to all target IDs.

-l <lun>: Specifies a LUN (0 to 7) of the specified target ID. If this option is not specified, the command applies to all LUNs. If this option is specified, the TID must also be specified.

-f or **-ff**: Specifies display of volume-type for a display column. If this is specified, **-f[g] [d]** option is invalid.

-fx: Displays the LDEV number in hexadecimal notation.

-fg: Specifies display of group_name for a display column. This option searches a group on the configuration definition file (local CCI instance) from the scanned LDEV, and displays a group_name when the scanned LDEV is contained in the group. If this option is specified, the **-f[f]** option is not allowed and the **-f[d]** option is invalid.

-fd: Displays the Device_File that was registered to the group of the HORCM in the output, based on the LDEV (as defined in local instance config. def. file). If this option is specified, **-f[f][g]** option is not allowed.

-fe: Displays the serial# (**E-Seq#**) and LDEV# (**E-LDEV#**) of the external LUNs only mapped to the LDEV. If the external LUN mapped to the LDEV on a specified port does not exist, then this option will do nothing. Also if this option is specified, -f[f][g][d] option is not allowed. Display example:

```
# raidscan -p cl1-a-0 -fe -CLI
PORT# /ALPA/C TID#  LU# Seq#   Num  LDEV# P/S  Status Fence  E-Seq# E-LDEV#
CL1-A-0  ef  0   0   48 62468     2   256 SMPL     -      -  30053     17
CL1-A-0  ef  0   0   49 62468     2   272 SMPL     -      -  30053     23
CL1-A-0  ef  0   0   50 62468     1   288 SMPL     -      -  30053     28
```

-CLI: Specifies display for command line interface (CLI). This option displays to the same position that defined number of columns, and displays one header. The delimiters between columns are displayed as spaces or hyphens (-). Display example:

```
Port# TargetID# Lun#  Seq#  Num LDEV#  P/S    Status  Fence   P-Seq#  P-LDEV#
CL1-C     1       0   30053   1  274   SMPL      -       -        -       -
CL1-C     2       2   30053   1  260   P-VOL  PAIR    NEVER   30053      268
CL1-C     2       3   30053   1  261   P-VOL  PAIR    NEVER   30053      269
```

-m <MU#>: Displays only the cascading mirror specified by -m <MU#> option. To display the cascading mirror descriptor for UR, -m <MU#> must be specified in TrueCopy or ShadowImage command environment. If you want to display all cascading mirror descriptor, specify “-m all” for displaying all MUs.

-pi <strings>: Changes a strings via STDIN for -find option to “**<strings>**“. If this option is specified, the -find option will be ignored a raw device file provided via STDIN, and **<strings>** will be used as input. A **<strings>** must be specified within 255 characters.

-find [op] [MU#]: Executes the specified **[op]** using a raw device file provided via STDIN. If **-pi <strings>** option is specified, this option does not use a strings via STDIN, and **-pi <strings>** will be used as input.

```
# raidscan  -p  cl1-r
Port#,   TargetID#,  Lun#   Num(LDEV#...)   P/S,    Status,  Fence,  LDEV#,  P-Seq#  P-LDEV#
CL1-R,         15,     7     5(100,101...)   P-VOL   PAIR    NEVER   100,    5678    200
CL1-R,     15,         6    5(200,201...)   SMPL    ----     ----    ----    ----

# raidscan  -p  cl1-r  -f
Port#,   TargetID#,  Lun#   Num(LDEV#...)   P/S,    Status,  Fence,   LDEV#,   Vol.Type
CL1-R,     15,         7    5(100,101...)   P-VOL   PAIR     NEVER    100,     OPEN-3
CL1-R,     15,         6    5(200,201...)   SMPL    ----     ----     ----     OPEN-3

# raidscan  -pd  /dev/rdsk/c0t15/d7  -fg
Port#,   TargetID#,  Lun#   Num(LDEV#...)   P/S,    Status,  Fence,   LDEV#,   Group
CL1-R,     15,         7    5(100,101...)   P-VOL   PAIR     NEVER    100,     oradb
CL1-R,     15,         6    5(200,201...)   SMPL    ----     ----     ----     oradb1
Specified device is LDEV# 0100.
```

Figure 4.27 Raidscan Command Examples for SCSI Ports

```
# raidscan  -p  cl1-r
PORT#/ALPA/C,    TID#,  LU#   Num(LDEV#...)   P/S,   Status,  Fence,  LDEV#,  P-Seq#  P-LDEV#
CL1-R/  ce/15,   15,     7     5(100,101..)   P-VOL  PAIR     NEVER   100,    5678      200
CL1-R/  ce/15,   15,     6     5(200,201..)   SMPL   ----     ----    ----    ----     -----

# raidscan  -p  cl1-r  -f
PORT#/ALPA/C,    TID#,  LU#   Num(LDEV#...)   P/S,   Status,  Fence,   LDEV#,   Vol.Type
CL1-R/  ce/15,   15,     7     5(100,101..)   P-VOL  PAIR     NEVER    100,     OPEN-3
CL1-R/  ce/15,   15,     6     5(200,201..)   SMPL   ----     ----     ----     OPEN-3
```

Figure 4.28 Raidscan Command Examples for Fibre-Channel Ports

```
# ls /dev/rdsk/* | raidscan -find
DEVICE_FILE     UID  S/F PORT    TARG  LUN    SERIAL  LDEV  PRODUCT_ID
/dev/rdsk/c0t0d4  0   S  CL1-M     0    4      31168   216  OPEN-3-CVS-CM
/dev/rdsk/c0t0d1  0   S  CL1-M     0    1      31168   117  OPEN-3-CVS
/dev/rdsk/c1t0d1  -   -  CL1-M     -    -      31170   121  OPEN-3-CVS
```

Figure 4.29 Example of -find Option for Raidscan

Output of the **raidscan** command:

- SCSI: **Port#, TargetID#, Lun#** = port ID, TID, and LU number (LUN)
- Fibre: **Port#, ALPA/C, TID#, LU#** = port ID, arbitrated loop phys. address, TID, LUN. For further information on fibre-to-SCSI address conversion, see Appendix C.

  Note: For ShadowImage, **raidscan** displays MU# for each LUN (e.g., LUN 7-0, 7-1, 7-2).
- **Num(LDEV#…)** = number of LDEVs and LDEV ID for the LUSE volume
- **P/S** = volume attribute
- **Status** = status of the paired volume
- **Fence** (TrueCopy only) = fence level
- **P-Seq#** = serial # of the storage system which contains the partner volume of the pair
- **P-LDEV#** = LDEV number of the partner volume of the pair

- **Vol.Type** = logical unit (LU) type (e.g., OPEN-V, OPEN-9)

- **Group** = group name (dev_group) as described in the configuration definition file
- **UID**: Displays the unit ID for multiple storage system configuration. If UID is displayed as '-', the command device for HORCM_CMD is not found.
- **S/F**: Displays whether a PORT is SCSI or fibre
- **PORT**: Displays the RAID storage system port number
- **TARG**: Displays the target ID (**which was converted by the fibre conversion table**)
- **LUN**: Displays the LUN (**which was converted by the fibre conversion table**)
- **SERIAL:** Displays the production (serial#) number of the RAID storage system
- **LDEV**: Displays the LDEV# within the RAID storage system
- **PRODUCT_ID**: Displays product-id field in the STD inquiry page

4.11.2 Raidar Command

The **raidar** command displays configuration, status, and I/O activity information for the specified port/TID(s)/device(s) at the specified time interval. The configuration information is acquired directly from the storage system (not from the configuration definition file). Table 4.25 lists and describes the **raidar** command parameters. Figure 4.30 shows an example of the **raidar** command and its output.

Note: The I/O activity of a TrueCopy S-VOL in the COPY or PAIR state includes TrueCopy remote I/Os (update copy operations) in addition to host-requested I/Os. The I/O activity of a ShadowImage S-VOL in the COPY or PAIR state includes only host-requested I/Os (ShadowImage update copy operations are excluded). The I/O activity of a P-VOL or simplex volume includes only host-requested I/Os. If state changed into SMPL in S-VOL (COPY, PAIR) I/O actively, and then I/O activity of the between is reported in the SMPL state.

Table 4.25 Raidar Command Parameters

Parameter	Value
Command Name	raidar
Format	raidar { -h | -q | -z | -p <port> <targ> <lun> | -pd[g] <raw_device | -s [interval] [count] }
Options	-h: Displays Help/Usage and version information. -q: Terminates the interactive mode and exits the command. -z or -zx (OpenVMS cannot use the -zx option): Makes raidar command enter interactive mode. The -zx option guards performing of the HORCM in the interactive mode. When this option detects a HORCM shutdown, interactive mode terminates. -I[H][M][instance#] or -I[TC][SI][instance#] Specifies the command as [HORC]/[HOMRCF], and used for specifying instance# of HORCM. -p <port> <targ> <lun> [mun]....: Monitors one or more (up to 16) devices at a time. <port>: Specifies the port to be reported: CL1-A to CL1-R and CL2-A to CL2-R (excluding CL1-I, CL1-O, CL2-I, CL2-O). For USP V/VM: CL3-a to CL3-r, or CLG-a to CLG-r for the expanded port. For TagmaStore USP V/VM: CL3-a to CL3-r, or CLG-a to CLG-r for the expanded port. For TagmaStore NSC: CL3-a to CL3-h, or CL8-a to CL8-h for the expanded port. For 9900V: CL3-a to CL3-r, or CL4-a to CL4-r for the expanded port. The port is not case sensitive (e.g. CL1-A= cl1-a= CL1-a= cl1-A, CL3-a= CL3-A= cl3-a= cl3-A). <targ>: Specifies the SCSI TID (0 to 15) of the specified port (see Appendix C for fibre address conversion information). <lun>: Specifies the LUN (0 to 7) on the specified TID. [mun]: Specifies the MU number of the specified LUN (ShadowImage only). -pd[g] <raw_device>: Allows designation of an LDEV by raw device file name. -pdg option is used to show a LUN on the host view by finding a host group (9900V and later). -s [interval] or -sm [interval]: Designates the time interval in seconds. -s: Interprets the time interval as seconds. -sm: Interprets the time interval as minutes. [interval]: Designates the time interval value (1 to 60). If not specified, the default interval (3) is used. [count]: Designates number of repeats. When omitted, this command repeats until CNTL-C.

```
# raidar -p cl1-a  15 6   -p cl1-b  14 5   -p cl1-a  12 3    -s 3
TIME[03]    PORT    T    L    VOL     STATUS   IOPS     HIT(%)   W(%)    IOCNT
13:45:25    -       -    -    -       -        -        -        -       -
13:45:28    CL1-A   15   6    SMPL    ---      200.0    80.0     40.0    600
            CL1-B   14   5    P-VOL   PAIR     133.3    35.0     13.4    400
            CL1-A   12   3    P-VOL   PSUS     200.0    35.0     40.6    600
```

Figure 4.30 Raidar Command Example

Output of the **raidar** command:

- **IOPS** = # of I/Os (read/write) per second (total I/O rate).
- **HIT(%)** = Hit rate for read I/Os (read hit rate).
- **W(%)** = Ratio of write I/Os to total I/Os (percent writes).
- **IOCNT** = number of write and read I/Os.

4.11.3 Raidqry Command

The **raidqry** command (RAID query) displays the configuration of the connected host and RAID storage system. Figure 4.31 shows an example of the **raidqry** command and its output. Table 4.26 lists and describes the **raidqry** command parameters.

```
# raidqry -l
No Group   Hostname    HORCM_ver    Uid  Serial#     Micro_ver    Cache(MB)
 1 ---     HOSTA       01-22-03/02   0   30053     50-04-00/00         256
 1 ---     HOSTA       01-22-03/02   1   30054     50-04-00/00         256

# raidqry -r oradb
No Group   Hostname    HORCM_ver    Uid  Serial#     Micro_ver    Cache(MB)
 1 oradb   HOSTA       01-22-03/02   0   30053     50-04-00/00         256
 2 oradb   HOSTB       01-22-03/02   0   30053     50-04-00/00         256
 1 oradb   HOSTA       01-22-03/02   1   30054     50-04-00/00         256
 2 oradb   HOSTB       01-22-03/02   1   30054     50-04-00/00         256

# raidqry -l  -f
No Group   Floatable Host  HORCM_ver    Uid  Serial#    Micro_ver   Cache(MB)
 1 ---     FH001          01-22-03/02    0   30053    50-04-00/00        256
```

Figure 4.31 Raidqry Command Examples

Output of the **raidqry** command:

- **No**: This column shows the order when the group name (dev_group) which is described in the configuration definition file has multiple remote hosts.
- **Group**: When the **-r** option is used, this column shows the group name (dev_group) which is described in the configuration definition file.
- **Floatable Host**: When the **-f** option is used, this column shows the host name (ip_address) which is described in the configuration definition file. Up to 30 host names can be displayed. The **-f** option interprets the host name as utilizing floatable IP for a host.
- **HORCM_ver**: This column shows the version of the HORC Manager on the local or remote host. The **-l** option specifies local host. The **-r** option specifies remote host.
- **Uid Serial# Micro_ver**: This column shows unitID, serial number, and (DKCMAIN) microcode version of the storage system which is connected to the local or remote host. The **-l** option specifies local host. The **-r** option specifies remote host.
- **Cache(MB)**: Shows the logical cache capacity (in MB) of the storage system connected to the local or remote host. The **-l** option specifies local host, and **-r** specifies remote host.

Table 4.26 Raidqry Command Parameters

Parameter	Value
Command Name	raidqry
Format	raidqry { -h │ -q │ -z │ -l │ -r <group> │ [-f] │ -g}
Options	**-h**: Displays Help/Usage and version information. **-q**: Terminates the interactive mode and exits the command. **-z** or **-zx** (OpenVMS cannot use the -zx option): Makes the **raidqry** command enter the interactive mode. The -zx option guards performing of the HORCM in the interactive mode. When this option detects a HORCM shut down, interactive mode terminates. **-I[H][M][instance#] or -I[TC][SI][instance#]** Specifies the command as [HORC]/[HOMRCF], and used for specifying instance# of HORCM. **-l**: Displays the configuration information for the local host and the local RAID storage system. **-r <group>**: Displays the configuration information for the remote host and the remote storage system which contains the specified group. **-f**: Displays the hostname (ip_address) as specified in the configuration definition file. Use this option if "floatable IP address" is used for the hostname (ip_address) in the configuration file. **-g** This option is used for displaying the lists of group name (dev_group) which described in the configuration file of a local host (instance).

```
# raidqry -g
GNo  Group           RAID_type   IV/H  IV/M  MUN/H  MUN/M
  1  ora             HTC_RAID      12     9      4     64
  2  orb             XP_RAID       12     9      4     64
  3  orc             HTC_DF         8     6      1      1
```

- GNo: shows as order when the group name (dev_group) which described in the configuration definition file.
- Group shows the group name (dev_group) which described in the configuration definition file.
- RAID_type shows the type of RAID configured a group.
- IV/H:shows the interface version for HORC that made the consistence in a group, this is used for the maintenance.
- IV/M: shows the interface version for HOMRCF that made the consistence in a group, this is used for the maintenance.
- MUN/H: shows the number of maximum MUs for HORC/UR that made the consistence in a group.
- MUN/M: shows the number of maximum MUs for HOMRCF that made the consistence in a group.

4.12 Performing Data Protection Operations

CCI supports the following three commands to set and verify the parameters for protection checking (Data Retention Utility, Database Validator) to each LU. The protection checking functions are available on the USP V/VM, USP/NSC, and Lightning 9900V (not 9900).

- **raidvchkset** (see section 4.12.1)
- **raidvchkdsp** (see section 4.12.2)
- **raidvchkscan** (see section 4.12.3)

For further information on Data Protection Operations, see section 2.7.

4.12.1 Raidvchkset Command

The **raidvchkset** command sets the parameters for validation checking of the specified volumes, and can also be used to turn off all validation checking without specifying [type]. Unit of checking for the validation is based on the group of CCI configuration definition file. Figure 4.32 shows examples of the **raidvchkset** command. Table 4.27 lists and describes the **raidvchkset** command parameters.

Note: This command will be controlled as protection facility. This command will be rejected with EX_ERPERM by connectivity checking between CCI and the RAID storage system.

```
raidvchkset -g oralog -vt redo8
                    ↖ Sets volumes in oralog group as redolog file prior to Oracle9I.

raidvchkset -g oradat -vt data8 -vs 16
           ↖ Sets volumes in oradat group as data file that Oracle block size is 8KB.

raidvchkset -g oradat -vt data8 -vs 32
          ↖ Sets volumes in oradat group as data file that Oracle block size is 16KB.

raidvchkset -g oralog -vt        ← Releases all checking to volumes in oralog group.

raidvchkset –g oralog –vt rd10g  ← Sets Oracle10g volumes for oralog group as redolog file

raidvchkset –g oradat –vt rd10g –vs 16   ← Sets Oracle10g volumes for oradat group as data
                                             file with block size of 8KB.

raidvchkset -g oralog -vg wtd          ← Disables writing to volumes in oralog group.

raidvchkset -g oralog -vg wtd 365
               ↖ Disables writing and sets retention time to volumes in oralog group.

raidvchkset -g oralog -vg        ← Releases all guarding to volumes in oralog group.
```

Figure 4.32 Raidvchkset Command Examples

Table 4.27 Raidvchkset Command Parameters

Parameter	Value
Command Name	raidvchkset
Format	raidvchkset { -h │ -q │ -z │ -g <group> │ -d <pair Vol> -d[g] <raw_device> [MU#] │ -d[g] <seq#> <LDEV#> [MU#] │ -nomsg │ -vt [type] │ -vs < bsize> [slba] [elba] │ -vg [type] [rtime] }
Options	**-h**: Displays Help/Usage and version information. **-q**: Terminates the interactive mode and exits the command. **-z** or **-zx** (OpenVMS cannot use the -zx option): Makes the **raidvchkset** command enter the interactive mode. The **-zx** option guards performing of the HORCM in the interactive mode. When this option detects a HORCM shut down, interactive mode terminates. **-I[H][M][instance#] or -I[TC][SI][instance#]** Specifies the command as [HORC]/[HOMRCF], and used for specifying instance# of HORCM. **-g <group>**: Specifies a group name written in the configuration definition file. **-d <pair Vol>**: Specifies paired logical volume name defined in the configuration definition file. When this option is specified, the command is executed for the specified paired logical volume. **-d[g] <raw_device> [MU#]**: Searches a group on the configuration definition file (local instance) for the specified raw_device, and if the specified raw_device is contained in the group, the target volume is executed as the paired logical volume (-d) or group (-dg). This option is effective without specification of "-g <group>" option. If the specified the raw_device is contained in two or more groups, the command is executed on the first group. **-d[g] <seq#> <LDEV#> [MU#]**: Searches a group on the configuration definition file (local instance) for the specified LDEV, and if the specified LDEV is in the group, the target volume is executed as the paired logical volume (-d) or group (-dg). This option is effective without specification of "-g <group>" option. If the specified LDEV is contained in two or more groups, the command is executed on the first group. The **<seq #> <LDEV #>** values can be specified in hexadecimal (by addition of "0x ") or decimal notation. **-nomsg**: Suppresses messages to be displayed when this command is executed. It is used to execute this command from a user program. **This option must be specified at the beginning of a command argument.** The command execution log is not affected by this option. **-vt [type]**: Specifies the following data type that assumes the target volumes as Oracle database. If **[type]** is not specified, then this option will disable all of the checking. **redo8**: The target volumes sets the parameter for validation checking as Oracle redo log files (including archive logs) prior Oracle9I. This option sets <bsize> to 1(512bytes) or 2(1024bytes). **data8**: The target volumes sets the parameter for validation checking as Oracle data files (including control files) prior Oracle9I. **redo9**: The target volumes sets the parameter for validation checking as Oracle redo log files (including archive logs) for Oracle9IR2 or later. This option sets <bsize> to 1 (512 bytes) or 2 (1024 bytes). **data9**: The target volumes sets the parameter for validation checking as Oracle data files (including control files) for Oracle9IR2 later. In case of Oracle for Tru64 or Windows, the user must set the parameter in the **init.ora** file to "_HARD_PROTECTION = TRUE ". If not so, a parameter for validation must be changed by using the following "-vmf we" option: **raidvchkset -vt data9 -vmf we** **rd10g :** The target volumes sets the parameter for validation checking as Oracle ALL files (including redo and data and RMAN backup piece) for Oracle10gR2 or later. This option sets <bsize> to 1(512bytes) or 2(1024bytes). This option sets to the low 5 bits DBA for checking regarding CHK-F2. **-vs <bsize> [slba] [elba]**: Specifies the data block size of Oracle I/O and a region on a target volume for validation checking. **<bsize>** is used for specifying the data block size of Oracle I/O, in units of 512 bytes. <bsize> is able to specify between 1 (512 bytes) and 64 (32 Kbytes) (effective size for Oracle is also 1-64). **[slba] [elba]** is used for specifying a region defined between Start_LBA (0 based) and End_LBA on a target volume for checking, in units of 512 bytes. **[slba] [elba]** can be specified in hexadecimal (by addition of "0x ") or decimal notation. If this option is not specified, then a region for a target volume is set as all blocks (slba=0,elba=0).

Parameter	Value
	-vg [type]: Specifies the following guard type to the target volumes for Data Retention Utility (Open LDEV Guard on 9900V). If **[type]** is not specified, this option will disable all of the guarding. **inv**: The target volumes are concealed from SCSI Inquiry command by responding “unpopulated volume”. **sz0**: The target volumes replies with “SIZE 0” through SCSI Read capacity command. **rwd**: The target volumes are disabled from reading and writing. **wtd**: The target volumes are disabled from writing. **svd**: If the target volume is SMPL, it is protected from paircreate (from becoming an SVOL). If the target volume is PVOL, it is protected from pairresync restore or pairresync swaps(p). If the target volume is SVOL_PSUS(SSUS), it is protected from pairresync synchronous copy. **[rtime]**: Specifies the retention time, in units of day. If [rtime] is not specified, the default time defined by the storage system will be used. The default time is “zero” in 9900V microcode version 21-08-xx. This option is ignored (default = infinite) in 9900V microcode version 21-06-xx or 21-07-xx. This option sets each four flags for guarding type as follows: **type** INQ RCAP READ WRITE **inv** 1 1 1 1 **Sz0** 0 1 1 1 **rwd** 0 0 1 1 **wtd** 0 0 0 1
Returned values	The command sets either of the following returned values in exit(), which allows users to check the execution results using a user program. Normal termination: 0 Abnormal termination: The **raidvchkset -vg** option command returns the following error code (see Table 4.28 below) as well as generic error (refer to Table 5.3).

Table 4.28 Specific Error Code for raidvchkset -vg Option

Category	Error Code	Error Message	Recommended Action	Value
Volume Status Unrecoverable	EX_EPRORT	Mode changes denied due to retention time	Please confirm the retention time for a target volume by using **raidvchkscan -v gflag** command.	208

Setting for Oracle H.A.R.D

Oracle 10g supports ASM (Automated Storage Manager), so users must change the setting according to the use of this ASM. The USP V/VM and TagmaStore USP/NSC support the setting for Oracle 10g. Table 4.29 shows the related CCI command settings.

Table 4.29 **Setting H.A.R.D for USP V/VM and TagmaStore USP/NSC**

	Oracle			
Storage System	Version	CHKDBA	ASM	Setting Parameter
TagmaStore USP/NSC	9iR2	Disable		Same as current setting
		Enable		`-vt redo9/data9 –vbf we bne` VM=9 is fixed
	10gR2	Disable	unused	`-vt rd10g`
			used	`-vt rd10g –vbf` (disable Block# check)
		Enable	unused	Impossible (Due to be fixed as VM=9)
			used	Impossible (Due to be fixed as VM=9)
USP V/VM	9iR2	Disable		Same as current setting
		Enable		`-vt redo9/data9 -vbf we bne` VM=9 is Val.
	10gR2	Disable	unused	`-vt rd10g`
			used	`-vt rd10g –vbf we nzd`
		Enable	unused	`-vt rd10g –vbf we bne` VM=5 is Val.
			used	`-vt rd10g –vbf we bne nzd` VM=5 is Val.

4.12.2 Raidvchkdsp Command

The **raidvchkdsp** command displays the parameters for validation checking of the specified volumes. Unit of checking for the validation is based on the group of CCI configuration definition file. Table 4.30 lists and describes the **raidvchkdsp** command parameters. Figure 4.34 - Figure 4.36 show examples of the **raidvchkdsp** command.

Note: This command will be controlled as protection facility. Non-permitted volume is shown without LDEV# information (LDEV# information is “ – ”). This command will be rejected with EX_ERPERM by connectivity checking between CCI and the storage system.

Table 4.30 Raidvchkdsp Command Parameters

Parameter	Value
Command Name	raidvchkdsp
Format	raidvchkdsp { -h ∣ -q ∣ -z ∣ -g <group> ∣ -d <pair Vol> -d[g] <raw_device> [MU#] ∣ -d[g] <seq#> <LDEV#> [MU#] ∣ -f[xde] ∣ -v <op> ∣ -c }

Parameter	Value
Options	**-h**: Displays Help/Usage and version information. **-q**: Terminates the interactive mode and exits the command. **-z** or **-zx** (OpenVMS cannot use the -zx option): Makes the **raidvchkdsp** command enter the interactive mode. The **-zx** option guards performing of the HORCM in the interactive mode. When this option detects a HORCM shut down, interactive mode terminates. **-I[H][M][instance#] or -I[TC][SI][instance#]** Specifies the command as [HORC]/[HOMRCF], and used for specifying instance# of HORCM. **-g <group>**: Specifies a group name written in the configuration definition file. **-d <pair Vol>**: Specifies paired logical volume name defined in the configuration definition file. When this option is specified, the command is executed for the specified paired logical volume. **-d[g] <raw_device> [MU#]**: Searches a group on the configuration definition file (local instance) for the specified raw_device, and if the specified raw_device is contained in the group, the target volume is executed as the paired logical volume (-d) or group (-dg). This option is effective without specification of “-g <group>“ option. If the specified the raw_device is contained in two or more groups, the command is executed on the first group. **-d[g] <seq#> <LDEV#> [MU#]**: Searches a group on the configuration definition file (local instance) for the specified LDEV, and if the specified LDEV is in the group, the target volume is executed as the paired logical volume (-d) or group (-dg). This option is effective without specification of “-g <group>“ option. If the specified LDEV is contained in two or more groups, the command is executed on the first group. The **<seq #> <LDEV #>** values can be specified in hexadecimal (by addition of “0x “) or decimal notation. **-fx**: Displays the LDEV/STLBA/ENLBA number in hexadecimal. **-fd**: Displays the relation between the Device_File and the paired Volumes, based on the Group (as defined in the local instance configuration definition file). If Device_File column shows “Unknown” to HOST (instance) (Figure 4.33), then the volume is not recognized on own HOST, and **raidvchkdsp** command will be rejected in protection mode. Non-permitted volume is shown without LDEV# information (LDEV# is “– ”). **-fe**: Displays the serial# and LDEV# of the external LUNs mapped to the LDEV for the target volume (Figure 4.33) by adding to last column (ignores the format of 80 column). **-c**: When RAID Manager starts, **HORCM_DEV** in horcm.conf will be translated from Port/target/lun numbers to the CU:Ldev information, on one hand **HORCM_LDEV** in horcm.conf will be translated from the CU:Ldev information to Port/target/lun numbers, because RAID needs to specify "Port#, Targ#, Lun#" and “LDEV” for specifying the target device, and then HORCM keeps this information as internal database for the configuration. If a storage administrator changes the LDEV to LUN/port mapping, such as ▪ a new/different LDEV is mapped to a previously used port/LUN, or ▪ an LDEV is mapped to a different/new port then pair operations might be rejected because the new mapping is different from the mapping information the database in the running HORCM instance. A pairdisplay command shows the real LDEV mapping at the time of the command execution and hence shows different information than what is stored in the internal database of the HORCM instance. The “-c” option for **raidvchkdsp** allows the user to see if there is a difference between the current running HORCM instance information and the real mapping. This indication should be used to find such issues which indicate that: ▪ the HORCM instance should be restarted to discover and use the new mapping information, or ▪ a configuration change occurred without changing the affected configuration files of the HORCM instance. Example change from LDEV#785 to LDEV#786:

```
# raidvchkdsp -g VG000 -c
Group  PairVol  Port#   TID LU  Seq#  LDEV#   LDEV#(conf) -change->  LDEV#
VG000  vg0001   CL4-E-0  0  17  63528   786     785(conf) -change->    786
# raidvchkdsp -g VG000 -c -fx
Group  PairVol  Port#   TID LU  Seq#  LDEV#   LDEV#(conf) -change->  LDEV#
VG000  vg0001   CL4-E-0  0  17  63528   312     311(conf) -change->    312
```

Example remove LDEV#785 from a port:

```
# raidvchkdsp -g VG000 -c
Group  PairVol  Port#   TID LU  Seq#  LDEV#   LDEV#(conf) -change->   LDEV#
VG000  vg0001   CL4-E-0  0  17  63528    -     785(conf) -change-> NO LDEV
# raidvchkdsp -g VG000 -c -fx
Group  PairVol  Port#   TID LU  Seq#  LDEV#   LDEV#(conf) -change->   LDEV#
VG000  vg0001   CL4-E-0  0  17  63528    -     311(conf) -change-> NO LDEV
```

```
raidvchkdsp -g vg01 -fd -v cflag         ← Example of -fd option showing Unknown vol.
Group   PairVol Device_File    Seq# LDEV#  BR-W-E-E  MR-W-B  BR-W-B  SR-W-B-S
vg01    oradb1  Unknown        2332    -    - - - -   - - -   - - -   - - - -
vg01    oradb2  c4t0d3         2332    3    D E B R   D D D   D E E   D E D D

# raidvchkdsp -g horc0 -v gflag -fe                          ← Example of -fe option.
Group ... TID  LU  Seq# LDEV# GI-C-R-W-S  PI-C-R-W-S  R-Time  EM  E-Seq#  E-LDEV#
horc0 ...  0   20 63528    65  E E E E E   E E E E E       0   -       -        -
horc0 ...  0   20 63528    66  E E E E E   E E E E E       0   -       -        -
```

Figure 4.33 Raidvchkdsp Command Examples with -fd and -fe Options

Output of the **raidqvchkdsp** command with **-fe** option:

- **EM**: This column displays the external connection mode.

  H = Mapped E-lun is hidden from the host.
  V = Mapped E-lun is visible to the host.
  —= Unmapped to the E-lun.
  BH = Mapped E-lun as hidden from the host, but LDEV blockading.
  BV = Mapped E-lun as visible to the host, but LDEV blockading.
  B = Unmapped to the E-lun, but LDEV blockading.

- **E-Seq#**: This column displays the production (serial) number of the external LUN (‘Unknown’ shown as ‘-’).
- **E-LDEV#**: This column displays the LDEV# of the external LUN (‘Unknown’ shown as ‘-’).

```
raidvchkdsp -g vg01 -fd -v cflag
Group   PairVol Device_File    Seq# LDEV# BR-W-E-E  MR-W-B  BR-W-B-Z  SR-W-B-S
vg01    oradb1  c4t0d2         2332    2    D E B R   D D D   D E E E  D E D D
vg01    oradb2  c4t0d3         2332    3    D E B R   D D D   D E E E  D E D D
```

Figure 4.34 Raidvchkdsp Command Example with -v cflag Option

Output of the **raidqvchkdsp** command with **-v cflag** option:

- **BR-W-E-E**: This column displays the flags for checking regarding data block size.

  R = E: Checking for data block size on Read is enabled.
  D: Checking for data block size on Read is disabled.
  W = E: Checking for data block size on Write is enabled.
  D: Checking for data block size on Write is disabled.
  E = L: Data block on Read/Write is interpreted as little endian format.
  B: Data block on Read/Write is interpreted as big endian format.
  E = W: Warning that Read/Write is not rejected when validation error is detected.
  C: Read/Write is rejected when validation error is detected.

- **MR-W-B**: This column displays the flags for checking regarding CHK-F3 in the data block.

  R = E: Checking for CHK-F3 on Read is enabled.
  D: Checking for CHK-F3 on Read is disabled.
  W = E: Checking for CHK-F3 on Write is enabled.
  D: Checking for CHK-F3 on Write is disabled.
  B = E: Checking for CHK-F3 in the data block #0 is enabled.
  D: Checking for CHK-F3 in the data block #0 is disabled.

- **BR-W-B-Z**: This column displays the flags for checking regarding CHK-F2 in the data block.

  R = E: Checking for CHK-F2 on Read is enabled.
  D: Checking for CHK-F2 on Read is disabled.
  W = E: Checking for CHK-F2 on Write is enabled.
  D: Checking for CHK-F2 on Write is disabled.
  B = E: Comparing for CHK-F2 in the data block is enabled.
  D: Comparing for CHK-F2 in the data block is disabled.
  Z = E: The NON zero checking for CHK-F2 in the data block shows to being enabled.
  D: The NON zero checking for CHK-F2 in the data block shows to being disabled.

- **SR-W-B-S**: Displays the flags for checking regarding CHK-F1 in the data block.

  R = E: Checking for CHK-F1 on Read is enabled.
  D: Checking for CHK-F1 on Read is disabled.
  W = E: Checking for CHK-F1 on Write is enabled.
  D: Checking for CHK-F1 on Write is disabled.
  B = E: Checking for CHK-F1 in the data block #0 is enabled.
  D: Checking for CHK-F1 in the data block #0 is disabled.
  S = E: Referring for CHK-F1 flag contained in the data block is enabled.
  D: Referring for CHK-F1 flag contained in the data block is disabled.

```
# raidvchkdsp -g vg01 -fd -v offset                   ← Example of -v offset option.
Group   PairVol Device_File    Seq# LDEV# Bsize        STLBA         ENLBA BNM
vg01    oradb1  c4t0d2         2332    2   1024            1        102400   9
vg01    oradb2  c4t0d3         2332    3   1024            1        102400   9
```

Figure 4.35 Raidvchkdsp Command Example with -v offset Option

Output of the **raidqvchkdsp** command with **-v offset** option:

- **Bsize**: This column displays the data block size of Oracle I/O, in units of bytes.
- **STLBA**: Displays the start of LBA on a target volume for checking, in units of 512 bytes.
- **ENLBA**: Displays the end of LBA on a target volume for checking, in units of 512 bytes.

  Note: If **STLBA** and **ENLBA** are both zero, this means to check all blocks.
- **BNM**: Displays the number of bits for checking regarding CHK-F2, in units of bits.
  If **BNM** is zero, this means the checking for CHK-F2 will be disabled.

```
# raidvchkdsp -g vg01 -fd -v errcnt                   ← Example of -v errcnt option.
Group   PairVol Device_File    Seq# LDEV#    CfEC      MNEC      SCEC      BNEC
vg01    oradb1  c4t0d2         2332    2        0         0         0         0
vg01    oradb2  c4t0d3         2332    3        0         0         0         0
```

Figure 4.36 Raidvchkdsp Command Example with -v errcnt Option

Output of the **raidqvchkdsp** command with **-v errcnt** option:

- **CfEC**: This column displays the error counter for checking of block size validation.
- **MNEC**: Displays the error counter for checking of CHK-F3 validation.
- **SCEC**: Displays the error counter for checking of CHK-F1 validation.
- **BNEC**: Displays the error counter for checking of CHK-F2 validation.

```
# raidvchkdsp -g vg01 -fd -v gflag                     ← Example of -v gflag option.
Group   PairVol Device_File    Seq# LDEV#  GI-C-R-W-S  PI-C-R-W-S R-Time
vg01    oradb1  c4t0d2         2332    2    E E D D E   E E D D E    365
vg01    oradb2  c4t0d3         2332    3    E E D D E   E E D D E      -
```

Figure 4.37 Raidvchkdsp Command Example with -v gflag Option

Output of the **raidqvchkdsp** command with **-v gflag** option:

- **GI-C-R-W-S**: This displays the flags for guarding as for the target volume.

  I → E: Enabled for Inquiry command.
  D: Disabled for Inquiry command.
  C → E: Enabled for Read Capacity command.
  D: Disabled for Read Capacity command.
  R → E: Enabled for Read command.
  D: Disabled for Read command.
  W→ E: Enabled for Write command.
  D: Disabled for Write command.
  S→ E: Enabled for becoming the SVOL.
  D: Disabled for becoming the SVOL.

- **PI-C-R-W-S**: This displays the permission flags that show whether each mode flag can be changed to enable or not.

  I → E: ”I” flag can be changed to enable.
  D: ”I” flag cannot be changed to enable.
  C → E: ”C” flag can be changed to enable.
  D: ”C” flag cannot be changed to enable.
  R → E: ”R” flag can be changed to enable.
  D: ”R” flag cannot be changed to enable.
  W→ E: ”W” flag can be changed to enable.
  D: ”W” flag cannot be changed to enable.
  S→ E: ”S” flag can be changed to enable.
  D: ”S” flag cannot be changed to enable.

- **R-Time**: This displays the retention time for write protect, in units of day. The hyphen (-) shows that the retention time is infinite. APP will be able to know whether the target volume is denied to change to writing enable by referring “R-Time”.

  Audit lock status is shown as the retention time plus 1000000.
  “R-Time + 1000000” shows the retention time with Audit lock status.

```
raidvchkdsp -g vg01 -v pool
Group   PairVol   Port#  TID LU  Seq# LDEV#  Bsize     Available      Capacity
Vg01    oradb1    CL2-D    2   7 62500  167    2048        100000    1000000000
Vg01    oradb2    CL2-D    2  10 62500  170    2048        100000    1000000000
```

Figure 4.38 Raidvchkdsp Command Example with -v pool Option

Output of the **raidqvchkdsp** command with **-v pool** option:

- **Bsize**: This displays the data block size of the pool, in units of block (512bytes).
- **Available(Bsize)**: This displays the available capacity for the volume data on the SnapShot pool in units of Bsize.
- **Capacity(Bsize)**: This displays the total capacity in the SnapShot pool in units of Bsize.

```
[Display example]
# raidvchkdsp -v aou -g AOU
Group   PairVol   Port# TID  LU   Seq# LDEV#  Used(MB) LU_CAP(MB) U(%) T(%) PID
AOU     AOU_001  CL2-D    2   7  62500   167    20050    1100000   10   70    1
AOU     AOU_002  CL2-D    2  10  62500   170   110000    1100000   10   70    1
```

Figure 4.39 Raidvchkdsp Command Example with -v aou Option

Output of the **raidqvchkdsp** command with **-v aou** option:

- **Used(MB)**: Displays the usage size of the allocated block on this LUN.
  Range: 0 ≤ Used (MB) < LU_CAP(MB) + 42MB
- **LU_CAP(MB)**: Displays the LUN capacity responded to the “Readcapacity” command as SCSI interface.
- **U(%)**: Displays the usage rate of the allocated block on the AOU pool containing this LU.
- **T(%)**: Displays the threshold rate being set to the AOU pool as high water mark.
- **PID**: Displays the AOU pool ID assigned to this AOU volume.

4.12.3 Raidvchkscan Command

The **raidvchkscan** command displays the fibre port of the storage system (9900V and later), target ID, LDEV mapped for LUN#, and the parameters for validation checking, regardless of the configuration definition file. Table 4.31 lists and describes the **raidvchkscan** command parameters. Figure 4.40 through Figure 4.42 show examples of the **raidvchkscan** command.

Note: This command will be rejected with EX_ERPERM by connectivity checking between CCI and the Hitachi RAID storage system.

Table 4.31 Raidvchkscan Command Parameters

Parameter	Value
Command Name	raidvchkscan
Format	raidvchkscan { -h │ -q │ -z │ -p <port> [hgrp] │ -pd[g] <raw_device> │ -s <seq#> │ -t <target> │ -l <lun> │ [-f[x]] │ -v <op> }

Parameter	Value
Options	**-h**: Displays Help/Usage and version information. **-q**: Terminates the interactive mode and exits the command. **-z** or **-zx** (OpenVMS cannot use the -zx option): Makes the **raidvchkscan** command enter the interactive mode. The **-zx** option guards performing of the HORCM in the interactive mode. When this option detects a HORCM shut down, interactive mode terminates. **-I[H][M][instance#] or -I[TC][SI][instance#]** Specifies the command as [HORC]/[HOMRCF], and used for specifying instance# of HORCM. **-g <group>**: Specifies a group name written in the configuration definition file. **-p <port> [hgrp]**: Specifies the port ID of the port to be scanned. Valid ports are CL1-A to CL1-R and CL2-A to CL2-R (excluding CL1-I, CL1-O, CL2-I, CL2-O). In addition: For USP V/VM: CL3-a to CL3-r, or CLG-a to CLG-r for the expanded port For USP: CL3-a to CL3-r, or CLG-a to CLG-r for the expanded port For NSC: CL3-a to CL3-h, or CL8-a to CL8-h for the expanded port. For 9900V: CL3-a to CL3-r, or CL4-a to CL4-r for the expanded port The port is not case sensitive (e.g. CL1-A= cl1-a= CL1-a= cl1-A, CL3-a= CL3-A= cl3-a= cl3-A). This option must be specified if “-find” or “-pd <raw_device>“option will not be specified. **[hgrp]** is specified to display only the LDEVs mapped to a host group on a port (9900V and later). **-pd[g] <raw_device>**: Specifies the raw device name. This option finds Seq# and port_name of the storage system to which the specified device can be connected, and scans the port of the storage system which corresponds with the unit ID that searches the unit ID from Seq#. This option must be specified if the “-find” option will not be specified. If this option is specified, the following **-s <Seq#>** option is invalid. **-pdg** (9900V and later): Shows a LUN on the host view by finding a host group (9900V and later). **-s <Seq#>**: Used to specify the Seq# (serial#) of the storage system when this option cannot specify the unit ID which is contained for “-p <port>“ option. This option scans the port specified by “-p <port>“ option of the storage system which corresponds with the unit ID that searches the unit ID from Seq#. If this option is specified, then the unit ID which is contained in “-p <port>“ option is invalid. **-t <target>**: Specifies a target ID (0 to 15) of the specified port. If this option is not specified, the command applies to all target IDs. **-l <lun>**: Specifies a LUN (0 to 7) of the specified target ID. If this option is not specified, the command applies to all LUNs. If this option is specified, the TID must also be specified. **-fx**: Displays the LDEV/STLBA/ENLBA number in hexadecimal notation. **-v [op]**: Specifies the following operation that displays each parameter for validation checking: **cflag**: Displays all flags for checking regarding data block validation for target vols (see Figure 4.40). **offset**: Displays the range setting for data block size of Oracle I/O and a region on a target volume for validation checking (see Figure 4.41). **errcnt**: Displays the statistical information counted as an error for each checking on the target volumes (see Figure 4.42). Each statistical information counted as an error will be cleared when the individual flag for validation checking is disabled. **gflag**: Displays the parameter for guarding on the specified target volumes (see Figure 4.43). **pool**: This option displays the pool capacity and the usable capacity for the pool ID to which the LDEV belongs. This will be needed to help the decision whether the restore operation is possible or not, because the pool capacity is consumed by the restore operation of the SnapShot (see Figure 4.44). **aou**: Displays the LUN capacity and usage rate for only HDP volume mapped to the specified port, and displays the ID of the pool to which LDEV belongs (see Figure 4.45).

```
# raidvchkscan -p CL1-A -v cflag
PORT# /ALPA/C TID# LU#   Seq#  Num LDEV#   BR-W-E-E  MR-W-B  BR-W-B-Z  SR-W-B-S
CL1-A / ef/ 0    0   0   2332    1     0    D E B R   D D D   D E E E  D E D D
CL1-A / ef/ 0    0   1   2332    1     1    D E B R   D D D   D E E E  D E D D
```

Figure 4.40 Raidvchkscan Command Example with -v cflag Option

Output of the **raidqvchkscan** command with **-v cflag** option:

- **BR-W-E-E**: This column displays the flags for checking regarding data block size.

  R = E: Checking for data block size on Read is enabled.
  D: Checking for data block size on Read is disabled.
  W = E: Checking for data block size on Write is enabled.
  D: Checking for data block size on Write is disabled.
  E = L: Data block on Read/Write is interpreted as little endian format.
  B: Data block on Read/Write is interpreted as big endian format.
  E = W: Warning that Read/Write is not rejected when validation error is detected.
  C: Read/Write is rejected when validation error is detected.

- **MR-W-B**: This column displays the flags for checking regarding CHK-F3 in the data block.

  R = E: Checking for CHK-F3 on Read is enabled.
  D: Checking for CHK-F3 on Read is disabled.
  W = E: Checking for CHK-F3 on Write is enabled.
  D: Checking for CHK-F3 on Write is disabled.
  B = E: Checking for CHK-F3 in the data block #0 is enabled.
  D: Checking for CHK-F3 in the data block #0 is disabled.

- **BR-W-B-Z**: This column displays the flags for checking regarding CHK-F2 in the data block.

  R = E: Checking for CHK-F2 on Read is enabled.
  D: Checking for CHK-F2 on Read is disabled.
  W = E: Checking for CHK-F2 on Write is enabled.
  D: Checking for CHK-F2 on Write is disabled.
  B = E: Comparing for CHK-F2 in the data block is enabled.
  D: Comparing for CHK-F2 in the data block is disabled.
  Z = E: The NON zero checking for CHK-F2 in the data block shows to being enabled.
  D: The NON zero checking for CHK-F2 in the data block shows to being disabled.

- **SR-W-B-S**: Displays the flags for checking regarding CHK-F1 in the data block.

  R = E: Checking for CHK-F1 on Read is enabled.
  D: Checking for CHK-F1 on Read is disabled.
  W = E: Checking for CHK-F1 on Write is enabled.
  D: Checking for CHK-F1 on Write is disabled.
  B = E: Checking for CHK-F1 in the data block #0 is enabled.
  D: Checking for CHK-F1 in the data block #0 is disabled.
  S = E: Referring for CHK-F1 flag contained in the data block is enabled.
  D: Referring for CHK-F1 flag contained in the data block is disabled.

```
# raidvchkscan -p CL1-A -v offset
PORT# /ALPA/C TID# LU#   Seq#  Num LDEV#   Bsize         STLBA         ENLBA BNM
CL1-A / ef/ 0    0   0   2332    1     0    1024             1        102400   9
CL1-A / ef/ 0    0   1   2332    1     1    1024             1        102400   9
CL1-A / ef/ 0    0   2   2332    1     2    1024             1        102400   9
CL1-A / ef/ 0    0   3   2332    1     3    1024             1        102400   9
CL1-A / ef/ 0    0   4   2332    1     4    1024             1        102400   9
```

Figure 4.41 Raidvchkscan Command Example with -v offset Option

Output of the **raidqvchkscan** command with **-v offset** option:

- **Bsize**: This column displays the data block size of Oracle I/O, in units of bytes.
- **STLBA**: Displays the Start of LBA on a target volume for checking, in units of 512 bytes.
- **ENLBA**: Displays the End of LBA on a target volume for checking, in units of 512 bytes.

  Note: If **STLBA** and **ENLBA** are both zero, this means to check all blocks.
- **BNM**: Displays the number of bits for checking regarding CHK-F2, in units of bits.
  If **BNM** is zero, this means the checking for CHK-F2 will be disabled.

```
# raidvchkscan -p CL1-A -v errcnt
PORT# /ALPA/C TID# LU#   Seq#  Num LDEV#      CfEC      MNEC      SCEC      BNEC
CL1-A / ef/ 0    0   0   2332    1     0         0         0         0         0
CL1-A / ef/ 0    0   1   2332    1     1         0         0         0         0
CL1-A / ef/ 0    0   2   2332    1     2         0         0         0         0
CL1-A / ef/ 0    0   3   2332    1     3         0         0         0         0
CL1-A / ef/ 0    0   4   2332    1     4         0         0         0         0
```

Figure 4.42 Raidvchkscan Command Example with -v errcnt Option

Output of the **raidqvchkscan** command with **-v errcnt** option:

- **CfEC**: This column displays the error counter for checking of block size validation.
- **MNEC**: Displays the error counter for checking of CHK-F3 validation.
- **SCEC**: Displays the error counter for checking of CHK-F1 validation.
- **BNEC**: Displays the error counter for checking of CHK-F2 validation.

```
# raidvchkscan -p CL1-A -v gflag                         ← Example of -v gflag option.
PORT# /ALPA/C TID# LU#   Seq#  Num LDEV#   GI-C-R-W-S  PI-C-R-W-S R-Time
CL1-A / ef/ 0    0   0   2332    1     0    E E D D E   E E D D E    365
CL1-A / ef/ 0    0   1   2332    1     1    E E D D E   E E D D E      -
CL1-A / ef/ 0    0   2   2332    1     2    E E D D E   E E D D E      0
```

Figure 4.43 Raidvchkscan Command Example with -v gflag Option

Output of the **raidqvchkscan** command with **-v gflag** option:

- **GI-C-R-W-S**: This displays the flags for guarding as for the target volume.

  I → E: Enabled for Inquiry command.
  D: Disabled for Inquiry command.
  C → E: Enabled for Read Capacity command.
  D: Disabled for Read Capacity command.
  R → E: Enabled for Read command.
  D: Disabled for Read command.
  W→ E: Enabled for Write command.
  D: Disabled for Write command.
  S→ E: Enabled for becoming the SVOL.
  D: Disabled for becoming the SVOL.

- **PI-C-R-W-S**: This displays the permission flags that show whether each mode flag can be changed to enable or not.

  I → E: ”I” flag can be changed to enable.
  D: ”I” flag cannot be changed to enable.
  C → E: ”C” flag can be changed to enable.
  D: ”C” flag cannot be changed to enable.
  R → E: ”R” flag can be changed to enable.
  D: ”R” flag cannot be changed to enable.
  W→ E: ”W” flag can be changed to enable.
  D: ”W” flag cannot be changed to enable.
  S→ E: ”S” flag can be changed to enable.
  D: ”S” flag cannot be changed to enable.

- **R-Time**: This displays the retention time for write protect, in units of day. The hyphen (-) shows that the retention time is infinite. APP will be able to know whether the target volume is denied to change to writing enable by referring “R-Time”.

  Audit lock status is shown as the retention time plus 1000000.
  “R-Time + 1000000” shows the retention time with Audit lock status.

```
# raidvchkscan -v pool -p CL2-d-0
PORT# /ALPA/C TID# LU#   Seq#  Num LDEV#   Bsize     Available      Capacity
CL2-D-0 /e4/ 0   2   0  62500    1   160    2048        100000    1000000000
CL2-D-0 /e4/ 0   2   1  62500    1   161    2048        100000    1000000000
```

Figure 4.44 Raidvchkscan Command Example with -v pool Option

Output of the **raidqvchkscan** command with **-v pool** option:

- **Bsize**: This displays the data block size of the pool, in units of block (512 bytes).
- **Available(Bsize)**: This displays the available capacity for the volume data on the SnapShot pool in units of Bsize.
- **Capacity(Bsize)**: This displays the total capacity in the SnapShot pool in units of Bsize.

```
# raidvchkscan -v aou -p CL2-d-0
PORT# /ALPA/C TID# LU#   Seq#  Num LDEV#  Used(MB)  LU_CAP(MB)  U(%) T(%) PID
CL2-D-0 /e4/ 0   2   0  62500    1   160    20050     1100000     1   60    1
CL2-D-0 /e4/ 0   2   1  62500    1   161   200500     1100000    18   60    2
```

Figure 4.45 Raidvchkscan Command Example with -v aou Option

Output of the **raidvchkscan** command with **-v aou** option:

- **Used(MB)**: Displays the usage size the allocated block on this LUN.
  Range: 0 ≤ Used (MB) < LU_CAP(MB) + 42MB
- **LU_CAP(MB)**: Displays the LUN capacity responded to the “Readcapacity” command as SCSI interface.
- **U(%)**: Displays the usage rate of the allocated block on the AOU pool containing this LU.
- **T(%)**: Displays the threshold rate being set to the AOU pool as high water mark.
- **PID**: Displays the AOU pool ID assigned to this AOU volume.

4.12.4 Raidvchkscan Command for Journal (UR)

The **raidvchkscan** command supports the (-v jnl [t] [unit#]) option to find the journal volume list setting via SVP. It also displays any information for the journal volume. The Universal Replicator function is available on the Hitachi USP V/VM and USP/NSC storage systems.

Table 4.32 Raidvchkscan Command Parameters (UR)

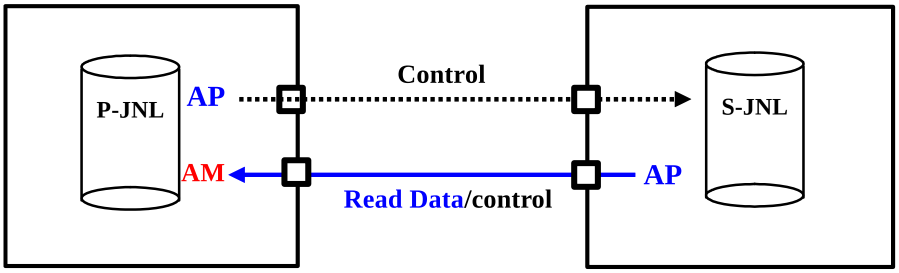
Parameter	Details
Command Name	raidvchkscan: Validation checking confirmation command
Format	raidvchkscan { -h | -q | -z | -v jnl [t] [unit#] | [-s <Seq#>] | [-f[x] | }
Options	-h: Displays Help/Usage and version information. -q: Terminates the interactive mode and exits the command. -z or -zx: Makes the **raidvchkscan** command enter the interactive mode. The -zx option guards performing of the HORCM in the interactive mode. When this option detects a HORCM shut down, interactive mode terminates. -I[H][M][instance#] or -I[TC][SI][instance#] Specifies the command as [HORC]/[HOMRCF], and used for specifying instance# of HORCM. -s <Seq#>: Used to specify the Seq# (serial#) of the storage system when this option cannot specify unitID which is contained for "-v jnl" option. If this option is specified, the unitID which is contained in "-v jnl" is invalid. -fx: Displays the LDEV number in hexadecimal notation. -v jnl: Displays information for the journal volume (see Figure 4.46). -v jnlt: Displays the DOW, DPW, and APW time-out values for controlling the journal (see Figure 4.48).

```
# raidvchkscan -v jnl 0
JID MU CTG  JNLS  AP  U(%)  Q-Marker   Q-CNT  D-SZ(BLK)   Seq# Nnm LDEV#
001  0   1  PJNN   4   21   43216fde      30     512345  62500   2   265
002  1   2  PJNF   4   95   3459fd43   52000     512345  62500   3   270
002  2   2  SJNS   4   95   3459fd43   52000     512345  62500   3   270
003  0   3  PJSN   4    0          -       -     512345  62500   1   275
004  0   4  PJSF   4   45   1234f432      78     512345  62500   1   276
005  0   5  PJSE   0    0          -       -     512345  62500   1   277
006  -   -  SMPL   -    -          -       -     512345  62500   1   278
007  0   6  SMPL   4    5   345678ef      66     512345  62500   1   278
```

Figure 4.46 Raidvchkscan Command Example with -v jnl 0 Option

Output of the **raidqvchkscan** command with **-v jnl 0** option:

- **JID:** Displays the journal group ID.
- **MU:** Displays the mirror descriptions on UR.
- **CTG:** Displays the CT group ID.
- **JNLS:** Displays the following status in the journal group.
  - SMPL: this means the journal volume which does not have a pair, or deleting.
  - P(S)JNN: this means “P(S)vol Journal Normal Normal”.
  - P(S)JNS this means “P(S)vol Journal Normal suspend” created with **-nocsus** option.
  - P(S)JSN: this means “P(S)vol Journal Suspend Normal”.
  - PJNF: this means “P(S)vol Journal Normal Full”.
  - P(S)JSF: this means “P(S)vol Journal Suspend Full”.
  - P(S)JSE: this means “P(S)vol Journal Suspend Error” including link failure.
  - P(S)JES this means “P(S)vol Journal Error suspend” created with **-nocsus** option.
- **AP:** Displays the following two conditions (status) according to the pair status.
  - Shows the number of active paths on the initiator port in UR links. ‘Unknown’ is shown as ‘-’.



  - AM: The activity monitor that detects whether or not there is a request for data from the initiator at regular intervals. If AM detects a time-out, the P-JNL state will be changed from P-JNN to PJSE.

    Note: The same path information is used for AP for three commands (pairvolchk, pairdisplay, raidvchkscan). The differential is that pairvolchk and pairdisplay are to show a special meaning with SSUS(SSWS) state.

- **Q-Marker**: Displays the sequence # of the journal group ID, called the Q-marker. For P-JNL, Q-Marker shows the latest sequence # on the P-JNL volume. For S-JNL, the Q-Marker shows the latest sequence # of the cache(DFW).

- **Q-CNT**: Displays the number of remaining Q-Markers within each journal volume.

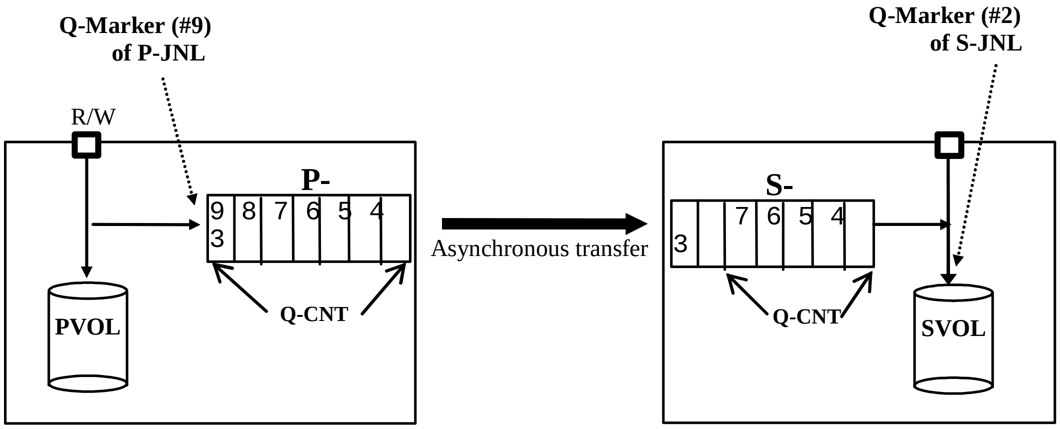


Figure 4.47 Example of Q-Marker and Q-CNT

- **U(%)**: Displays the usage rate of the journal data.
- **D-SZ**: Displays the capacity for the journal data on the journal volume.
- **Seq#**: Displays the serial number of the RAID storage system.
- **Num**: Displays the number of LDEV configured the journal volume.
- **LDEV#**: Displays the first number of the LDEV that is configured for the journal volume. Using a combination of JNLS status and other information, the application will know the following detail state.

Table 4.33 lists information about the different journal volume statuses. QCNT=0 indicates that the number of remaining Q-Markers is ‘0’. The letter ‘N’ indicates a non-zero.

Table 4.33 Detailed Status of the Journal Volume

JNLS		Other Information		Description
P-JNL	S-JNL	QCNT	AP	
SMPL		0	-	Configured as journal volume, but NOT pair
		N	-	Deleting the journal volume
PJNN (PJNS)	SJNN (SJNS)	0	-	Normal state of the journal volume without data
PJNN (PJNS)	-	N	-	Normal state of the journal volume with data
-	SJNN (SJNS)	N	N	Normal state of the journal volume with data
			0	Still normal state of the journal volume at Link failure
PJSN	SJSN	0	-	Suspended journal volume via operation
		N	-	Suspending the journal volume
PJNF	-	N	-	High water mark state
PJSF	SJSF	0	-	Suspended journal volume due to full journal
		N	-	Suspending the journal volume due to full journal
PJSE	-	0	-	Suspended journal volume due to failure/Link failure
		N	-	Suspending the journal volume due to failure/Link failure
-	SJSE	0	N	Suspended journal volume due to failure
			0	Suspended journal volume due to Link failure
		N	N	Suspending the journal volume due to failure
			0	Suspending the journal volume due to Link failure

```
# raidvchkscan -v jnlt
JID MU CTG  JNLS  AP  U(%)   Q-Marker   Q-CNT  D-SZ(BLK)   Seq# DOW PBW APW
001  0   1  PJNN   4   21    43216fde      30     512345  63528  20 300  40
002  1   2  PJNF   4   95    3459fd43   52000     512345  63528  20 300  40
003  0   3  PJSN   4    0           -       -     512345  63528  20 300  40
```

Figure 4.48 Raidvchkscan Command Example with -v jnlt Option

Output of the **raidqvchkscan** command with **-v jnlt** option:

- **DOW**: This shows “Data Overflow Watch” timer (in unit of Sec.) setting per the Journal group.
- **PBW**: This shows “Path Blockade Watch” (in unit of Sec.) timer setting per the Journal group. Also this will be shown as “0” on “SMPL” state.
- **APW**: This shows “Active Path Watch” timer (in unit of Sec.) for detecting Link failure.

4.12.5 Raidvchkscan Command for Snapshot Pool and Dynamic Provisioning

The **raidvchkscan** command supports the option (-v pid[a] [unit#]) to find the SnapShot pool or HDP pool settings via SVP, and displays information for the SnapShot pool or HDP pool.

Table 4.34 Raidvchkscan Command Parameters (Snapshot/HDP)

Parameter	Details
Command Name	raidvchkscan: Validation checking confirmation command
Format	raidvchkscan { -h | -q | -z | -v pid[a] [unit#] | [-s <Seq#>] | [-f[x] | }
Options	-h: Displays Help/Usage and version information. -q: Terminates the interactive mode and exits the command. -z or -zx: Makes the **raidvchkscan** command enter the interactive mode. The -zx option guards performing of the HORCM in the interactive mode. When this option detects a HORCM shut down, interactive mode terminates. -I[H][M][instance#] or -I[TC][SI][instance#] Specifies the command as [HORC]/[HOMRCF], and used for specifying instance# of HORCM. -s <Seq#>: Used to specify the Seq# (serial#) of the storage system when this option cannot specify unitID which is contained for "-v jnl" option. If this option is specified, the unitID which is contained in "-v jnl" is invalid. -fx: Displays the LDEV number in hexadecimal notation. -v pid: Displays information for the snapshot pool (see Figure 4.49). -v pida: Displays information for the HDP pool (see Figure 4.50).

```
# raidvchkscan -v pid 0
PID  POLS   U(%)  SSCNT  Available(MB)  Capacity(MB)     Seq#  Num  LDEV#  H(%)
001  POLN    10     330      10000000    1000000000     62500    2    265   80
002  POLF    95    9900        100000    1000000000     62500    3    270   70
003  POLS   100   10000           100    1000000000     62500    1    275   70
004  POLE     0       0             0             0     62500    0      0   80
```

Figure 4.49 Raidvchkscan Command Example with -v pid Option

Output of the **raidqvchkscan** command with **-v pid** option:

- **PID**: Displays the SnapShot pool ID.
- **POLS**: Displays the following status in the SnapShot pool.
  - **POLN** = "Pool Normal"
  - **POLF** = "Pool Full"
  - **POLS** = "Pool Suspend"
  - **POLE** = "Pool failure". In this state, information for the pool cannot be displayed.
- **U(%)**: Displays the usage rate of the SnapShot pool.
- **SSCNT**: Displays the number of SnapShot volume in SnapShot pool.
- **Available(MB)**: Displays the available capacity for the volume data on the SnapShot pool.
- **Capacity(MB)**: Displays the total capacity in the SnapShot pool.
- **Seq#**: Displays the serial number of the RAID storage system.

- **Num**: Displays the number of LDEV configured the SnapShot pool.
- **LDEV#**: Displays the first number of LDEV configured the SnapShot pool.
- **H(%):** Displays the threshold rate being set to the SnapShot pool as High water mark. ‘Unknown’ will be shown as ‘-’.

```
# raidvchkscan -v pida 0
PID  POLS U(%)  AV_CAP(MB)  TP_CAP(MB) W(%) H(%) Num LDEV#  LCNT  TL_CAP(MB)
001  POLN  10    45000000    50000000   50   80    2   265    33   65000000
002  POLF  95       10000   100000000   50   80    3   270   900  100000000
004  POLN   0    10000000   100000000   80   90    2   280     0          0
```

Figure 4.50 Raidvchkscan Command Example with -v pida Option

Output of the **raidqvchkscan** command with **-v pida** option:

- **PID**: Displays the HDP pool ID.
- **POLS**: Displays the status of the HDP pool:
  - **POLN** = “Pool Normal”
  - **POLF** = “Pool Full”
  - **POLS** = “Pool Suspend”
  - **POLE** = “Pool failure”. In this state, information for the pool cannot be displayed.
- **U(%)**: Displays the usage rate of the HDP pool.
- **AV_CAP(MB)**: Displays the available capacity for the HDP volumes mapped to this pool.
- **TP_CAP(MB)**: Displays the total capacity of the HDP pool.
- **W(%)**: Displays the threshold rate for “WARNING” set for this HDP pool.
- **H(%)**: Displays the threshold rate set for the HDP pool as high water mark.
- **Num**: Displays the number of LDEVs configured the HDP pool.
- **LDEV#**: Displays the first number of LDEV configured the HDP pool.
- **LCNT**: Displays the total number of HDP volumes mapped to this HDP pool.
- **TL_CAP(MB)**: Displays the total capacity of all HDP volumes mapped to this HDP pool.

4.13 Controlling CCI Activity

4.13.1 Horcmstart Command

The horcmstart command is a shell script that starts the HORCM application (/etc/horcmgr). This shell script also sets the environment variables for HORCM as needed (e.g., HORCM_CONF, HORCM_LOG, HORCM_LOGS). Table 4.35 lists and describes the horcmstart command parameters.

Table 4.35 Horcmstart Command Parameters

Parameter	Value
Command Name	horcmstart
Format	horcmstart.sh { inst ... } (UNIX systems) horcmstart.exe { inst ... } (Windows systems)

Options	Inst: Specifies the HORCM instance number (numerical value). When this option is specified, the horcmstart shell script sets the environment variables (HORCMINST, HORCM_CONF, HORCM_LOG, HORCM_LOGS) which correspond to the instance number, and starts the specified HORCM instance. (Environment variables set by the user become invalid.) When this option is not specified, the horcmstart shell script starts 1 HORCM and uses the environment variables set by the user. If you have designated full environment variables, you should use horcmstart.sh without any arguments. If you did not designate environment variables (HORCM_CONF, HORCM_LOG, HORCM_LOGS), then this shell script sets the environment variables as follows:
	For UNIX-based platforms:
	If HORCMINST is specified:
	HORCM_CONF = /etc/horcm*.conf (* is instance number)
	HORCM_LOG = /HORCM/log*/curlog
	HORCM_LOGS = /HORCM/log*/tmplog
	If no HORCMINST is specified:
	HORCM_CONF = /etc/horcm.conf
	HORCM_LOG = /HORCM/log/curlog
	HORCM_LOGS = /HORCM/log/tmplog
	For Windows platform:
	If HORCMINST is specified:
	HORCM_CONF = \WINNT\horcm*.conf (* is instance number)
	HORCM_LOG = \HORCM\log*\curlog
	HORCM_LOGS = \HORCM\log*\tmplog
	If no HORCMINST is specified:
	HORCM_CONF = \WINNT\horcm.conf
	HORCM_LOG = \HORCM\log\curlog
	HORCM_LOGS = \HORCM\log\tmplog
	[environmental variable]
	The HORCM_LOGS environment variable is used to specify the log file directory for automatic storing. When HORCM starts up, the log files created in the operation are stored automatically in the HORCM_LOGS directory. This log directory must give an equality class with HORCM_LOG
	HORCMSTART_WAIT (for waiting the RM instance with start-up). Horcmgr does fork/exec() horcmd_XX as deamon process, and verifies/waits until HORCM become ready state. The timeout is used for only avoiding infinite loop, currently the default time is 200 sec in consideration of maximum LDEV.
	However, it may be needed to change the default timeout value for starting HORCM under high-loading of the server, or the remote command device. In such a case, this environmental variable is used to change a timeout value (in units of Sec) from the current default value (200 sec), this value must be specified more than 5 seconds and multiple of 5 seconds. For Example setting 500 sec:
	`HORCMSTART_WAIT=500`
	`Export HORCMSTART_WAIT`
	For OpenVMS® platform: OpenVMS needs to make the Detached LOGINOUT.EXE Process as a JOB in the background by using the 'RUN /DETACHED' command. Refer to item (4) in section 3.5.1 for details.

4.13.2 Horcmshutdown Command

The horcmshutdown command is a shell script for stopping the HORCM application (`/etc/horcmgr`). Table 4.36 describes the shutdown command parameters.

Table 4.36 Horcmshutdown Command Parameters

Parameter	Value
Command Name	horcmshutdown
Format	horcmshutdown.sh {inst...} horcmshutdown.exe {inst...}
Option	**Inst**: Specifies the HORCM (CCI) instance number (numerical value). When this option is specified, the command stops the specified HORCM instance. When this option is not specified, the command refers to the instance (environment variable HORCMINST) of the execution environment of this shell script and stops the following the HORCM instance. When HORCMINST is specified, this command stops the HORCM instance of the execution environment of this shell script. When HORCMINST is not specified, this command stops the HORCM having no instance setting.

4.13.3 Horcctl Command

The HORCM and Hitachi TrueCopy software have logs that identify the cause of software and/or hardware errors as well as a tracing function for investigating such errors. The location of the log files depends on the user's command execution environment and the HORC Manager's execution environment. The command trace file and core file reside together under the directory specified in the HORC Manager's execution environment. See Appendix A for log file and log directory information.

The Hitachi TrueCopy horcctl command can be used for both maintenance and troubleshooting. The horcctl command allows you to change and display the internal trace control parameters (e.g., level, type, buffer size) of the HORC Manager and/or Hitachi TrueCopy commands. If a new value for a parameter is not specified, the current trace control parameter is displayed. Table 4.37 lists and describes the horcctl command parameters.

Caution: Do not change the trace level unless directed to do so by a Hitachi Data Systems representative. Level 4 is the normal trace level setting. Levels 0-3 are for troubleshooting. Setting a trace level other than 4 may impact problem resolution. If you request a change of the trace level using the **horcctl -l <level>** command, a warning message is displayed, and this command enters interactive mode.

Table 4.37 Horcctl Command Parameters

Parameter	Value
Command Name	horcctl
Format	horcctl { -h │ -q │ -z │ -d │ -c │ -l <level> │ -d <y/n> │ -s <size(KB)> │ -t <type> │ -S │ -D[I] │ -C │ [-u <-unitid> │ -ND │ -NC │ -g <group>}

Parameter	Value

Options	-h: Displays Help/Usage and version information.
	-q: Terminates the interactive mode and exits the command.
	-z or -zx (OpenVMS cannot use the -zx option): Makes the horcctl command enter the interactive mode. The -zx option guards performing of the HORCM in the interactive mode. When this option detects a HORCM shut down, interactive mode terminates.
	-I[H][M][instance#] or -I[TC][SI][instance#] Specifies the command as [HORC]/[HOMRCF], and used for specifying instance# of HORCM.
	-d: Interprets the control options following this option (-l <level>, -b <y/n>, -s <size(KB)>, and -t <type>) as the parameters of the TrueCopy commands.
	-c: Interprets the control options following this option (-l <level>, -b <y/n> and -t <type>) as the parameters of the HORC Manager (HORCM).
	-l <level>: Sets the trace level (range = 0 to 15). If a negative value is specified, the trace mode is canceled. A negative value “n” must be specified as “--n”.
	Caution: Do not change the trace level unless directed to do so by a Hitachi Data Systems representative. Level 4 is the normal trace level setting. Levels 0-3 are for troubleshooting. Setting a trace level other than 4 may impact problem resolution. If you request a change of the trace level using the horcctl -l <level> command, a warning message is displayed, and this command enters interactive mode.
	-b <y/n>: Sets the trace writing mode: Y = buffer mode, N = synchronous mode.
	-t <type>: Sets the trace type (range = 0 to 511). When this option is used, only traces of the specified type are output. One or more values can be specified.
	-s <size(KB)>: Changes the default trace buffer size, which is 1 MB, in units of 1024 bytes.
	-S: Shuts down HORCM.
	-D: Displays the command device name currently used by HORCM. If the command device is blocked due to online maintenance (microcode replacement) of the storage system, you can check the command device name in advance using this option.
	-C: Changes the command device name being used by HORCM and displays the new command device name. If the command device is blocked due to online maintenance (microcode replacement) of the storage system, you can change the command device in advance using this option.
	[NOTE]: `horcctl -D -C` command designates a protection mode command device by adding ‘*’ to the device file name as follows:
	HP-UX Example:
	`# horcctl -D`
	`Current control device = /dev/rdsk/c0t0d0*`
	"`horcctl -DI`" command shows the number of RM instances of when HORCM has being started as follows:
	HP-UX Example without command device security:
	`# horcctl -DI`
	`Current control device = /dev/rdsk/c0t0d0  AI = 14 TI = 0 CI = 1`
	AI : NUM of Actual instances in use
	TI : NUM of temporary instances in RAID
	CI : NUM of instances using current (own) instance
	-u <unitid>: Used to specify the unit ID of a command device as the target. This option is effective when the -D or -C option is specified. If this option is not specified, the unit ID is 0.
	-ND -g <group>: Displays the network address and port name being used by HORCM. The -g <group> option is used to specify the group name defined in the configuration definition file.
	-NC -g <group>: Changes the network address and port name being used by HORCM and displays the new network address name. The -g <group> option specifies the group name defined in the configuration definition file.

4.13.4 3DC Control Command using HORC/UR NEW

This is a scripted command for executing several HORC operation commands combined. It checks the volume attribute (optionally specified) and decides a takeover action.

The horctakeoff operation is defined to change from 3DC multi-target to 3DC multi-hop with the state of running APP, after that horctakeover command will be able to configure 3DC multi-target on the remote site without stopping the APP.

The granularity of either a logical volume or volume group can be specified with this command.

Table 4.38 Horctakeoff Command Parameters

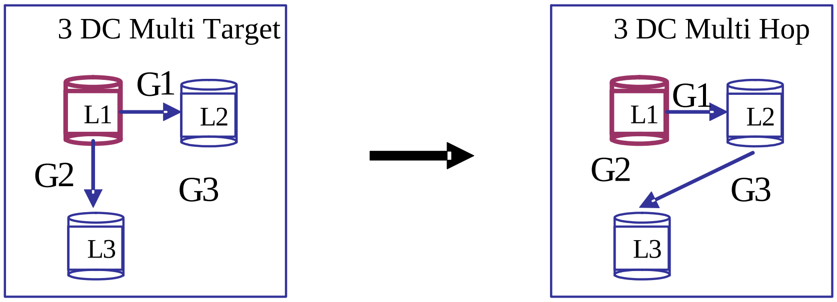
Parameter	Value
Command name	horctakeoff
Format	horctakeoff | -h | -q | -z | -g[s] ▫group▫ | -d[s] ▫pair Vol▫| -d[g][s] <raw_device> [MU#] | -d[g][s] <seq#> <LDEV#> [MU#] | -jp <id> | -js <id> | [-t <timeout>]| -nomsg }

Parameter	Value
Options	**-h** displays Help/Usage, and version information. **-q** terminates interactive mode and exits this command. **-z** or **-zx** (OpenVMS cannot use -zx option) This option makes this command enter interactive mode. The -zx option prevents using HORCM in interactive mode. This option terminates interactive mode upon HORCM shut-down. **-I[H][M][instance#] or -I[TC][SI][instance#]** This option used for specifying the command as [HORC]/[HOMRCF], and used for specifying Instance# of HORCM (refer to section 4.1.1). **-g[s] <group>** This option is used to specify a group name (defined in the configuration definition file). The command is executed for the specified group unless the -d <pair Vol> option shown below is specified. **-d[s] <pair Vol>** This option is used to specify a logical (named) volume (defined in the configuration definition file). When this option is specified, the command is executed for the specified paired logical volume. **-d[g][s] <raw_device> [MU#]** ...This option searches the RM configuration file (local instance) for a volume that matches the specified raw device. If a volume is found, the command is executed on the paired volume (-d) or group (-dg).This option is effective without specification of the "-g <group>" option. If the specified raw_device is listed in multiple device groups, this will apply to the first one encountered. **-d[g][s] <seq#> <LDEV#> [MU#]** This option searches the RM instance configuration file (local instance) for a volume that matches the specified sequence # and LDEV. If a volume is found, the command is executed on the paired logical volume (-d) or group (-dg).This option is effective without specification of the "-g <group>" option. If the specified LDEV is listed in multiple device groups, this will apply to the first one encountered. <seq #> <LDEV #> can be specified in a hexadecimal (by addition of "0x ") or decimal. **-jp <id>** (HORC/UR only)Horctakeoff command can be changed 3DC configuration from 3 DC multi-target to 3 DC multi-hop.In order to create 3 DC multi-hop (CA_Sync→CA_Sync/UR_PVOL→UR), it will be needed to specify a journal group ID for UR_PVOL. So this option is used for that purpose. If this option will not be specified, a journal group ID for UR_PVOL used for 3 DC multi-target will be inherited automatically. **-js <id>**(HORC/UR only)Horctakeoff command can be changed 3DC configuration from 3 DC multi-target to 3 DC multi-hop.In order to create 3 DC multi-hop (CA_Sync→CA_Sync/UR→UR_SVOL), it will be needed to specify a journal group ID for UR_SVOL. So this option is used for that purpose. If this option will not be specified, a journal group ID for UR_SVOL used with 3 DC multi-target will be inherited automatically. The CTGID will also be inherited automatically for the internal paircreate command. **-t <timeout>**The -t <timeout> option specifies the maximum time to wait for the Sync_PVOL to Sync_SVOL delta data re-synchronizing operation. It is used for the internal pairresync command with the time-out period in units of seconds. If this option will not be specified, the default timeout value (7200 sec) is used. **-nomsg** This option is used to suppress messages when this command is executed from a user program. This option must be specified at the beginning of the command arguments.
Returned values	The horctakeoff command returns one of the following values in exit (), which allows users to check the execution results using a user program or script. \\ Normal termination 0: \\• Abnormal termination The horctakeoff command returns the following error codes as well as generic error.\\Specific error code for horctakeoff

Category	Error Code	Error Message	Value
Volume status	EX_ENQVOL	Unmatched volume status within the group	236
	EX_INCSTG	Inconsistent status in group	229
	EX_EVOLCE	Pair Volume combination error	235
Unrecoverable	EX_VOLCRE	Local and Remote Volume currency error	223
Timer Recoverable	EX_EWSTOT	Timeout waiting for specified status	233

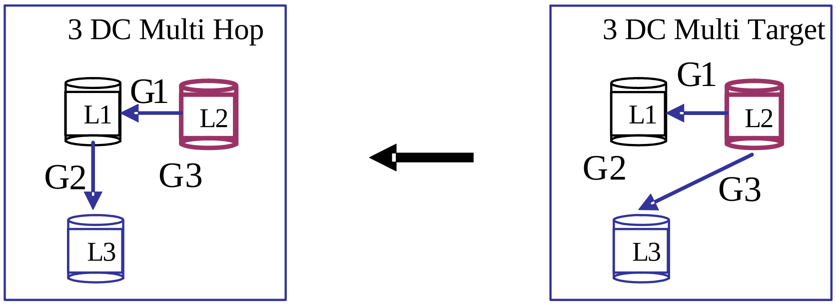
Note: Unrecoverable error should have been done without re-execute by handling of an error code.
The command has failed, and then the detailed status will be logged on Raid Manager command log ($HORCC_LOG), even though the user script has no error handling.

4.13.4.1 Horctakeoff Command Examples



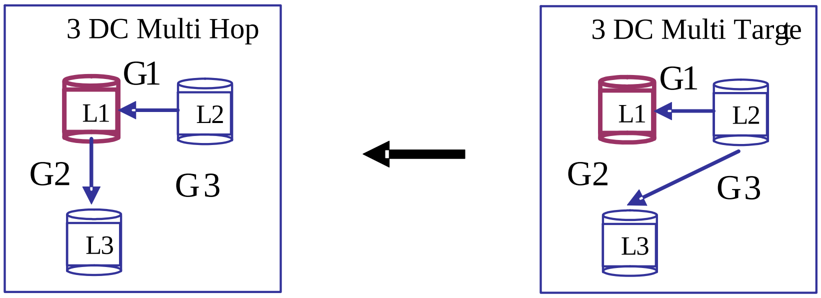
- horctakeoff command on L1 local site

```
# horctakeoff -g G1 -gs G2
horctakeoff : 'pairsplit -g G1 -S -FHORC 2' is in progress
horctakeoff : 'pairsplit -g G1' is in progress
horctakeoff : 'pairsplit -g G2 -S' is in progress
horctakeoff : 'paircreate -g G1 -gs G2 -FHORC 2 -nocopy -f async -jp
0 -js 1' is in progress
horctakeoff : 'pairsplit -g G1 -FHORC 2' is in progress
horctakeoff : 'pairresync -g G1' is in progress
horctakeoff : 'pairresync -g G1 -FHORC 2' is in progress
horctakeoff : horctakeoff done
```



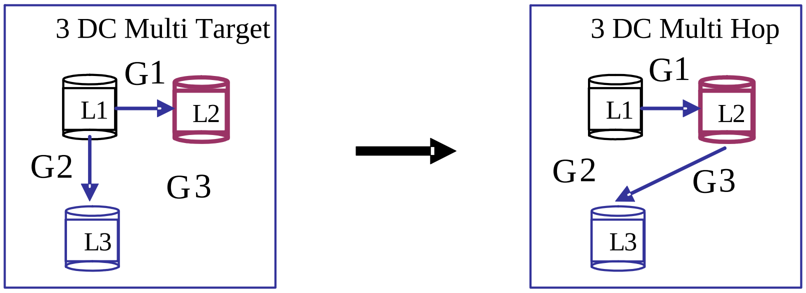
- horctakeoff command on L2 local site

```
# horctakeoff -g G1 -gs G3
horctakeoff : 'pairsplit -g G1 -S -FHORC 1' is in progress.
horctakeoff : 'pairsplit -g G1' is in progress.
horctakeoff : 'pairsplit -g G3 -S' is in progress.
horctakeoff : 'paircreate -g G1 -gs G3 -FHORC 1 -nocopy -f async -jp
0 -js 1' is in progress.
horctakeoff : 'pairsplit -g G1 -FHORC 1' is in progress.
horctakeoff : 'pairresync -g G1' is in progress.
horctakeoff : 'pairresync -g G1 -FHORC 1' is in progress.
horctakeoff : horctakeoff done.
```



- horctakeoff command on L1 remote site

```
# horctakeoff -g G1 -gs G2
horctakeoff : 'pairsplit -g G2 -S' is in progress.
horctakeoff : 'pairsplit -g G1' is in progress.
horctakeoff : 'pairsplit -g G1 -FHORC 2 -S' is in progress.
horctakeoff : 'paircreate -g G2 -vl -nocopy -f async -jp 0 -js 1' is
in progress.
horctakeoff : 'pairsplit -g G2' is in progress.
horctakeoff : 'pairresync -g G1' is in progress.
horctakeoff : 'pairresync -g G2' is in progress.
horctakeoff : horctakeoff done.
```



horctakeoff command on L2 remote site

```
# horctakeoff -g G1 -gs G3
horctakeoff : 'pairsplit -g G3 -S' is in progress.
horctakeoff : 'pairsplit -g G1' is in progress.
horctakeoff : 'pairsplit -g G1 -FHORC 1 -S' is in progress.
horctakeoff : 'paircreate -g G3 -vl -nocopy -f async -jp 0 -js 1' is
in progress.
horctakeoff : 'pairsplit -g G3' is in progress.
horctakeoff : 'pairresync -g G1' is in progress.
horctakeoff : 'pairresync -g G3' is in progress.
horctakeoff : horctakeoff done.
```

4.13.5 Windows Subcommands

The CCI software provides subcommands for the Windows platforms which are executed as options (-x <command> <arg>) of another command. When you specify a subcommand as the only option of a command, you do not need to start HORCM. If another option of the command and the subcommand are specified on the same command line, place the other option after the subcommand.

4.13.6 Findcmddev Subcommand

The findcmddev subcommand (find command device) searches for command devices within the specified range of disk drive numbers. If it is found, the command device is displayed in the same format as in the configuration definition file. This subcommand is used when the command device name is not known and when the HORCM is not started. Figure 4.51 shows an example of the findcmddev subcommand used as an option of the **raidscan** command and its output. Table 4.39 lists and describes the findcmddev subcommand parameters.

```
D:\HORCM\etc> raidscan  -x  findcmddev   hdisk0, 20
cmddev of Ser#   62496 = \\.\PhysicalDrive0
cmddev of Ser#   62496 = \\.\E:
cmddev of Ser#   62496 = \\.\Volume{b9b31c79-240a-11d5-a37f-00c00d003b1e}
```

This example searches for command devices in the range of disk drive numbers 0-20.

Figure 4.51 Findcmddev Subcommand Example

Caution: The findcmddev subcommand must be used when HORCM is not running.

Note: The findcmddev subcommand searches for the physical and logical drives associated with the command device. If the command device is indicated as a logical drive in addition to a physical drive, then a drive letter is assigned to the command device. You must delete the drive letter assigned to the command device to prevent utilization by general users.

The "Volume{GUID}" must be made by setting a partition using the disk management without file system format, and is used to keep as the same command device even though the physical drive numbers are changed on every reboot in a SAN environment.

Table 4.39 Findcmddev Subcommand Parameters

Parameter	Value
Command Name	findcmddev
Format	-x findcmddev drive#(0-N)
Argument	drive#(0-N): Specifies the range of disk drive numbers on the Windows system.

4.13.7 Drivescan Subcommand

The drivescan subcommand displays the relationship between the disk numbers assigned by the Windows system and the LDEVs on the RAID storage system, and also displays attribute and status information for each LDEV. Table 4.40 lists and describes the drivescan subcommand parameters. Figure 4.52 shows an example of the drivescan subcommand used as an option of the **raidscan** command and its output.

Table 4.40 Drivescan Subcommand Parameters

Parameter	Value
Command Name	drivescan
Format	-x drivescan drive#(0-N)
Argument	**drive**#(0-N): Specifies the range of disk drive numbers on the Windows system.

```
raidscan -x drivescan  harddisk0,20
Harddisk 0... Port[ 1] PhId[ 0] TId[  0] Lun[  0]  [HITACHI] [DK328H-43WS]
Harddisk 1... Port[ 2] PhId[ 4] TId[ 29] Lun[  0] [HITACHI] [OPEN-3]
              Port[CL1-J] Ser#[   30053] LDEV#[   9(0x009)]
              HORC = P-VOL  HOMRCF[MU#0 = SMPL MU#1 = SMPL MU#2 = SMPL]
              RAID5[Group  2- 1] SSID = 0x0008 CTGID = 3
Harddisk 2... Port[ 2] PhId[ 4] TId[ 29] Lun[  1] [HITACHI] [OPEN-3]
              Port[CL1-J] Ser#[   30053] LDEV#[  10(0x00A)]
              HORC = S-VOL  HOMRCF[MU#0 = SMPL MU#1 = SMPL MU#2 = SMPL]
              RAID5[Group  2- 1] SSID = 0x0004 CTGID = 3
Harddisk 3... Port[ 2] PhId[ 4] TId[ 29] Lun[  6] [HITACHI] [OPEN-3-CM]
              Port[CL1-J] Ser#[   30053] LDEV#[  15(0x00F)]
```

Note: This example displays the devices for the range of disk drive numbers from 0 to 20.

Figure 4.52 Drivescan Subcommand Example

Output of the drivescan subcommand:

- **Harddisk #**: Shows the hard disk recognized by the Windows system.
- **Port**: Shows the port number on the device adapter recognized by the Windows system.
- **Phid**: Shows the bus number on the device adapter port recognized by Windows system.
- **Tid**: Shows the target ID of the hard disk(s) on the specified port and bus. For further information on fibre-to-SCSI address conversion, see Appendix C.
- **LUN**: Shows the LU number of the hard disk on the specified port, bus, and TID.
- **Port[CLX-Y]**: Shows the port number on the storage system.
- **Ser#**: Shows the production number (serial number) of the storage system.
- **LDEV#**: Shows the LDEV ID (hexadecimal) of the specified volume.
- **HORC**: Shows the TrueCopy attribute (P-VOL, S-VOL, SMPL) of the specified volume.
- **ShadowImage**: Shows the ShadowImage attribute (P-VOL, S-VOL, or SMPL) and MU number (0-2) of the specified volume.
- **RAIDX[Group]**: Shows the physical location (frame number-parity group number) of the specified volume and the RAID level of this parity group.
- **SSID**: Shows the SSID of the specified volume.
- **CTGID** (TrueCopy Async/UR only): Shows the consistency group ID of specified volume.

4.13.8 Portscan Subcommand

The portscan subcommand displays the devices on the specified port(s). Table 4.41 lists and describes the portscan subcommand parameters. Figure 4.53 shows an example of the portscan subcommand used as an option of the **raidscan** command and its output.

Table 4.41 Portscan Subcommand Parameters

Parameter	Value
Command Name	portscan
Format	-x portscan port#(0-N)
Argument	port#(0-N): Specifies the range of port numbers on the Windows system.

```
raidscan  -x  portscan  port0,20
PORT[ 0] IID [ 7] SCSI Devices
         PhId[ 0] TId[  3] Lun[  0]  [MATSHIT] [CD-ROM CR-508  ] ...Claimed
         PhId[ 0] TId[  4] Lun[  0]  [HP      ] [C1537A         ] ...Claimed
PORT[ 1] IID [ 7] SCSI Devices
         PhId[ 0] TId[  0] Lun[  0]  [HITACHI ] [DK328H-43WS    ] ...Claimed
PORT[ 2] IID [ 7] SCSI Devices
         PhId[ 0] TId[  5] Lun[  0]  [HITACHI ] [OPEN-3         ] ...Claimed
         PhId[ 0] TId[  5] Lun[  1]  [HITACHI ] [OPEN-3         ] ...Claimed
         PhId[ 0] TId[  5] Lun[  2]  [HITACHI ] [OPEN-3         ] ...Claimed
         PhId[ 0] TId[  6] Lun[  0]  [HITACHI ] [3390-3A        ] ...Claimed
```

Note: This example displays the devices for the range of ports from 0 to 20.

Figure 4.53 Portscan Subcommand Example

Output of the portscan subcommand:

- **Port**: Shows the port number on the device adapter recognized by the Windows system
- **IID**: Shows the initiator ID on the specified device adapter port
- **Phid**: Shows the BUS number on the specified device adapter port
- **Tid**: Shows the target ID of the hard disk(s) on the specified adapter port and bus. For further information on fibre-to-SCSI address conversion, see Appendix C.
- **LUN**: Shows the LU number of each hard disk on the specified device adapter port/bus. This item shows LDEV# of the partner who becomes a pair in or among the RAID storage system.

4.13.9 Sync and Syncd Subcommands

The sync (synchronization) subcommand sends unwritten data remaining on the Windows server to the specified device(s) to synchronize the pair(s) before the CCI command is executed. The syncd (synchronization delay) subcommand waits the delayed IO for dismount after issued “sync”. Table 4.52 lists and describes the sync and syncd subcommand parameters.

Table 4.42 Sync and Syncd Subcommand Parameters

Parameter	Value
Command Name	sync syncd
Format	-x sync[d] A: B: C: ... -x sync[d] all -x sync[d] drive#(0-N) -x sync[d] Volume# ... for Windows 2008/2003/2000 -x sync[d] D:\Directory or \Directory pattern ... for Windows 2008/2003/2000 systems
Arguments	**A: B: C: [\directory or \Directory pattern]** Specifies the logical drive that you want to synchronize. Data is flushed into the specified logical drive and the physical drive corresponding to the logical drive. If the specified logical drive has the directory mount volumes then SYNC will be executed to all of the volumes on the logical drive as shown below:

```
pairsplit  -x  sync  D:
[SYNC] D: HarddiskVolume2
[SYNC] D:\hd1 HarddiskVolume8
[SYNC] D:\hd2 HarddiskVolume9
```

[\directory or \Directory pattern] is used to find the directory mount point on the logical drive. If the **directory** is specified, then SYNC does execute to a directory mounted volume only.

```
pairsplit  -x sync  D:\hd1
[SYNC] D:\hd1 HarddiskVolume8
```

If the **directory pattern** is specified, then SYNC does execute to any directory mounted volumes identified to **“\directory pattern”**.

```
pairsplit  -x  sync  D:\h
[SYNC] D:\hd1 HarddiskVolume8
[SYNC] D:\hd2 HarddiskVolume9
```

all: Synchronizes all logical drives and the physical drives corresponding to the logical drives assuming that they are on the hard disks. The logical drive on which the CCI software is installed and the logical drive containing the Windows directory are excluded. If the logical drive has the directory mount volumes then SYNC will be executed to all volumes on the logical drive as shown below:

```
pairsplit  -x  sync  all
[SYNC] C: HarddiskVolume1
[SYNC] D:\hd1 HarddiskVolume8
[SYNC] D:\hd2 HarddiskVolume9
[SYNC] G: HarddiskVolume10
```

drive#(0-N): Specifies the range of drives on the Windows system.

Volume#(0-N): Specifies the LDM volumes to be flushed. Volume# must be specified ‘**\Vol# or \Dms# or \Dmt# or \Dmr#**’ as LDM volume for Windows 2008/2003/2000 systems. To flush HarddiskVolumeX:

```
-x sync  \VolX
```

See section 4.18.1 for information on ‘**\Vol# or \Dms# or \Dmt# or \Dmr#**’ for LDM volumes.

The following examples show the sync subcommand used as an option of the pairsplit command. For the example in Figure 4.54, the data remaining on logical drives C: and D: is written to disk, all pairs in the specified group are split (status = PSUS), and read/write access is enabled for all S-VOLs in the specified group.

```
pairsplit -x sync  C: D:  -g  oradb  -rw
```

Figure 4.54 Sync Subcommand Example – Pairsplit

For the example in Figure 4.55, the data remaining on physical devices harddisk2 and harddisk3 is written to disk, all pairs in the specified group are deleted (status = SMPL), which enables read/write access for all secondary volumes.

```
pairsplit -x sync  hdisk2  hdisk3 -g oradb -S
```

Figure 4.55 Sync Subcommand Example – Pairsplit -S

Note: **Sync** has the following behavior on any conditions:

- If the logical drives designated as the objects of the sync command will not be opened to any applications, then **sync** flushes the system buffer to a drive and makes the dismount state for this drive.
- If the logical drives designated as the objects of the sync command are already opened to any applications, then **sync** only flushes the system buffer to a drive.

  This will be allowed to flush the system buffer before pairsplit without unmounting the PVOL (opening state), and indicates as **[WARNING]** below:

  ```
  pairsplit -x sync  C:
  WARNING: Only flushed to [\\.\C:] drive due to be opening
  [SYNC] C: HarddiskVolume3
  ```

Note: **Syncd** has the following behavior as well:

- If the logical drives designated as the objects of the sync command will not be opened to any applications, then syncd flushes the system buffer to a drive and waits (30 sec) the delayed (paging) IO for dismount after made the dismount state about the drive.
- This avoids a problem that NTFS on PVOL will be split on inconsistent state because Windows 2003 delays the IO for dismounting.

4.13.10 Mount Subcommand

The mount subcommand mounts the specified drive to the specified partition on the specified hard disk drive using the drive letter. When the mount subcommand is executed without an argument, all currently mounted drives (including directory mounted volumes) are displayed, and logical drive has been mounting an LDM volume then displays Harddisk#[n] configured an LDM volume.

Table 4.43 lists and describes the mount subcommand parameters. Figure 4.56 and Figure 4.57 show examples of the mount subcommand used as an option of the pairsplit command and its output.

Table 4.43 Mount Subcommand Parameters

<table>
<tr><th>Parameter</th><th>Value</th></tr>
<tr><td>Command Name</td><td>mount</td></tr>
<tr><td>Format</td><td>-x mount
-x mount drive: hdisk# [partition#] for Windows NT
-x mount drive: Volume# for Windows 2008/2003/2000
-x mount drive: [\directory] Volume# for Windows 2008/2003/2000</td></tr>
<tr><td>Arguments</td><td>drive: hdisk# [partition #]: Specifies the logical drive, hard disk drive (number), and partition to be mounted.
drive: [\directory] Volume#: Specifies the logical drive and LDM volume name and number to be mounted. Volume# must be specified '\Vol# or \Dms# or \Dmt# or \Dmr# ' as LDM volume for Windows 2008/2003/2000. To mount HarddiskVolumeX: -x mount C: hdX or -x mount C: \VolX
See section4.18.1 for information on '\Vol# or \Dms# or \Dmt# or \Dmr#' for LDM volumes.
[\directory]: Specifies the directory mount point on the logical drive.
pairsplit -x mount D:\hd1 \Vol8
D:\hd1 <+> HarddiskVolume8
pairsplit -x mount D:\hd2 \Vol9
D:\hd2 <+> HarddiskVolume9</td></tr>
<tr><td>Restriction</td><td>The partition on the specified disk drive (hard disk) must be recognized on the Windows system.
[\directory] for the mount must be specified a mount point without imbedded space character.
If [\directory] will be detected as mount point with embedded space (i.e. aaa bbb), then the directory will be shown by adding "…" to first strings as below.<pre>
pairsplit -x mount
Drive   FS_name VOL_name Device   Partition ... Port PathID Targ Lun
D: NTFS   Null   Harddiskvolume3   ...   Harddisk2
D:\aaa… NTFS   Null   Harddiskvolume4   ...   Harddisk3
</pre>The same method is used for "inqraid $LETALL" and "raidscan -pi $LETALL -find" command.</td></tr>
</table>

```
pairsplit -x mount F: hdisk2 p1   -x mount G: hdisk1 p1
pairsplit -x mount

Drive   FS_name  VOL_name   Device      Partition   ...  Port  PathID  Targ  Lun
C:      FAT      Null       Harddisk0   Partition1   ...   1       0      0    0
F:      FAT      Null       Harddisk2   Partition1   ...   2       0      5    1
G:      NTFS     Null       Harddisk1   Partition1   ...   2       0      5    0
Z:      CDFS     Null       CdRom0                  ... Unknown
```

Figure 4.56 Mount Subcommand Example for Windows NT

The example in Figure 4.56executes mount from command option of the pairsplit, mounting the “F:” drive to partition1 on disk drive2 and the “G:” drive to partition1 on disk drive1, and then displays the mounted devices.

```
pairsplit -x mount  F: hdisk2
pairsplit  -x mount
Drive    FS_name    VOL_name    Device      Partition    ...  Port  PathID  Targ  Lun
C:       NTFS        Null        Harddiskvolume1         ...   Harddisk0
F:       NTFS        Null        Harddiskvolume2         ...   Harddisk1
D:       NTFS        Null        Harddiskvolume3         ...   Harddisk2
D:\hd1   NTFS        Null        Harddiskvolume4         ...   Harddisk3
D:\hd2   NTFS        Null        Harddiskvolume5         ...   Harddisk4
G:       NTFS        Null        HarddiskDmVolumes\…\Volume1  ... Harddisk5[3]
```

Figure 4.57 Mount Subcommand Example for Windows 2008/2003/2000

The example in Figure 4.57executes mount from command option of the pairsplit and then displays the mounted devices. The **F:** drive is mounted to harddiskvolume2, **D:** is mounted to harddiskvolume3, **D:\hd1** directory (‘hd1’ directory on D: drive) is mounted to harddiskvolume4, **D:\hd2** directory is mounted to harddiskvolume5, and **G:** drive is mounted to harddiskDmVolumes\…\Volume1 for spanned volume configured with three harddisks

Output of the mount subcommand:

- **Drive**: Shows the logical drive recognized by the Windows system
- **FS_name**: Shows the name of the file system formatted on the specified drive
- **VOL_name**: Shows the volume label name for the specified drive
- **Device, Partition**: Shows the device name and partition for the specified drive
- **Port,Phid,Tid,Lun**: Shows the port number, path ID (bus), target ID, and LUN for the specified drive. For further information on fibre-to-SCSI address conversion, see Appendix C.

4.13.11 Umount and Umountd Subcommands

The umount subcommand unmounts the specified logical drive and deletes the drive letter. Before deleting the drive letter, this subcommand executes sync internally for the specified logical drive and flushes unwritten data. The umountd subcommand unmounts the logical drive after waiting the delayed IO for dismount. Table 4.44 lists and describes the umount and umountd subcommand parameters. Figure 4.58 shows an example of the umount subcommand used as an option of the pairsplit command.

Table 4.44 Umount and Umountd Subcommand Parameters

<table>
<tr><th>Parameter</th><th>Value</th></tr>
<tr><td>Command Name</td><td>umount
umountd</td></tr>
<tr><td>Format</td><td>-x umount[d] drive: [time]
-x umount[d] drive:[\directory] [time] for Windows 2008/2003/2000</td></tr>
<tr><td>Argument</td><td>drive: Specifies the mounted logical drive.
[\directory]: Specifies the directory mount point on the logical drive.
<pre>
pairsplit -x umount D:\hd1 \Vol8
D:\hd1 <-> HarddiskVolume8
pairsplit -x umount D:\hd2 \Vol9
D:\hd2 <-> HarddiskVolume9
</pre>
Example for waiting 45 sec:
<pre>
pairsplit -x umount D: 45
D: <-> HarddiskVolume8
</pre></td></tr>
<tr><td>Restriction</td><td>The logical drive to be unmounted and the corresponding physical drive must be closed to all applications.</td></tr>
</table>

```
pairsplit -x umount F:  -x umount G: -g oradb -rw
pairsplit -x mount

Drive   FS_name   VOL_name   Device       Partition  ...  Port PathID  Targ  Lun
C:      FAT       Null       Harddisk0    Partition1  ...   1      0      0    0
Z:      Unknown   Unknown    CdRom0                   ...  Unknown
```

Figure 4.58 Umount Subcommand Example

The example in Figure 4.58 unmounts the F: and G: drives, splits all pairs in the specified group (status = PSUS), enables read/write access to all secondary volumes in the specified group, and then displays all mounted drives.

Output of the umount subcommand:

- **Drive**: Shows the logical drive recognized by the Windows system
- **FS_name**: Shows the name of the file system formatted on the specified drive
- **VOL_name**: Shows the volume label name for the specified drive
- **Device, Partition**: Shows the device name and partition for the specified drive
- **Port,Phid,Tid,Lun**: Shows the port number, path ID (bus), target ID, and LUN for the specified drive. For further information on fibre-to-SCSI address conversion, see Appendix C.

Note: The umount command flushes (sync) the system buffer of the associated drive before deleting the drive letter. If umount has failed, you need to confirm the following conditions:

- The logical and physical drives designated as the objects of the umount command are not opened to any applications. For example, confirm that Explore is not pointed on the target drive. If it is, then the target drive will be opening.
- Umount command does not ignore the detected error on the NT file system, so that umount is successful in a normal case (NO ERROR case) only on NT file system. For example, confirm the target drive has no failure on the system for Event Viewer. If so, you must reboot the system or delete the partition and reconfigure the target drive.

Note: Umountd has the following behavior as well.

- Unmount the logical drive after waiting (30 sec) the delayed (paging) IO for dismount after flushed the system buffer to a drive.
- This avoids a problem (Windows 2003 only) that NTFS on PVOL will be split on inconsistent state because Windows 2003 delays the IO for dismounting. This also avoids a problem that the delayed (paging) IO for dismounting will be written on SVOL_PAIR(Writing Disable) state by rescan, and logged as windows event (i.e., ID51,57).

  These problems do not occur on Windows 2008 systems.

4.13.12 Environment Variable Subcommands

If no environment variables are set in the execution environment, the environment variable subcommand sets or cancels an environment variable within the CCI command. The setenv subcommand sets the specified environment variable(s). The usetenv subcommand deletes the specified environment variable(s). The env subcommand command displays the environment variable(s). The sleep subcommand causes CCI to wait for the specified time. Table 4.45 lists and describes the environment variable subcommands and their parameters.

Table 4.45 Environment Variable Subcommand Parameters

Parameter	Value
Command Name	setenv usetenv env sleep
Format	-x setenv vaname value -x usetenv vaname -x env -x sleep time
Argument	Vaname: Specifies the environment variable to be set or canceled. Value: Specifies the value or character string of the environment variable to be set. Time: Specifies the sleep time in seconds.
Restriction	The environment variables must be set before connecting to HORCM, and must be specified during interactive mode (-z option). Changing an environment variable after a CCI command execution error is invalid.

Figure 4.59 shows an example of the setenv and usetenv subcommands used as an option of the **raidscan** command. This example changes from “HORC” to “HOMRCF” an execution environment of the **raidscan** command which makes a dialog mode, because of establishing “HORCC_MRCF” as an environment variable.

```
raidscan[HORC]:  -x setenv  HORCC_MRCF 1
raidscan[MRCF]:

raidscan[MRCF]:  -x usetenv  HORCC_MRCF
raidscan[HORC]:
```

Figure 4.59 Environment Variable Subcommand Examples

4.14 CCI Command Tools

4.14.1 Inqraid Command Tool

CCI provides the inqraid command tool for confirming the drive connection between the storage system and host system. The inqraid command displays the relation between special file(s) on the host system and actual physical drive of the RAID storage system.
Table 4.46 lists and describes the inqraid command and parameters. Figure 4.60 shows examples of using inqraid and system command to display the connection between special file of STDIN and actual physical drive of storage system. Figure 4.61 - Figure 4.68 show examples of the **-find**, **-findc**, **-CLI**, **-sort [CM]**, **-gvinf**, and **-svinf** options.

Table 4.46 Inqraid Command Parameters

Parameter	Value
Command Name	/HORCM/usr/bin/inqraid
Format	/HORCM/usr/bin/inqraid [-h | quit | -inqdump | -f[x][p][l][g] | -find[c] | <special file> | -CLI[WPN] | -sort | -CM | -gvinf | -svinf | -gplba | -pin | -fv(Windows only)]
Options	**-h**: Displays Help/Usage. **quit**: Terminates from waiting STDIN and exits this command. **-inqdump**: Displays information for standard inquiry with Dump Image of hexadecimal. **-fx**: Displays the LDEV number with hexadecimal. **-find[c]**: Finds the appropriate group within the configuration file using a special file provided by STDIN. **-find**: Searches a group on the configuration definition file (local instance) from <special file> of STDIN by using pairdisplay command, and uses the following options of the pairdisplay command to display its state. This option must be specified HORCMINST as command execution environment. For ShadowImage: **pairdisplay -d** <Seq#> <LDEV#> 0 1 2 -l [-fx] [-CLI] 2>/dev/null For Hitachi TrueCopy: **pairdisplay -d** <Seq#> <LDEV#> -l [-fx] [-CLI] 2>/dev/null *Note:* <Seq#> and <LDEV#> are included using SCSI Inquiry command. <special file>: This option is used to specify the special file name as argument of command. If no argument, this command makes mode that wait for STDIN without argument. **-findc**: Uses the following options of the pairdisplay command, and displays with CLI format by editing an output of pairdisplay command. For ShadowImage: **pairdisplay -d** <Seq#> <LDEV#> <MU#> -fd -CLI 2>/dev/null For Hitachi TrueCopy: **pairdisplay -d** <Seq#> <LDEV#> -fd -CLI 2>/dev/null *Note:* <Seq#> and <LDEV#> are included using SCSI Inquiry command. **<special file>**: Specifies a special file name as the argument of a command. **No argument**: Expects STDIN to provide the arguments. **-CLI**: Displays structured column output for Command Line Interface (CLI) parsing. Also used for "-find" option. The delimiters between columns can be spaces and/or dashes (-). **-CLIWP, -CLIWN**: Displays the WWN (world wide name for HOST adapter) and LUN with CLI format, also used for "-find" option. **-sort [CM]**: Sorts the target devices by Serial#,LDEV# order. **[CM]** Displays the command device only in horcm.conf image. This option is valid within "-sort" option **-gvinf** (only Windows systems) **-gvinfex** (for GPT disk on Windows 2008/2003): Gets the signature and volume layout information of a raw device file provided via STDIN or arguments, and saves this information to the system disk with the following format: \WindowsDirectory\VOLssss_llll.ini where ssss = serial#, llll = LDEV# Normally this option is used to save the signature and volume layout information once after the user has set the new partition for SVOL using the Windows Disk Management.

Parameter	Value

-svinf[=PTN] (only Windows systems)
-svinfex[=PTN] (for GPT disk on Windows 2008/2003): Sets the signature and volume layout information that was saved to the system disk to a raw device file provided via STDIN or arguments. Gets the serial# and LDEV# for the target device using SCSI Inquiry, and sets the signature and volume layout information into VOL**ssss_llll**.ini file to the target device. This option will set correctly because the signature and volume layout information is managed by the serial# and LDEV# without depend on Harddisk#, even if Harddisk# is changed by the configuration changes.
[=PTN]: Specifies a strings pattern to interpret the strings provided via STDIN as a raw device.

\Device\HarddiskVolume#(number) is made in a sequential order executed **-svinf** to Harddisk, and its number will remain the same as long as the system configuration is not changed. If you want to make \Device\HarddiskVolume#(number) more absolutely, then make \Device\HarddiskVolume# in serial# and LDEV# order by using the “-sort” option as shown below:

```
   D:\HORCM\etc>echo hd5 hd4 hd3 | inqraid -svinf -sort
  [VOL61459_451_5296A763] -> Harddisk3        [OPEN-3          ]
  [VOL61459_452_5296A760] -> Harddisk4        [OPEN-3          ]
  [VOL61459_453_5296A761] -> Harddisk5        [OPEN-3          ]
```

-gplba (only Windows systems)
-gplbaex (for GPT disk on Windows 2008/2003): Displays usable LBA on a physical drive in units of 512 bytes, and specifies **[slba] [elba]** options for **raidvchkset** command.

Example: `C:\HORCM\etc>inqraid $Phys -CLI -gplba -sort`

```
Harddisk11 : SLBA = 0x00003f00 ELBA = 0x000620d9 PCNT = 7 [OPEN-3-CVS     ]
Harddisk12 : SLBA = 0x00003f00 ELBA = 0x00042ad1 PCNT = 4 [OPEN-3-CVS     ]
Harddisk13 : SLBA = 0x0000003f ELBA = 0x000620d9 PCNT = 1 [OPEN-3-CVS     ]
```

SLBA: Displays usable starting LBA in units of 512 bytes.
ELBA: Displays usable ending LBA (ELBA -1) in units of 512 bytes.
PCNT: Displays the number of partitions.

Example for setting of Harddisk11:

```
    C:\HORCM\etc>raidvchkset -d hd11 -vs 16 0x00003f00 0x000620d9
```

-fv (only Windows 2008/2003/2000 systems): Displays the Volume{GUID} via $Volume with wide format.
Example:

```
   C:\HORCM\etc>inqraid -CLI $Vol -fv
  DEVICE_FILE      PORT   SERIAL  LDEV CTG  H/M/12  SSID R:Group PRODUCT_ID
   Volume{cec25efe-d3b8-11d4-aead-00c00d003b1e}\Vol3\Dsk0  CL2-D  62496
256
   -       -     -       - OPEN-3-CVS-CM
```

-fp or **-fl** or **-pin**: Shows a data protection volume with “-CLI” option by appending ‘*’ to the device file name. If the **-fp** option is specified, the data protection volume is a Database Validator volume. If the **-fl** option is specified, the data protection volume is a Data Retention Utility (Open LDEV Guard on 9900V) volume. If the **-pin** option is specified, shows that the volume is PIN track volume because of HDD double drive failure and/or external connection disks failure especially.

```
    # ls /dev/rdsk/c57t4* | ./inqraid -CLI -fp
  DEVICE_FILE     PORT    SERIAL  LDEV CTG  H/M/12  SSID R:Group PRODUCT_ID
  c57t4d0*        CL1-D    62496    32   -  s/P/ss  0004 5:01-03 OPEN-3
  c57t4d3*        CL1-D    62496    35   -  s/P/ss  0004 5:01-03 OPEN-3
  c57t4d4         CL1-D    62496    36   -  s/P/ss  0004 5:01-01 OPEN-3
  c57t4d5         CL1-D    62496    37   -  s/P/ss  0004 5:01-02 OPEN-3
```

This example shows that c57t4d0 and c57t4d3 (marked by *) are set to enable Database Validator checking (-fp option). The **raidvchkset** command (section 4.12.1) is used to enable/disable volume protection.

-fg (9900V and later): Shows a LUN on the host view by finding a host group for (9900V and later).

-fw: Displays all of the cascading volume statuses on the STD Inquiry Page. If this option is not specified, then only four cascading mirrors are displayed.

Example:

```
# ls /dev/rdsk/* | inqraid -CLI -fw
DEVICE_FILE PORT  SERIAL LDEV CTG H../M/..         SSID R:Group PRODUCT_ID
c1t2d10s2   CL2-D 62500  266   -  Psss/P/PP-----------  0005 1:01-02 OPEN-3
c1t2d11s2   CL2-D 62500  267   -  ssss/P/PP-----------  0005 1:01-02 OPEN-3
```

Parameter	Value
	-CLIB -sort: This option is used to know how much pair is possible to create the paired volume on the actual array, and calculates the total Bitmap page for HORC/HOMRCF and the unused Bitmap page by sorting the specified special file (the standard input or the argument) with Serial#,LDEV# order. The default is HOMRCF. This option is valid within "**-sort**" option. *Note:* An identical LDEV which was sorted in Serial#, LDEV# is accepted to calculate the Bitmap page (LDEVs shared by multiple ports are calculated as one LDEV). Also, a command device is excepted from the total. *Example:*

```
# ls /dev/rdsk/* | inqraid -sort -CLIB
DEVICE_FILE     PORT    SERIAL  LDEV SL CL  +SI/SI  UNUSED  PRODUCT_ID
c1t0d0          CL1-E    63516     0  0  0       -       -  OPEN-9-CM
c1t0d1          CL1-E    63516 12288  0  0       1   30718  OPEN-3
c1t0d2          CL1-E    63516 12403  0  0       4   30718  OPEN-9
c1t0d3          CL1-E    63516 12405  0  0       9   30718  OPEN-E
c1t0d4          CL1-E    63516 12800  0  0      12   30718  OPEN-8
c1t0d5          CL1-E    63516 12801  0  0      18   30718  OPEN-8*2
c1t0d6          CL1-E    63516 13057  0  0      31   30718  OPEN-L
c2t0d6          CL2-E    63516 13057  0  0      31   30718  OPEN-L
```

	-fh[c]: Used to specify the Bitmap page for HORC/UR. "-fc" option is used to calculate the Bitmap page of cylinder size for HORC. *Example:*

```
# ls /dev/rdsk/* | inqraid -sort -CLIB -fh
DEVICE_FILE     PORT    SERIAL  LDEV SL CL  +TC/UR  UNUSED  PRODUCT_ID
c1t0d0          CL1-E    63516     0  0  0       -       -  OPEN-9-CM
c1t0d1          CL1-E    63516 12288  0  0       1   11605  OPEN-3
c1t0d2          CL1-E    63516 12403  0  0       3   11605  OPEN-9
c1t0d3          CL1-E    63516 12405  0  0      10   11605  OPEN-E
c1t0d4          CL1-E    63516 12800  0  0      11   11605  OPEN-8
c1t0d5          CL1-E    63516 12801  0  0      13   11605  OPEN-8*2
c1t0d6          CL1-E    63516 13057  0  0      21   11605  OPEN-L
c2t0d6          CL2-E    63516 13057  0  0      21   11605  OPEN-L
```

	SL: This displays the SLPR number of LDEV. **CL**: This displays the CLPR number of LDEV. **+SI/SI**: This shows the total of Bitmap for the HOMRCF. The increase page shows necessary Bitmap page as **one paired volume** of HOMRCF. **+TC/UR**: This shows the total of Bitmap for the HORC or UR. The increase page shows necessary Bitmap page as **one volume** of HORC or UR. **UNUSED**: This shows the unused Bitmap page for each HOMRCF and HORC/UR. One Page is about 64 KB.
Restriction	STDIN or special files are specified as follows (lines starting with '#' via STDIN are interpreted as comments): HP-UX: /dev/rdsk/* or /dev/rdisk/disk* Solaris: /dev/rdsk/*s2 or c*s2 Linux : /dev/sd... or /dev/rd... ,/dev/raw/raw*. zLinux: /dev/sd... or /dev/dasd… or /dev/rd... ,/dev/raw/raw*. AIX: /dev/rhdisk* or /dev/hdisk* or hdisk* DIGITAL or Tru64: /dev/rrz*c or /dev/rdisk/dsk*c or /dev/cport/scp* DYNIX: /dev/rdsk/sd* or sd* for only unpartitioned raw device IRIX64: /dev/rdsk/*vol or /dev/rdsk/node_wwn/*vol/* or /dev/dsk/*vol or /dev/dsk/node_wwn/*vol/* OpenVMS: 1* or DK* or DG* or GK* Windows NT: hdX-Y, $LETALL, $Phys, D:\DskX\pY, \DskX\pY Windows 2008/2003/2000: hdX-Y,$LETALL,$Volume,$Phys, D:\Vol(Dms,Dmt,Dmr)X\DskY, \Vol(Dms,Dmt,Dmr)X\DskY See section 4.18.1 for further information on LDM volumes for Windows 2008/2003/2000 systems. Lines starting with '#' via STDIN are interpreted as comments.

HP-UX System:

```
# ioscan -fun | grep rdsk | ./inqraid
/dev/rdsk/c0t2d1 -> [HP] CL2-D Ser =  30053 LDEV =   9 [HP     ] [OPEN-3        ]
                    HORC = P-VOL  HOMRCF[MU#0 = SMPL MU#1 = SMPL MU#2 = SMPL]
                    RAID5[Group  2- 1] SSID = 0x0008 CTGID = 3
/dev/rdsk/c0t4d0 -> [HP] CL2-D Ser =  30053 LDEV =  14 [HP     ] [OPEN-3-CM     ]
                    RAID5[Group  2- 1] SSID = 0x0008
```

Linux and zLinux System:

```
# ls /dev/sd* | ./inqraid
/dev/sdh -> CHNO =   0 TID =   1 LUN =   7
            [HP] CL2-B Ser =   30053 LDEV =  23 [HP     ] [OPEN-3        ]
            HORC = P-VOL  HOMRCF[MU#0 = SMPL MU#1 = SMPL MU#2 = SMPL]
            RAID5[Group  1- 2] SSID = 0x0004 CTGID = 2
/dev/sdi -> CHNO =   0 TID =   4 LUN =   0
            [HP] CL2-B Ser =   30053 LDEV =  14 [HP     ] [OPEN-3-CM     ]
            RAID5[Group  1- 2] SSID = 0x0004
```

Solaris System:

```
# ls /dev/rdsk/* | ./inqraid
/dev/rdsk/c0t2d1 -> [HP] CL2-D Ser =   30053 LDEV =   9 [HP      ] [OPEN-3    ]
                    CA = P-VOL  BC[MU#0 = SMPL MU#1 = SMPL MU#2 = SMPL]
                    RAID5[Group  2- 1] SSID = 0x0008 CTGID = 3
/dev/rdsk/c0t4d0 -> [HP] CL2-D Ser =   30053 LDEV =  14 [HP      ] [OPEN-3-CM    ]
                    RAID5[Group  2- 1] SSID = 0x0008
```

AIX System:

```
# lsdev -C -c disk | grep hdisk | ./inqraid
hdisk1 -> [SQ] CL2-D Ser =   30053 LDEV =   9 [HITACHI ] [OPEN-3          ]
          HORC = P-VOL  HOMRCF[MU#0 = SMPL MU#1 = SMPL MU#2 = SMPL]
          RAID5[Group  2- 1] SSID = 0x0008 CTGID = 3
hdisk2 -> [SQ] CL2-D Ser =   30053 LDEV =  14 [HITACHI ] [OPEN-3-CM       ]
          RAID5[Group  2- 1] SSID = 0x0008
```

Windows System:

```
C:\HORCM\etc> echo hd1-2 | inqraid ( or inqraid hd1-2 )
Harddisk 1 -> [SQ] CL2-D Ser =   30053 LDEV =   9 [HITACHI ] [OPEN-3          ]
               HORC = P-VOL  HOMRCF[MU#0 = SMPL MU#1 = SMPL MU#2 = SMPL]
               RAID5[Group  2- 1] SSID = 0x0008 CTGID = 3
Harddisk 2 -> [SQ] CL2-D Ser =   30053 LDEV =  14 [HITACHI ] [OPEN-3-CM       ]
               RAID5[Group  2- 1] SSID = 0x0008
```

Tru64 UNIX System:

```
# ls /dev/rdisk/dsk* | ./inqraid
/dev/rdisk/dsk10c -> [SQ] CL2-D Ser =   30053 LDEV =   9 [HITACHI ] [OPEN-3       ]
                     HORC = P-VOL  HOMRCF[MU#0 = SMPL MU#1 = SMPL MU#2 = SMPL]
                     RAID5[Group  2- 1] SSID = 0x0008 CTGID = 3
/dev/rdisk/dsk11c -> [SQ] CL2-D Ser =   30053 LDEV =  14 [HITACHI ] [OPEN-3-CM     ]
                     RAID5[Group  2- 1] SSID = 0x0008
```

DYNIX® System:

```
# dumpconf -d | grep sd | ./inqraid
sd1-> [SQ] CL2-D Ser =   30053 LDEV =   9 [HITACHI ] [OPEN-3          ]
      HORC = P-VOL  HOMRCF[MU#0 = SMPL MU#1 = SMPL MU#2 = SMPL]
      RAID5[Group  2- 1] SSID = 0x0008 CTGID = 3
Sd2-> [SQ] CL2-D Ser =   30053 LDEV =  14 [HITACHI ] [OPEN-3-CM       ]
      RAID5[Group  2- 1] SSID = 0x0008
```

Figure 4.60   Inqraid Command Tool Examples (continues on the next page)

IRIX System with FC_AL:

```
# ls /dev/rdsk/*vol | ./inqraid
/dev/rdsk/dks1d6vol -> [SQ] CL2-D Ser =   30053 LDEV =   9 [HITACHI   ] [OPEN-3     ]
                      HORC = P-VOL  HOMRCF[MU#0 = SMPL MU#1 = SMPL MU#2 = SMPL]
                      RAID5[Group  2- 1] SSID = 0x0008 CTGID = 3
/dev/rdsk/dks1d7vol -> [SQ] CL2-D Ser =  30053 LDEV =  14 [HITACHI    ] [OPEN-3-CM  ]
                       RAID5[Group  2- 1] SSID = 0x0008
```

IRIX System with Fabric:

```
# ls /dev/rdsk/*/*vol/* | ./inqraid
/dev/rdsk/50060e8000100262/lun3vol/c8p0 -> [SQ] CL2-D Ser = 30053 LDEV = 9 [HITACHI] [OPEN-3]
                                        HORC = P-VOL  HOMRCF[MU#0 = SMPL MU#1 = SMPL MU#2 = SMPL]
                                        RAID5[Group  2- 1] SSID = 0x0008 CTGID = 3
/dev/rdsk/50060e8000100262/lun4vol/c8p0 -> [SQ] CL2-D Ser=30053 LDEV = 14 [HITACHI] [OPEN-3-CM]
                                            RAID5[Group  2- 1] SSID = 0x0008
```

OpenVMS® System:

```
$ inqraid dka145-146
DKA145 -> [ST] CL2-D Ser =   30053 LDEV =   9 [HITACHI ] [OPEN-3         ]
          HORC = P-VOL  HOMRCF[MU#0 = SMPL MU#1 = SMPL MU#2 = SMPL]
          RAID5[Group  2- 1] SSID = 0x0008 CTGID = 3
DKA146 -> [ST] CL2-D Ser =   30053 LDEV =  14 [HITACHI ] [OPEN-3-CM       ]
          RAID5[Group  2- 1] SSID = 0x0008
```

Figure 4.60 Inqraid Command Tool Examples

The following items are output for the inqraid command tool:

CL*X*-*Y*: Displays the port number on the RAID storage system.

Ser: Displays the production (serial#) number on the RAID storage system.

LDEV: Displays the LDEV# in the RAID storage system.

HORC: Displays the attribute (“PVOL/SVOL/SMPL”) of a volume as TrueCopy in the RAID storage system.

HOMRCF: Displays the attribute (“PVOL/SVOL/SMPL”) of a volume as MU#0-2 of ShadowImage/Snapshot in the RAID storage system.

Group: Displays the physical position of an LDEV according to mapping of LDEV in the RAID storage system.

LDEV Mapping	Display Formats
RAID Group	RAID1[Group Group number - Sub number] RAID5[Group Group number - Sub number] RAID6[Group Group number - Sub number]
SnapShot SVOL	SNAPS[PoolID poolID number]
Unmapped	UNMAP[Group 00000]
External LUN	E-LUN[Group External Group number]
HDP (AOU) volume	A-LUN[PoolID poolID number]

SSID: Displays Sub System ID of the LDEV in the RAID storage system.

CTGID: Displays CT group ID of TrueCopy Async/UR when the LDEV has been defined as the PVOL or SVOL of the TrueCopy Async/UR.

CHNO: Displays the channel number on the device adapter that recognizes on the Linux host. Displayed only for Linux systems.

TID: Displays target ID of the hard disk that connects on the device adapter port. Displayed only for Linux systems.

LUN: Displays logical unit number of the hard disk that connects on the device adapter port. Displayed only for Linux systems.

Note: The display of **Group**, **SSID**, and **CTGID** depends on the storage system microcode level. The **CHNO**, **TID**, and **LUN** items are displayed only for Linux systems.

```
ls /dev/sd* | inqraid -find
/dev/sdb -> No such on the group
Group   PairVol(L/R) (Port#,TID,LU),Seq#,LDEV#.P/S,Status,Fence, Seq#,P-LDEV# M
oradb   oradev2(L)  (CL2-N , 3,  2) 8071   22..SMPL  ---- ------,-----  ----  -
->/dev/sdc
```

Figure 4.61 Inqraid: Example of -find Option (Linux example shown)

```
# echo /dev/rdsk/c23t0d0 /dev/rdsk/c23t2d3 | ./inqraid -find
Group   PairVol(L/R) (Port#,TID,LU-M),Seq#,LDEV#.P/S,Status, Seq#,P-LDEV# M
horc1   dev00(L)    (CL2-J , 0,  0-0)61456  192..S-VOL SSUS,-----    193  -
->/dev/rdsk/c23t0d0
Group   PairVol(L/R) (Port#,TID,LU-M),Seq#,LDEV#.P/S,Status, Seq#,P-LDEV# M
horc1   dev10(L)    (CL2-J , 2,  3-0)61456  209..S-VOL SSUS,-----    206  -
->/dev/rdsk/c23t2d3
```

Figure 4.62 Inqraid: Example of -find Option (HP-UX example shown)

```
# echo /dev/rdsk/c23t0d0 /dev/rdsk/c23t2d3 | ./inqraid -findc
DEVICE_FILE     M Group    PairVol    P/S   Stat  R_DEVICE     M P/S   Stat LK
c23t0d0         0 horc1    dev00      S-VOL SSUS  c23t0d1      0 P-VOL PSUS OK
/dev/rdsk/c23t0d0[1] -> No such on the group
/dev/rdsk/c23t0d0[2] -> No such on the group
DEVICE_FILE     M Group    PairVol    P/S   Stat  R_DEVICE     M P/S   Stat LK
c23t2d3         0 horc1    dev10      S-VOL SSUS  c23t2d2      0 P-VOL PSUS OK
/dev/rdsk/c23t2d3[1] -> No such on the group
/dev/rdsk/c23t2d3[2] -> No such on the group

# echo /dev/rdsk/c23t0d0 /dev/rdsk/c23t2d3 | ./inqraid -findc -CLI
DEVICE_FILE     M Group    PairVol    P/S   Stat  R_DEVICE     M P/S   Stat LK
c23t0d0         0 horc1    dev00      S-VOL SSUS  c23t0d1      0 P-VOL PSUS OK
c23t2d3         0 horc1    dev10      S-VOL SSUS  c23t2d2      0 P-VOL PSUS OK
```

Figure 4.63 Inqraid: Example of -findc Option (HP-UX example shown)

DEVICE_FILE: Device file name.
M: MU# of local and remote.
Group: Group name (dev_group) defined in the configuration file.
PairVol: Paired vol. name (dev_name) within the group defined in the configuration file.
P/S: Volume attribute (PVOL or SVOL or simplex).
Stat: Status of the paired volume.
R_DEVICE: Device file name of remote site.
LK: Check result of the paired volume connection path.

```
# ls /dev/sd* | ./inqraid -CLI
DEVICE_FILE     PORT    SERIAL  LDEV  CTG  H/M/12  SSID  R:Group  PRODUCT_ID
sdh             CL2-B    30053    23   2   S/P/ss  0004  5:02-01  OPEN-3
sdi             CL1-A    64015    14   -        -  0004  E:00002   OPEN-3-CM
sdj                 -        -     -   -        -     -        -        -
```

Figure 4.64 Inqraid: Example of -CLI Option (Linux example shown)

DEVICE_FILE: Displays the device file name only.

PORT: Displays the RAID storage system port number.

SERIAL: Displays the production (serial#) number of the storage system.

LDEV: Displays the LDEV# within the storage system.

CTG: Displays the CT group ID of TrueCopy Async/UR when the LDEV has been defined as a TrueCopy Async/UR PVOL or SVOL.

H/M/12: Displays attribute (PVOL is "P", SVOL is "S", SMPL is "s") of a TrueCopy volume, ShadowImage/Snapshot volume, and ShadowImage/Snapshot MU#1,2 volumes.

SSID: Displays the Sub System ID of an LDEV in the storage system.

R:Group: Displays the physical position of an LDEV according to mapping of LDEV in the storage system.

LDEV Mapping	R:	Group
RAID Group	RAID Level 1 → RAID1 5 → RAID5 6 → RAID6	RAID Group number - Sub number
SnapShot SVOL	S	Pool ID number
Unmapped	U	00000
External LUN	E	External Group number
HDP (AOU) volume	A	Pool ID number

PRODUCT_ID: Displays product-id field in the STD inquiry page.

Note: In case of a command device, PORT/SERIAL/LDEV/PRODUCT_ID is the SCCSI Inquiry information for the external command device, if the command device is mapped as ELUN(**R:** =E).

```
# echo /dev/rdsk/c23t0d0 /dev/rdsk/c23t0d1 | ./inqraid -CLIWP
DEVICE_FILE     PWWN             AL PORT   LUN    SERIAL  LDEV PRODUCT_ID
c23t0d0         500060e802f01018  - CL2-J    -     61456   192 OPEN-3
c23t0d1         500060e802f01018  - CL2-J    -     61456   193 OPEN-3

# echo /dev/rdsk/c0t2d3 | ./inqraid -CLIWN
DEVICE_FILE     NWWN             AL PORT   LUN    SERIAL  LDEV PRODUCT_ID
c0t2d3          5000E000E0005000  - CL1-A    -     30015  2054 OPEN3-CVS
```

Figure 4.65 Inqraid: Example of -CLIWP and -CLIWN Options (HP-UX example shown)

DEVICE_FILE: Displays the device file name only.

WWN: CLIWP option displays Port_WWN of the host adapter included in the STD inquiry page. CLIWN option displays Node_WWN of host adapter included in STD inquiry page.

AL: This option always displays as "-".

PORT: Displays the RAID storage system port number.

LUN: This option always displays as "-".

SERIAL: Displays the production (serial#) number of the storage system.

LDEV: Displays the LDEV# within the storage system.

PRODUCT_ID: Displays product-id field in the STD inquiry page.

```
#ioscan -fun | grep rdsk | ./inqraid -sort -CM -CLI
HORCM_CMD
#dev_name               dev_name                dev_name
#UnitID 0 (Serial# 30012)
/dev/rdsk/c0t3d0        /dev/rdsk/c1t2d1
#UnitID 1 (Serial# 30013)
/dev/rdsk/c2t3d0
```

Figure 4.66 Inqraid: Example of -sort[CM] Option (HP-UX example shown)

```
D:\HORCM\etc>inqraid $Phys -gvinf -CLI
\\.\PhysicalDrive0:
# Harddisk0        -> [VOL61459_448_DA7C0D91] [OPEN-3          ]
\\.\PhysicalDrive1:
# Harddisk1        -> [VOL61459_449_DA7C0D92] [OPEN-3          ]
\\.\PhysicalDrive2:
# Harddisk2        -> [VOL61459_450_DA7C0D93] [OPEN-3          ]
                            ↖S/N  ↖LDEV  ↖Signature
```

Figure 4.67 Inqraid: Example of -gvinf Option

```
D:\HORCM\etc>pairdisplay -l -fd -g URA
Group   PairVol(L/R) Device_File   M ,Seq#,LDEV#.P/S,Status, Seq#,P-LDEV# M
URA     URA_000(L)   Harddisk3     0 61459  451..S-VOL SSUS,-----    448  -
URA     URA_001(L)   Harddisk4     0 61459  452..S-VOL SSUS,-----    449  -
URA     URA_002(L)   Harddisk5     0 61459  453..S-VOL SSUS,-----    450  -

D:\HORCM\etc>pairdisplay -l -fd -g URA | inqraid -svinf=Harddisk
[VOL61459_451_5296A763] -> Harddisk3        [OPEN-3          ]
[VOL61459_452_5296A760] -> Harddisk4        [OPEN-3          ]
[VOL61459_453_5296A761] -> Harddisk5        [OPEN-3          ]
```

Caution: If the SVOL is created with "Noread" option (ShadowImage only) and the system is rebooted, the system will not be able to create a Device object (\Device\HarddiskVolume#) and Volume{guid} for SVOL, but a Device object (\Device\HarddiskVolume#) and Volume{guid} will be created by using **-svinf** option after splits the SVOL.

Figure 4.68 Inqraid: Example of -svinf[=PTN] Option

4.14.2 Mkconf Command Tool

The mkconf command tool is used to make a configuration file from a special file (raw device file) provided via STDIN. Execute the following steps to make a configuration file:

1. Make a configuration file for only HORCM_CMD by executing “inqraid -sort -CM -CLI”.
2. Start a HORCM instance without a description for HORCM_DEV and HORCM_INST for executing the **raidscan** command with next step.
3. Make a configuration file included HORCM_DEV and HORCM_INST by executing “raidscan -find conf” from a special file (raw device file) provided via STDIN.
4. Start a HORCM instance with a configuration file including HORCM_DEV and HORCM_INST for verification of the configuration file.
5. Execute “raidscan -find verify” to verify the correspondence of the device file and the configuration file.

Table 4.47 lists and describes the mkconf command and parameters. Figure 4.69 shows an example of the mkconf command. The configuration file is created as “horcm*.conf” in the current directory. The log directory of HORCM is specified as “log*” in the current directory. The user must modify the “ip_address & service” of an existing configuration file as needed.

Table 4.47 Mkconf Command Parameters

Parameter	Value
Command Name	/HORCM/usr/bin/mkconf.sh (UNIX systems) \HORCM\Tool\mkconf.exe (Windows and OpenVMS® systems)
Format	mkconf.sh [-g[g] <group> [-m <mu#>] [-i <inst#>] [-s <service>] [-a]] mkconf.exe [-g[g] <group> [-m <mu#>] [-i <inst#>] [-s <service>] [-a] [-c <drive#>]]
Options	No argument: No option displays Help/Usage. -g <group>: Specifies the “dev_group” name for a configuration file. If not specified, ‘VG’ will be used as default. -gg (9900V and later): Shows a LUN on the host view by finding a host group (9900V and later). -m <mu#>: Specifies the mirror descriptor for ShadowImage volume. TrueCopy volume does not specify the mirror descriptor. -i <inst#>: Specifies the instance number for HORCM. -s <service>: Specifies the service name for a configuration file. If not specified, ‘52323’ will be used as default. -a: Specifies an addition of the group to a configuration file. -c <drive#> (only Windows): Specifies the range of drive numbers that should be examined in order to discover the command devices. If not specified, ‘$PhysicalDrive’ will be used as default. -c <DKA#-#> (only OpenVMS®): Specifies the range of drive numbers that should be examined in order to discover the command devices. If not specified, ‘1DGA0-10000 DKA0-10000 DGA0-10000’ will be used as default.

```
# cd /tmp/test
# cat /etc/horcmperm.conf | /HORCM/usr/bin/mkconf.sh -g ORA -i 9 -m 0
starting HORCM inst 9
HORCM inst 9 starts successfully.
HORCM Shutdown inst 9 !!!
A CONFIG file was successfully completed.
starting HORCM inst 9
HORCM inst 9 starts successfully.
DEVICE_FILE             Group    PairVol     PORT   TARG  LUN M   SERIAL  LDEV
/dev/rdsk/c23t0d0       ORA      ORA_000     CL2-J     0    0 0    61456   192
/dev/rdsk/c23t0d1       ORA      ORA_001     CL2-J     0    1 0    61456   193
/dev/rdsk/c23t0d2       ORA      ORA_002     CL2-J     0    2 0    61456   194
/dev/rdsk/c23t0d3       ORA      ORA_003     CL2-J     0    3 0    61456   195
/dev/rdsk/c23t0d4       ORA      ORA_004     CL2-J     0    4 0    61456   256
/dev/rdsk/c23t0d5       ORA      ORA_005     CL2-J     0    5 0    61456   257
/dev/rdsk/c23t0d6       ORA      ORA_006     CL2-J     0    6 0    61456   258
/dev/rdsk/c23t0d7       -        -           -         -    - 0    61456   259
HORCM Shutdown inst 9 !!!
Please check '/tmp/test/horcm9.conf','/tmp/test/log9/curlog/horcm_*.log', and modify
'ip_address & service'.

# ls                                             ←Verify configuration and log files.
horcm9.conf  log9
# vi *.conf                          ←Verify config file, check ip address & service.

# Created by mkconf.sh on Mon Jan 22 17:59:11 JST 2001

HORCM_MON
#ip_address        service         poll(10ms)     timeout(10ms)
127.0.0.1          52323                 1000              3000

HORCM_CMD
#dev_name               dev_name                dev_name
#UnitID 0 (Serial# 61456)
/dev/rdsk/c23t3d0

HORCM_DEV
#dev_group         dev_name        port#     TargetID     LU#     MU#
# /dev/rdsk/c23t0d0    SER =    61456  LDEV =  192 [ FIBRE FCTBL = 4 ]
ORA                ORA_000         CL2-J            0       0       0
# /dev/rdsk/c23t0d1    SER =    61456  LDEV =  193 [ FIBRE FCTBL = 4 ]
ORA                ORA_001         CL2-J            0       1       0
# /dev/rdsk/c23t0d2    SER =    61456  LDEV =  194 [ FIBRE FCTBL = 4 ]
ORA                ORA_002         CL2-J            0       2       0
# /dev/rdsk/c23t0d3    SER =    61456  LDEV =  195 [ FIBRE FCTBL = 4 ]
ORA                ORA_003         CL2-J            0       3       0
# /dev/rdsk/c23t0d4    SER =    61456  LDEV =  256 [ FIBRE FCTBL = 4 ]
ORA                ORA_004         CL2-J            0       4       0
# /dev/rdsk/c23t0d5    SER =    61456  LDEV =  257 [ FIBRE FCTBL = 4 ]
ORA                ORA_005         CL2-J            0       5       0
# /dev/rdsk/c23t0d6    SER =    61456  LDEV =  258 [ FIBRE FCTBL = 4 ]
ORA                ORA_006         CL2-J            0       6       0
# ERROR [CMDDEV] /dev/rdsk/c23t0d7  SER = 61456  LDEV = 259 [ OPEN-3-CM ] ←See Notes
                                                                              below

HORCM_INST
#dev_group        ip_address      service
ORA               127.0.0.1       52323                   ←Check and update as needed.
```

Figure 4.69 Mkconf Command Tool Example (HP-UX example shown)

Notes on mkconf:

- A unitID is added to the Serial# order. If two or more command devices exist in the storage system, then this option selects the multiple device files linked to a command device (an LDEV).
- If the target device is the command device, then the target device is suppressed as comment as shown below:

```
# ERROR [CMDDEV] /dev/rdsk/c23t0d7    SER =  61456  LDEV = 259 [ OPEN-3-CM    ]
```

- If the target device has shared an LDEV among multiple device files and an LDEV is displayed by another target device already, then its target device is suppressed as comment as shown below:

```
# ERROR [LDEV LINK] /dev/rdsk/c24t0d3  SER =  61456  LDEV = 195 [FIBRE FCTBL = 4]
```

- If the target device does not have a valid MU#, then its target device is suppressed as comment as shown below:

```
# ERROR [INVALID MUN (2 < 1)] /dev/rdsk/c24t0d3  SER = 61456 LDEV = 195 [ OPEN-3 ]
```

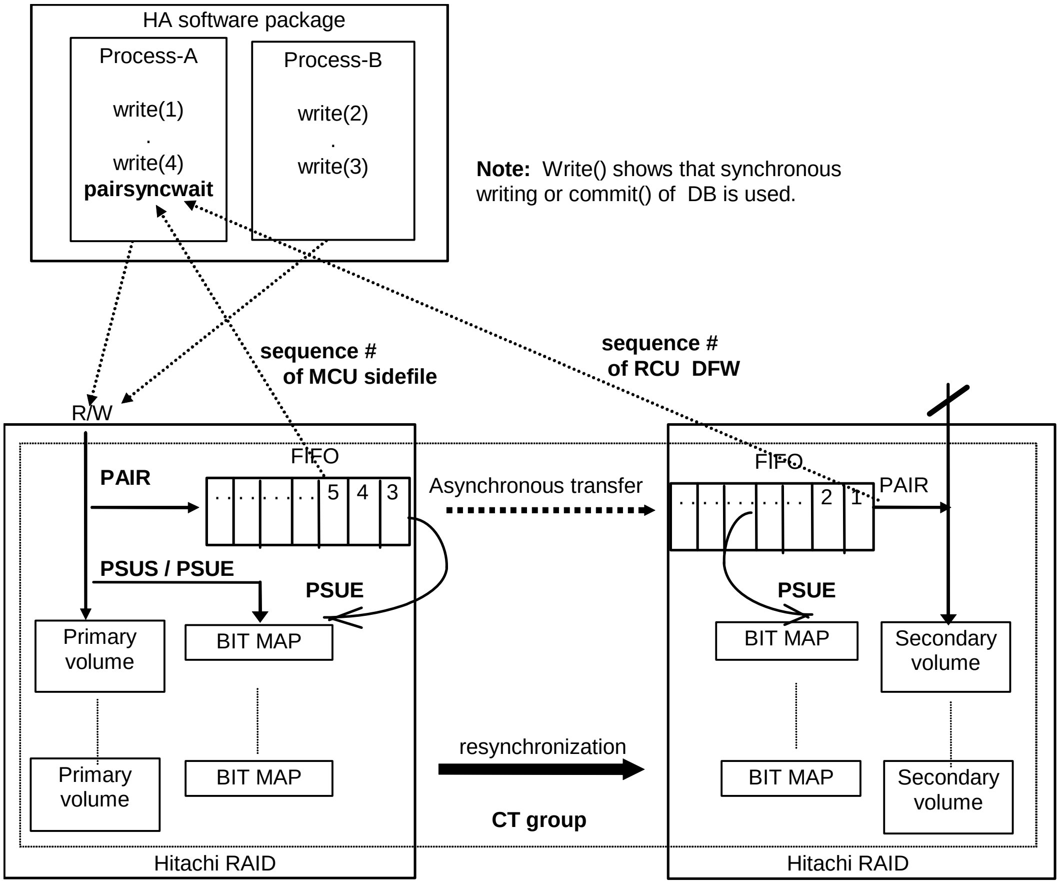
- If the target device has been mixing with difference between RAID TYPE, then its target device is suppressed as comment as shown below:

```
# ERROR [MIXING RAID TYPE] /dev/rdsk/c24t0d3   SER = 61456  LDEV = 195 [ OPEN-3 ]
```

4.15 Synchronous Waiting Command (Pairsyncwait) for Hitachi TrueCopy Async/UR

More robust systems need to confirm the data consistency between the Hitachi TrueCopy Async/UR PVol and SVOL. In DB operations (e.g., Oracle), the commit() of DB transaction (see Figure 4.70) is needed to confirm that a last writing for the commit() on a local site reached to remote site by using CCI-unique API command. The pairsyncwait command is used to confirm that required writing was stored in DFW area of RCU, and it will be able to confirm whether or not a last writing of just before this command is reached to RCU DFW area.

When a client issued the pairsyncwait command, this command is placed on the queue buffer for waiting in the HORCM daemon as a command request. HORCM get the latest sequence # from MCU sidefile and the sequence # whose block was transferred and stored in DFW area of RCU with data consistency, and will compare the latest sequence # of MCU sidefile with the sequence # of RCU DFW area within the term. HORCM replies return code to this command, when the write of MCU sidefile was stored in RCU DFW area. In use this function, a client will be able to confirm that a commit() has been reached to remote site, and also the backup utility on a remote site will be able to split the cascading ShadowImage volumes (TrueCopy Async/UR → TrueCopy Async/ShadowImage/UR) without splitting for TrueCopy Asynchronous/UR.



Note: Write() shows that synchronous writing or commit() of DB is used.

Figure 4.70 Synchronization for Hitachi TrueCopy Async/UR

Table 4.48 lists and describes the pair synchronization waiting command parameters and returned values. Table 4.49 lists and describes the error codes for the pairsyncwait command. The pairsyncwait command is used to confirm that required writing was stored in DFW area of RCU, and it will be able to confirm whether or not a last writing of just before this command is reached to RCU DFW area. This command gets the latest sequence # of MCU sidefile (PVOL latest sequence # within the CT group ID) and the sequence # of RCU DFW within the CT group ID which correspond to the <group> or <raw_device> that is specified by pairsyncwait, and compares MCU with RCU sequence # at that time and at regular interval. If RCU sequence # is over the value of MCU sequence # within the term that was specified by pairsysncwait, this command reports the return code 0 with the meaning of completion of synchronization. The -nowait option shows the latest sequence # (Q-marker) of MCU PVol and CTGID. The marker is shown in hexadecimal of ten characters.

Table 4.48 Pairsyncwait Command Parameters

Parameter	Value
Command Name	pairsyncwait
Format	pairsyncwait{ -h │ -q │ -z │ -g <group> │ -d <pair Vol> │ -d[g] <raw_device> [MU#] │ -d[g] <seq#> <LDEV#> [MU#] │ -m <marker> │ -t <timeout> │ -nowait │ -nomsg ⎤ -fq}

Parameter	Value
Options	**-h**: Displays Help/Usage and version information. **-q**: Terminates the interactive mode and exits the command. **-z** or **-zx** (OpenVMS cannot use the -zx option): Makes the **raidar** command enter the interactive mode. The **-zx** option guards performing of the HORCM in the interactive mode. When this option detects a HORCM shut down, interactive mode terminates. **-I[H][M][instance#] or -I[TC][SI][instance#]** Specifies the command as [HORC]/[HOMRCF], and is used to specify the instance# of HORCM. **-g <group>**: Specifies a group name defined in the configuration definition file. The command is executed for the specified group unless the -d <pair Vol> option is specified. **-d <pair Vol>**: Specifies paired logical volume name defined in the configuration definition file. When this option is specified, the command is executed for the specified paired logical volume. **-d[g] <raw_device> [MU#]**: Searches a group on the configuration definition file (local instance) for the specified raw_device. If the specified raw_device is found, the command is executed on the paired logical volume (-d) or group (-dg). This option is effective without specification of "-g <group>" option. If the specified the raw_device is contained in two or more groups, the command is executed on the first group. **-d[g] <seq#> <LDEV#> [MU#]**: Searches a group on the configuration definition file (local instance) for the specified LDEV, and if the specified LDEV is contained in the group, the command is executed on the paired logical volume (-d) or group (-dg). This option is effective without specification of "-g <group>" option. If the specified LDEV is contained in two or more groups, the command is executed on the first group. The **<seq #> <LDEV #>** values can be specified in hexadecimal (by addition of "0x ") or decimal. **-m <marker>**: Specifies the sequence # of MCU PVOL, called the Q-marker. If the application gets Q-marker as the result of execution of pairsyncwait because of timeout or "-nowait", the application can reconfirm the completion of Async transfer by using pairsysncwait with Q-marker. If the application does not specify Q-marker, CCI uses the latest sequence # when CCI receives pairsysncwait. It is also possible to wait for the completion from SVOL side with this option. **Q-Marker format:** = iissssssss, where ii = incarnation # of pair volume, and ssssssss = PVOL serial #. **-t <timeout>**: Specifies the timeout value to wait for the completion of RCU DFW area. The unit is 100 ms. MCU gets the latest sequence # from RCU at regular interval. **-nowait**: Gets the latest sequence # of MCU PVol and CTGID without waiting. When this option is specified, the latest sequence # of MCU PVol is reported immediately, and -t <timeout>option is ignored. **-nomsg**: Suppresses messages to be displayed when this command is executed from a user program. This option must be specified at the beginning of the command arguments. **-fq**: Displays the number of remaining Q-Markers within the CT group by adding "QM-Cnt" to the last column. "QM-Cnt" will be shown as follows: • In case of specifying "-nowait -fq" "QM-Cnt" will be shown as the number of remaining Q-Marker at this time within CT group. • In case of specifying "-nowait -m <marker> -fq" "QM-Cnt" will be shown as the number of remaining Q-Marker from the specified <marker> within CT group. • In case of "TIMEOUT" without "-nowait" "QM-Cnt" will be shown as the number of remaining Q-Marker at this timeout within CT group. "QM-Cnt" will be shown as "-", if the status for Q-Marker is invalid (i.e. status is "BROKEN" or "CHANGED"). *Example*:

Options

```
# pairsyncwait -g oradb  -nowait -fq
UnitID  CTGID     Q-Marker  Status    Q-Num   QM-Cnt
    0      3   01003408ef  NOWAIT        2      120
# pairsyncwait -g oradb  -nowait -m 01003408e0 -fq
UnitID  CTGID     Q-Marker  Status    Q-Num   QM-Cnt
    0      3   01003408e0  NOWAIT        2      105
# pairsyncwait -g oradb  -t 50 -fq
UnitID  CTGID     Q-Marker  Status    Q-Num   QM-Cnt
    0      3   01003408ef  TIMEOUT       2       5
```

Parameter	Value
Returned values	When the **-nowait** option is specified: Normal termination: 0: The status is **NOWAIT**. Abnormal termination: other than 0 to 127, refer to the execution logs for error details. When the **-nowait** option is not specified: Normal termination: 0: The status is **DONE** (completion of synchronization). 1: The status is **TIMEOUT** (timeout). 2: The status is **BROKEN** (Q-marker synchronized process is rejected). 3: The status is **CHANGED** (Q-marker is invalid due to resynchronize). Abnormal termination: other than 0 to 127, refer to the execution logs for error details.
Restriction	Specified <group> volume must be PVol with status PAIR. Other cases reply with error (EX_INVVOL). It is possible to issue pairsysncwait from SVOL side with **-m <marker>**.

Table 4.49 Specific Error Code for Pairsyncwait

Category	Error Code	Error Message	Recommended Action	Value
Volume status Unrecoverable	EX_INVVOL	Invalid volume status	Confirm pair status using pairdisplay -l.	222

Note: Unrecoverable errors are fixed and will not be resolved, even after re-executing the command. If the command failed, the detailed status will be logged in the CCI command log ($HORCC_LOG) (see Table A.2), even if the user script has no error handling.

Figure 4.71 shows examples of the pairsyncwait command with and without the **-nowait** option. The output of the pairsyncwait command is:

- **UnitID**: Unit ID in case of multiple storage system connection
- **CTGID**: CTGID within Unit ID
- **Q-Marker**: The latest sequence # of MCU PVol (Marker) when the command is received.
- **Status**: The status after the execution of command.
- **Q-Num**: The number of process queue to wait for synchronization within the CTGID.
- **QM-Cnt**: The number of remaining Q-Markers within CT group of the Unit. HORCAsync/UR sends a token called "dummy recordset" at regular intervals, therefore QM-Cnt always shows "2" or "3" even if Host has NO writing.

  Following is an arithmetic expression for determining the remaining Data in a CT group:

  Remaining data in CT group = Sidefile capacity * Sidefile percentage / 100

  Sidefile percentage is the rate showed to "%" column with "PAIR" state by Pairdisplay command. Sidefile capacity is the capacity within 30% to 70% of the cache setting as the sidefile.

  Following is an arithmetic expression for determining the average data per Q-Marker in a CT group:

  Data per Q-Marker = Remaining data in CT group / QM-Cnt

```
# pairsyncwait -g oradb  -nowait                             ← -nowait is specified.
UnitID  CTGID     Q-Marker  Status    Q-Num
     0      3   01003408ef  NOWAIT        2

# pairsyncwait -g oradb  -t 100                              ← -nowait is not specified.
UnitID  CTGID     Q-Marker  Status    Q-Num
     0      3   01003408ef  DONE           2

# pairsyncwait -g oradb  -t 1
UnitID  CTGID     Q-Marker  Status    Q-Num
     0      3   01003408ef  TIMEOUT        3

# pairsyncwait -g oradb  -t 100 -m 01003408ef
UnitID  CTGID     Q-Marker  Status    Q-Num
     0      3   01003408ef  DONE           0

# pairsyncwait -g oradb  -t 100
UnitID  CTGID     Q-Marker  Status    Q-Num
     0      3   01003408ef  BROKEN        0

# pairsyncwait -g oradb  -t 100     -m  01003408ef
UnitID  CTGID     Q-Marker  Status    Q-Num
     0      3   01003408ef  CHANGED        0
                                   ↖ Q-Marker(01003408ef) is invalid  when PVOL was
                                     resynchronized while this command is executed.
```

Figure 4.71 Pairsyncwait Command Examples

4.16 Protection Facility

The Protection Facility permits main operations to volumes that the user can see on the host, and prevents wrong operations. CCI controls protected volumes at the result of recognition of protection. CCI recognizes only volumes that the host shows. For that purpose current Hitachi SANtinel is provided for the CCI environment.

It is not possible to turn ON or OFF the Protection Facility from CCI. The Protection Facility ON/OFF is controlled by Remote Console/SVP or SNMP. The Protection Facility uses an enhanced command device that the user defines using the LUN Manager remote console software (or SNMP). When the user defines the command device, the Protection Facility is turned ON or OFF to each command device, which has attribute to enable Protection Facility. CCI distinguishes the attribute ON from OFF when CCI recognizes the command device. Figure 4.72 shows the definition of protected volumes.

Note: If the command device is set to enable protection mode, there is no impact on CCI operations. CCI controls pairs under current specification.

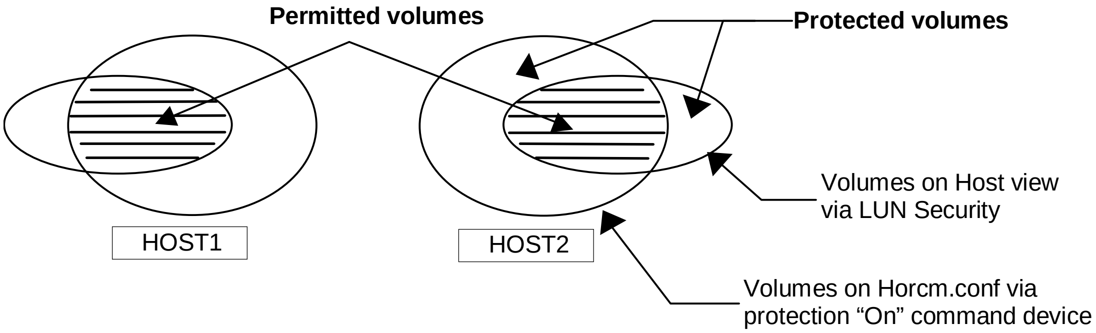


Figure 4.72 Definition of the Protection Volume

4.16.1 Protection Facility Specification

Only the permitted volumes must be registered in horcm.conf. When the user makes the horcm.conf file, the user can describe volumes from only view that host shows. CCI manages mirror descriptor (Hitachi TrueCopy, ShadowImage/MU#0/1/2) as the unit. The Protection Facility has two specifications: one must be volume that the user can see from host such as Inquiry tool, and the other must be mirror descriptor volume that was registered in horcm.conf. Table 4.50 shows the registration for the mirror descriptor.

Table 4.50 Registration for the Mirror Descriptor

	Mirror Descriptor on Horcm.conf							
	TrueCopy		ShadowImage					
			MU#0		MU#1		MU#2	
Volumes on Horcm.conf	E	none	E	none	E	none	E	none
Unknown								
/dev/rdsk/c0t0d0	▨		▨		▨		▨	
Unknown								

Permitted Volumes

E = Mirror descriptor volume to be registered in horcm.conf.
Unknown: Volumes that own host cannot recognize, even though volumes were registered in horcm.conf.

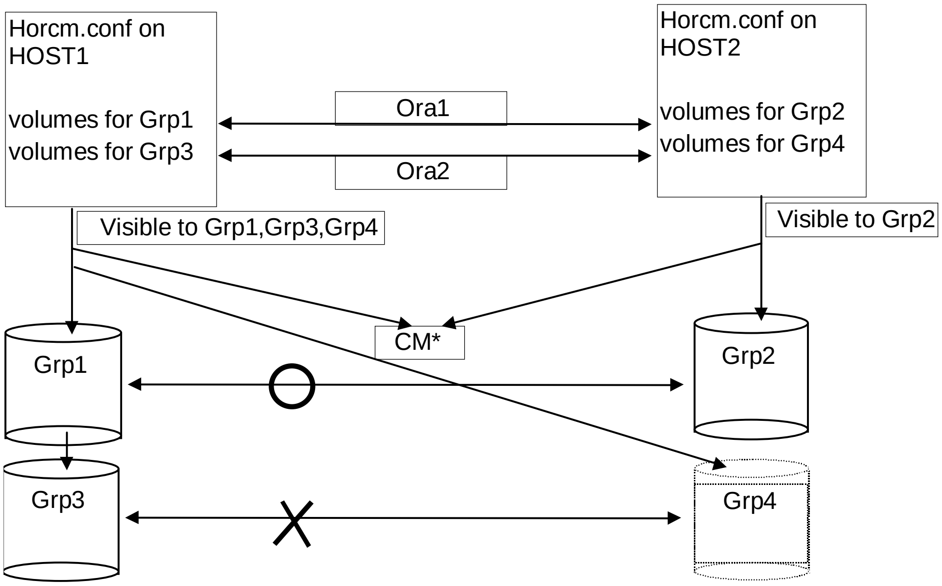
- CCI permits operation after "Permission command" at startup of HORCM. The target is volume that was registered in the horcm.conf file.
- "Permission command" is necessary to permit the protected volume at first. "Permission command" compares an identification for volumes of horcm.conf to all of own host volumes, and the result is registered within HORCM. And HORCM makes tables for protected volume and permitted volumes from horcm.conf and Inquiry result. Inquiry result is based on configuration of Hitachi Data Retention Utility. When the user controls pair volumes, request to protected volumes is rejected with error code "**EX_ENPERM**".
- Protection Facility is based on host side view at the result of Hitachi SANtinel. You need to configure SANtinel before CCI operation. CCI checks SANtinel by Inquiry within CCI.
- Protection Facility is supported for Lightning 9900 storage systems and later (not for 7700E). For Hitachi 7700E you can protect the volumes by using Hitachi SANtinel.
- Protection Facility can be enabled separately for each command device. If you want to use protection and non-protection modes in the same storage system at the same time, you can define two (or more) command devices: one with protection ON, one with protection OFF. Protection mode is enabled for the host that has Hitachi SANtinel and ON command device.

4.16.2 Examples for Configuration and Protected Volumes

Case (1): Two Hosts (Figure 4.73). In protect mode Ora2 are rejected to be operate the paired volume, because of Unknown for Grp4 on HOST2.

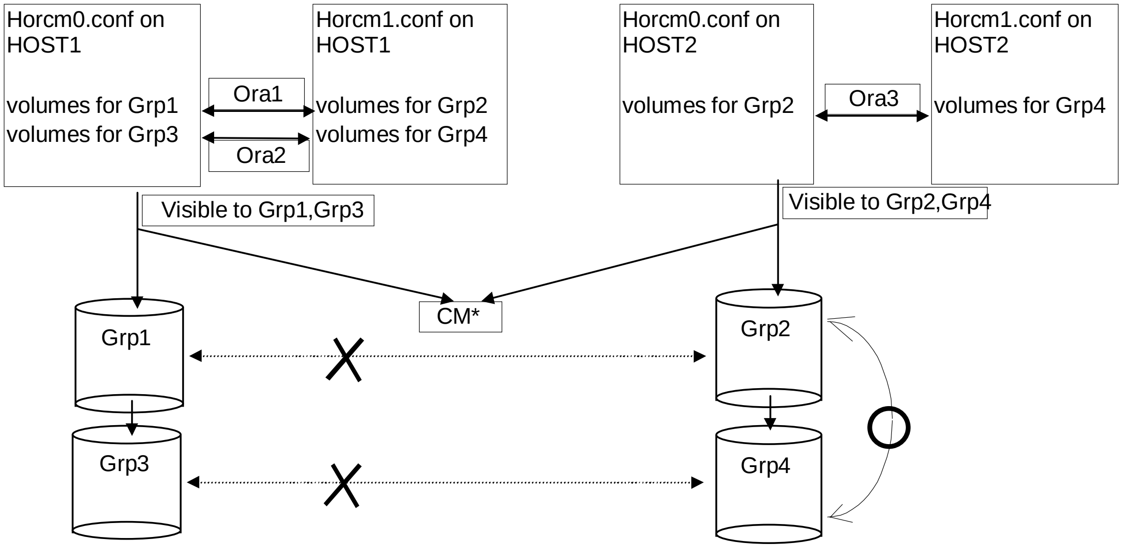
Case (2): One Host (Figure 4.74). In protect mode Ora1 and Ora2 are rejected to be operate the paired volume, because of Unknown for Grp2 and Grp4 on HOST1. If HOST1 has a protection OFF command device, then Ora1 and Ora2 are permitted to operate the paired volume.

Note: The Protection Facility is implemented by only CCI. CCI needs to know the protection attribute for the command device whether should be permitted the operation for paired volume. If HORCM has protection ON command device at its time, then HORCM checks a permission for a paired volume.



* CM = protection “On” command device

Figure 4.73 Example for the Two Host Configuration



* CM = protection “On” command device

Figure 4.74 Example for the One Host Configuration

4.16.3 Target Commands for Protection

The following commands are controlled by the Protection Facility: **Horctakeover**, **Paircurchk**, **Paircreate**, **Pairsplit**, **Pairresync**, **Pairvolchk**, **Pairevtwait**, **Pairsyncwait**, **raidvchkset**, **raidvchkdsp**. **Pairdisplay** is not included. When the command is issued to non-permitted volumes, CCI rejects the request with error code “**EX_ENPERM**”.

- **Pairdisplay** command shows all volumes, so that you can confirm non-permitted volumes. Non-permitted volumes are shown without LDEV# information. As shown below, the LDEV# information is “ ******** ” (-CLI is “ **-** ”).

```
# pairdisplay -g oradb
Group   PairVol(L/R) (Port#,TID,LU-M),Seq#, LDEV#.P/S,Status, Seq#,P-LDEV# M
oradb   oradev1(L)  (CL1-D , 3,  0-0) 35013 ****..----  ----,-----   ----  -
oradb   oradev1(R)  (CL1-D , 3,  1-0) 35013 ****..----  ----,-----   ----  -
```

- **Raidscan** command shows all volumes same as current specification, because it does not need HORCM_DEV and HORCM_INST on horcm.conf. If you want to know permitted volumes at **raidscan**, you can use **raidscan -find**. The **-find** option shows device file name and storage system information by using internal Inquiry result. You can use **raidscan -find** to make horcm.conf, because only permitted volumes are shown with host side view. Example for HP-UX systems:

```
# ioscan  -fun | grep rdsk | raidscan -find
DEVICE_FILE         UID  S/F PORT   TARG  LUN    SERIAL  LDEV  PRODUCT_ID
/dev/rdsk/c0t3d0     0    F  CL1-D     3    0     35013    17  OPEN-3
/dev/rdsk/c0t3d1     0    F  CL1-D     3    1     35013    18  OPEN-3
```

4.16.4 Permission Command

CCI recognizes permitted volumes at the result of “permission command”. The permission command is **-find inst** option of **raidscan**. This option issues Inquiry to specified device file to get Ser# and LDEV# from RAID storage system, and checks an identification for volumes of horcm.conf to all of own host volumes, then stores the result within HORCM of the instance. This permission command is started by **/etc/horcmgr** automatically.

The following example shows the relation between device file and horcm.conf in case of a manual operation for HP-UX system. All of volumes of ioscan are permitted.

```
# ioscan  -fun | grep rdsk | raidscan -find inst
DEVICE_FILE             Group    PairVol     PORT   TARG  LUN M   SERIAL  LDEV
/dev/rdsk/c0t3d0        oradb    oradev1     CL1-D     3    0 -    35013    17
/dev/rdsk/c0t3d0        oradb    oradev1     CL1-D     3    0 0    35013    17
```

4.16.5 New Options for Security

(1) raidscan

-find inst. The **-find inst** option is used to register the device file name to all mirror descriptors of the LDEV map table for CCI and permit the matching volumes on horcm.conf in protection mode, and is started from **/etc/horcmgr** automatically. Therefore the user will not normally need to use this option. This option issues Inquiry to device file from the result of STDIN. And CCI gets Ser# and LDEV# from RAID storage system. Then, CCI compares Inquiry result to content of horcm.conf, and the result is stored within HORCM of the instance. At the same time CCI shows the result of this option about the relation. This option will also be terminated to avoid wasteful scanning when the registration has been finished with based on horcm.conf, because HORCM does not need the registration any more.

```
# ioscan  -fun | grep rdsk | raidscan -find inst
DEVICE_FILE            Group    PairVol     PORT   TARG  LUN M   SERIAL  LDEV
/dev/rdsk/c0t3d0       oradb    oradev1     CL1-D     3    0 -    35013    17
/dev/rdsk/c0t3d0       oradb    oradev1     CL1-D     3    0 0    35013    17
```

Note: When multiple device files share the same LDEV, the first device file is registered to the LDEV map table.

-find verify [MU#]. This option shows relation between group on horcm.conf and Device_File registered to the LDEV map tables from DEVICE_FILE of STDIN.

```
# ioscan  -fun | grep rdsk | raidscan -find verify -fd
DEVICE_FILE            Group    PairVol     Device_File      M   SERIAL  LDEV
/dev/rdsk/c0t3d0       oradb    oradev1     c0t3d0           0    35013    17
/dev/rdsk/c0t3d1       oradb    oradev2     Unknowm          0    35013    18
/dev/rdsk/c0t3d2       -        -           -                0    35013    19
```

Note: It shows shared LDEV among multiple device files, if there is difference between DEVICE_FILE and Device_File. The user can also use this option to the command device that specified non-protection mode. It is used for the purpose to see the relation between DEVICE_FILE and the group of Horcm.conf.

-f[d]. The **-f[d]** option shows the Device_File that was registered on the group of HORCM, based on the LDEV (as defined in the local instance configuration definition file).

```
# raidscan -p  cl1-d  -fd
Port# ,TargetID#,Lun#..Num(LDEV#....)...P/S, Status,Fence,LDEV#,Device_File
CL1-D ,       3,   0...1(17)............SMPL  ----  ------ ----,c0t3d0
CL1-D ,       3,   1...1(18)............SMPL  ----  ------ ----,c0t3d1
```

(2) pairdisplay

-f[d]. The **-f[d]** option shows the relation between the Device_File and the paired volumes (protected volumes and permitted volumes), based on the group, even though this option does not have any relation with protection mode.

```
# pairdisplay -g oradb -fd
Group   PairVol(L/R) Device_File    M ,Seq#,LDEV#.P/S,Status, Seq#,P-LDEV# M
oradb   oradev1(L)   c0t3d0         0 35013   17..P-VOL COPY, 35013    18  -
oradb   oradev1(R)   c0t3d1         0 35013   18..S-VOL COPY, 35013    17  -
```

If either the local or the remote host (instance) has not been shown the **Device_File**, then pair operation are rejected (except the local option such as "-l") in protection mode because of **Unknown** volume, as shown in the following example.

```
# pairdisplay -g oradb -fd
Group   PairVol(L/R) Device_File    M ,Seq#,LDEV#.P/S,Status, Seq#,P-LDEV# M
oradb   oradev1(L)   c0t3d0         0 35013   17..P-VOL COPY, 35013    18  -
oradb   oradev1(R)   Unknown        0 35013 ****..----  ----, -----  ----  -
```

4.16.6 Permitting the Protected Volumes

Protection Mode needs recognition step to check accessible volumes and horcm.conf at the startup of HORCM on protection mode. The protected volumes must be registered to enable Protection Facility at each startup of HORCM, so that this registration process is executed automatically by **/etc/horcmgr** (see (1) and (2) below).

(1) The following is executed for registration of permitted volume file ($HORCMPERM file), if $HORCMPERM file is existing and there are permitted volumes. If the user wants to permit only the volumes specified, then the volume list must be described in $HORCMPERM file.

Naming of $HORCMPERM file:

- **UNIX systems.** $HORCMPERM is "/etc/horcmperm.conf" or "/etc/horcmperm*.conf" (* is the instance number) as default. Example for HP-UX systems:
  cat $HORCMPERM | /HORCM/usr/bin/raidscan -find inst

```
# The following are an example to permit the LVM Volume groups.
# For MU# 0
vg00  /dev/rdsk/c0t3d0  /dev/rdsk/c0t3d1
vg00  /dev/rdsk/c0t3d2  /dev/rdsk/c0t3d3

# For MU# 1
vg01  /dev/rdsk/c0t3d0  /dev/rdsk/c0t3d1
vg01  /dev/rdsk/c0t3d2  /dev/rdsk/c0t3d3
.
```

Verifying a group for vg01. The following are examples to verify whether LVM volume group is mapped to group (MU#**1** for ShadowImage) on the horcm.conf correctly.

```
# export HORCC_MRCF=1
# cat /etc/horcmperm.conf | grep vg01 | raidscan -find verify 1 -fd
OR
# vgdisplay -v /dev/vg01|grep dsk|sed 's/\/*\/dsk\//\/rdsk\//g'|raidscan -find verify 1 -fd
DEVICE_FILE            Group    PairVol     Device_File      M   SERIAL  LDEV
/dev/rdsk/c0t3d0       oradb1   oradev1     c0t3d0           1    35013    17
/dev/rdsk/c0t3d1       oradb1   oradev2     c0t3d1           1    35013    18
/dev/rdsk/c0t3d2       oradb    oradev3     c0t3d2           1    35013    19
/dev/rdsk/c0t3d3       -        -           -                1    35013    20
```

Mapping to another group on horcm.conf !!

Unknown on horcm.conf !!

- **Windows systems.** $HORCMPERM is “\WINNT\horcmperm.conf” or “\WINNT\horcmperm*.conf”(* is the instance number) as default.
  type $HORCMPERM | x:\HORCM\etc\raidscan.exe -find inst

```
# The following are an example to permit the DB Volumes.
# Note: a numerical value is interpreted as Harddisk#.
# DB0 For MU# 0
Hd0-10
harddisk12  harddisk13  harddisk17

# DB1 For MU# 1
hd20-23
```

Verifying a group for DB1. The following is an example to verify whether DB volume group is mapped to group (MU#**1** for ShadowImage) on the horcm.conf correctly.

```
D:\HORCM\etc> set HORCC_MRCF=1
D:\HORCM\etc> echo hd20-23 | raidscan -find verify 1 -fd
DEVICE_FILE          Group    PairVol     Device_File      M   SERIAL  LDEV
Harddisk20           oradb1   oradev1     Harddisk20       1    35013    17
Harddisk21           oradb1   oradev2     Harddisk21       1    35013    18
Harddisk22           oradb    oradev3     Harddisk22       1    35013    19
Harddisk23           -        -           -                1    35013    20
```

Mapping to another group on horcm.conf !!
Unknown on horcm.conf !!

(1) If no $**HORCMPERM** file exists, then the following is executed to permit all volumes on the host:

For HP-UX: `ioscan -fun | grep -e rdisk -e rdsk | /HORCM/usr/bin/raidscan -find inst`
For Linux: `ls /dev/sd* | /HORCM/usr/bin/raidscan -find inst`
For zLinux: `ls /dev/sd* /dev/dasd*| /HORCM/usr/bin/raidscan -find inst`
For Solaris: `ls /dev/rdsk/* | /HORCM/usr/bin/raidscan -find inst`
For AIX: `lsdev -C -c disk | grep hdisk | /HORCM/usr/bin/raidscan -find inst`
For Tru64 UNIX: `ls /dev/rdisk/dsk* | /HORCM/usr/bin/raidscan -find inst`
For Digital UNIX: `ls /dev/rrz* | /HORCM/usr/bin/raidscan -find inst`
For DYNIX/ptx: `/etc/dumpconf -d | grep sd | /HORCM/usr/bin/raidscan -find inst`
For IRIX64: `ls /dev/rdsk/*vol /dev/rdsk/*/*vol/* | /HORCM/usr/bin/raidscan -find inst`
For OpenVMS: `/HORCM/usr/bin/raidscan -pi ‘$1$DGA0-10000 DKA0-10000 DGA0-10000’ -find inst`
For Windows: `x:\HORCM\etc\raidscan.exe -pi $PhysicalDrive -find inst`

Note: This registration process has risk because it is executed automatically by **/etc/horcmgr** without judgment for protection mode in order to validate **-fd** option. This registration brings a degradation in **horcmstart.sh**, but HORCM daemon has been running as usual, and it will depend on how many devices a host has. In non-protection mode, if a user wants to start faster at HORCM start-up, then it is required to put $HORCMPERM file of “SIZE 0 byte” as dummy file or to set HORCMPERM=MGRNOINST. At this time, **-fd** option will show Device_File name as Unknown, and after a user will be able to use **raidscan -find inst** in order to validate the **-fd** option.

4.16.7 Environmental Variables

$HORCMPROMOD. This environmental parameter turns protection mode ON as specified in Table 4.51. If your command device is set for non-protection mode, this parameter sets it to protection mode.

Table 4.51 Relation between HORCMPROMOD and Command Device

Command Device	HORCMPROMOD	Mode
Protection mode	Don't care	Protection mode
Non-protection mode	Not specified	Non-protection mode
	Specified	Protection mode

$HORCMPERM. This variable is used to specify HORCM permission file name. If no file name is specified, "/etc/horcmperm.conf" or "/etc/horcmperm*.conf" (* is the instance number) is the default.

- If HORCM permission file exists, then "/etc/horcmgr" executes the following command to permit the volumes specified.

  Example for UNIX systems:

  ```
  cat $HORCMPERM | /HORCM/usr/bin/raidscan -find inst
  ```

  Example for Windows systems:

  ```
  type $HORCMPERM | x:\HORCM\etc\raidscan.exe -find inst
  ```

- If no HORCM permission file exists, then "/etc/horcmgr" executes the built-in command to permit all volumes of own host. *Examples*:

  HP-UX: **ioscan -fun | grep -e rdisk -e rdsk | /HORCM/usr/bin/raidscan -find inst**
  Linux: **ls /dev/sd* | /HORCM/usr/bin/raidscan -find inst**
  zLinux: **ls /dev/sd* /dev/dasd*| /HORCM/usr/bin/raidscan -find inst**
  Solaris: **ls /dev/rdsk/* | /HORCM/usr/bin/raidscan -find inst**
  AIX: **lsdev -C -c disk | grep hdisk | /HORCM/usr/bin/raidscan -find inst**
  Tru64 UNIX: **ls /dev/rdisk/dsk* | /HORCM/usr/bin/raidscan -find inst**
  Digital UNIX: **ls /dev/rrz* | /HORCM/usr/bin/raidscan -find inst**
  DYNIX/ptx: **/etc/dumpconf -d | grep sd | /HORCM/usr/bin/raidscan -find inst**
  IRIX64: **ls /dev/rdsk/*vol /dev/rdsk/*/*vol/* | /HORCM/usr/bin/raidscan -find inst**
  OpenVMS:
  /HORCM/usr/bin/raidscan -pi '1DGA0-10000 DKA0-10000 DGA0-10000' -find inst
  Windows: **x:\HORCM\etc\raidscan.exe -pi $PhysicalDrive -find inst**

- "/etc/horcmgr" does not execute the built-in command if the following are specified to **$HORCMPERM**. This is used to execute a system command to permit the volumes specified from a user's shell script.

  ```
  HORCMPERM=MGRNOINST.
  ```

4.16.8 Determining the Protection Mode Command Device

The inquiry page is not changed for a command device with protection mode ON. Therefore, CCI provides how to find the protection mode command device. To determine the currently used command device, use the **horcctl -D** command. This command shows the protection mode command device by adding an asterisk (*) to the device file name.

Example for HP-UX systems:

```
# horcctl -D
Current control device = /dev/rdsk/c0t0d0*       ← * indicates protection ON.
```

4.17 Group Version Control for Mixed Storage System Configurations

Before executing each option of a command, CCI checks the facility version of the Hitachi storage system internally to verify that the same version is installed on mixed storage system configuration. If the configuration includes older storage systems (e.g., 9900), this method may not meet the requirements for the mixed storage system environment, because the older storage system limits the availability enhancements in later facility versions. If the facility versions of the storage systems are different, the user will not be able to use USP/NSC-specific facility, because CCI applies the minimum version to all storage systems. To expand the capability for mixed storage system configurations and avoid problems such as this, CCI supports the following "group version control" to manage a version for each group.

- CCI (HORCM daemon) makes a facility version for each group based on a configuration file at the start-up of HORCM.
- In a mixed storage system configuration, if the facility version of the storage systems (e.g., USP/NSC and 9900V) is different on a group, CCI will apply the minimum version for each group (see Figure 4.75).

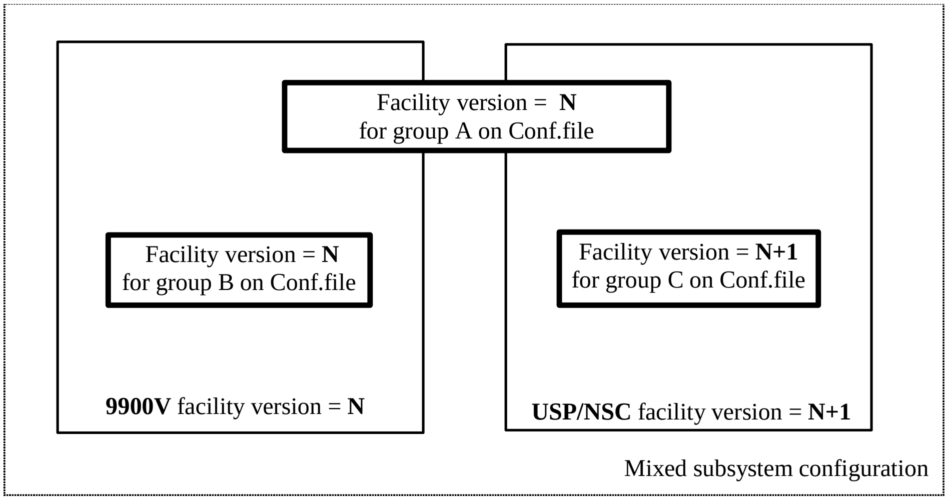


Figure 4.75 Definition of the Group Version

4.18 LDM Volume Discovery and Flushing for Windows

Windows systems support the Logical Disk Manager (LDM) (such as VxVM), and a logical drive letter is typically associated with an LDM volume (“\Device\HarddiskVolumeX”). Therefore, the user will not be able to know the relationship between LDM volumes and the physical volumes of the RAID storage system. The user makes the CCI configuration file, and then needs to know the relationship that is illustrated in Figure 4.76.

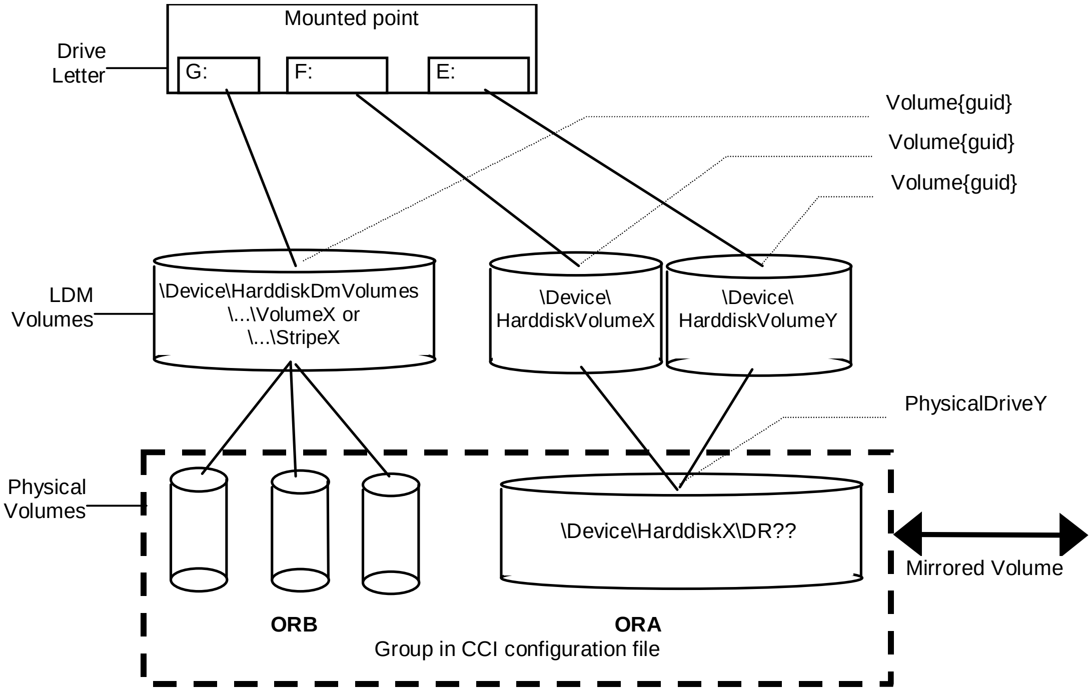


Figure 4.76 LDM Volume Configuration

4.18.1 Volume Discovery Function

CCI supports the volume discovery function of three levels that shows the relationship between LDM volumes and the physical volumes.

- **Physical level.** CCI shows the relationship between ‘PhysicalDrive’ and LDEV by given **$Physical** as KEY WORD for the discovery.
- **LDM volume level.** CCI shows the relationship between ‘LDM volume & PhysicalDrives’ and LDEV by given **$Volume** as KEY WORD for the discovery.
- **Drive letter level.** CCI shows the relationship between ‘Drive letter & LDM volume & PhysicalDrives’ and LDEV by given **$LETALL** as KEY WORD for the discovery.

The KEY WORD(**$Physical,$Volume,$LETALL**) can be used with ‘**raidscan -find,inqraid,mkconf**’ commands.

In Windows, DOS devices (i.e. C:, Volume{}) are linked to a Device Object Name (\Device\...). CCI indicates as the following by abbreviating a long Device Object Name.

- Device Object Name of the LDM for Windows 2008/2003/2000:
  - \Device\HarddiskVolumeX for Partition → **\VolX\DskY**
    DskY shows that VolX are configured through HarddiskY.
- Device Object Name of the LDM for Windows 2003/2000:
  - \Device\HarddiskDmVolumes\ ... \VolumeX for spanned volume → **\DmsX\DskYs**
  - \Device\HarddiskDmVolumes\ ... \StripeX for striped volume → **\DmtX\DskYs**
  - \Device\HarddiskDmVolumes\ ... \RaidX for Raid-5 volume → **\DmrX\DskYs**
  - DskYs shows that DmsX(DmtX,Dmr) volumes are configured through bundling multiple HarddiskY1 Y2….
- Device Object Name of the PhysicalDrive for Windows 2008/2003/2000:
  - \Device\HarddiskX\DR?? → **HarddiskX**

The user will be able to know the relationship between LDM volumes and LDEV by given a **KEY WORD** to “**inqraid**” command.

```
inqraid $LETALL -CLI
DEVICE_FILE     PORT    SERIAL  LDEV CTG  H/M/12  SSID R:Group PRODUCT_ID
D:\Vol2\Dsk4    -            -     -   -       -     -       - DDRS-34560D
E:\Vol44\Dsk0   CL2-K    61456   194   -  s/s/ss  0004 1:01-10 OPEN-3
F:\Vol45\Dsk0   CL2-K    61456   194   -  s/s/ss  0004 1:01-10 OPEN-3
G:\Dmt1\Dsk1    CL2-K    61456   256   -  s/s/ss  0005 1:01-11 OPEN-3
G:\Dmt1\Dsk2    CL2-K    61456   257   -  s/s/ss  0005 1:01-11 OPEN-3
G:\Dmt1\Dsk3    CL2-K    61456   258   -  s/s/ss  0005 1:01-11 OPEN-3
```

```
inqraid $Volume -CLI
DEVICE_FILE     PORT    SERIAL  LDEV CTG  H/M/12  SSID R:Group PRODUCT_ID
\Vol2\Dsk4      -            -     -   -       -     -       - DDRS-34560D
\Vol44\Dsk0     CL2-K    61456   194   -  s/s/ss  0004 1:01-10 OPEN-3
\Vol45\Dsk0     CL2-K    61456   194   -  s/s/ss  0004 1:01-10 OPEN-3
\Dmt1\Dsk1      CL2-K    61456   256   -  s/s/ss  0005 1:01-11 OPEN-3
\Dmt1\Dsk2      CL2-K    61456   257   -  s/s/ss  0005 1:01-11 OPEN-3
\Dmt1\Dsk3      CL2-K    61456   258   -  s/s/ss  0005 1:01-11 OPEN-3
```

```
inqraid $Phy -CLI
DEVICE_FILE     PORT    SERIAL  LDEV CTG  H/M/12  SSID R:Group PRODUCT_ID
Harddisk0       CL2-K    61456   194   -  s/s/ss  0004 1:01-10 OPEN-3
Harddisk1       CL2-K    61456   256   -  s/s/ss  0005 1:01-11 OPEN-3
Harddisk2       CL2-K    61456   257   -  s/s/ss  0005 1:01-11 OPEN-3
Harddisk3       CL2-K    61456   258   -  s/s/ss  0005 1:01-11 OPEN-3
Harddisk4       -            -     -   -       -     -       - DDRS-34560D
```

- Device Object Name of the Partition for Windows NT
  - \Device\HarddiskX\PartitionY → **\DskX\pY**
- Device Object Name of the PhysicalDrive for Windows NT
  - \Device\HarddiskX\Partition0 → **HarddiskX**

```
inqraid $LETALL -CLI
DEVICE_FILE     PORT    SERIAL  LDEV CTG  H/M/12  SSID R:Group PRODUCT_ID
D:\Dsk0\p1      -            -     -   -       -     -       - DDRS-34560D
E:\Dsk1\p1      CL2-K    61456   194   -  s/s/ss  0004 1:01-10 OPEN-3
F:\Dsk1\p2      CL2-K    61456   194   -  s/s/ss  0004 1:01-10 OPEN-3
```

```
inqraid $Phy -CLI
DEVICE_FILE     PORT    SERIAL  LDEV CTG  H/M/12  SSID R:Group PRODUCT_ID
Harddisk0       -            -     -   -       -     -       - DDRS-34560D
Harddisk1       CL2-K    61456   194   -  s/s/ss  0005 1:01-11 OPEN-3
```

The user wants to know the relationship between LDM volumes and a group of the configuration files, and then will be able to find a group of the configuration file by given a **KEY WORD** to "**raidscan -find verify**" command.

```
raidscan -pi $LETALL -find verify
DEVICE_FILE             Group    PairVol     PORT   TARG  LUN M   SERIAL  LDEV
E:\Vol44\Dsk0           ORA      ORA_000     CL2-K     7    2 -    61456   194
F:\Vol45\Dsk0           ORA      ORA_000     CL2-K     7    2 -    61456   194
G:\Dmt1\Dsk1            ORB      ORB_000     CL2-K     7    4 -    61456   256
G:\Dmt1\Dsk2            ORB      ORB_001     CL2-K     7    5 -    61456   257
G:\Dmt1\Dsk3            ORB      ORB_002     CL2-K     7    6 -    61456   258
```

```
raidscan -pi $LETALL -find
DEVICE_FILE         UID  S/F PORT   TARG  LUN    SERIAL  LDEV  PRODUCT_ID
E:\Vol44\Dsk0         0   F  CL2-K     7    2     61456   194  OPEN-3
F:\Vol45\Dsk0         0   F  CL2-K     7    2     61456   194  OPEN-3
G:\Dmt1\Dsk1          0   F  CL2-K     7    4     61456   256  OPEN-3
G:\Dmt1\Dsk2          0   F  CL2-K     7    5     61456   257  OPEN-3
G:\Dmt1\Dsk3          0   F  CL2-K     7    5     61456   258  OPEN-3
```

4.18.2 Mountvol Attached to Windows 2008/2003/2000 Systems

The user must pay attention to ‘**mountvol /D**’ command attached to a Windows 2008, 2003, or 2000 system, that it does not flush the system buffer associated with the specified logical drive. The mountvol command shows the volume mounted as Volume{guid} as follows:

```
mountvol
Creates, deletes, or lists a volume mount point.
.
.
MOUNTVOL [drive:]path VolumeName
MOUNTVOL [drive:]path /D
MOUNTVOL [drive:]path /L

    \\?\Volume{56e4954a-28d5-4824-a408-3ff9a6521e5d}\
        G:\
    \\?\Volume{bf48a395-0ef6-11d5-8d69-00c00d003b1e}\
        F:\
```

The user will be able to know what ‘\\?\Volume{guid}\’ is configured, as follows:

```
inqraid $Volume{bf48a395-0ef6-11d5-8d69-00c00d003b1e} -CLI
DEVICE_FILE     PORT    SERIAL  LDEV CTG  H/M/12  SSID R:Group PRODUCT_ID
\Vol46\Dsk1     CL2-K    61456   193   -  S/s/ss  0004 1:01-10 OPEN-3

raidscan -pi $Volume{bf48a395-0ef6-11d5-8d69-00c00d003b1e} -find
DEVICE_FILE         UID  S/F PORT   TARG  LUN    SERIAL  LDEV  PRODUCT_ID
\Vol46\Dsk1           0   F  CL2-K     7    1     61456   193  OPEN-3
```

4.18.3 System Buffer Flushing Function

The logical drive to be flushed can be specified by the following two methods. One method is that logical drive (e.g., G:\hd1 drive, as below) is specified immediately, but this method must know about the logical drive which corresponds to a group before executes the sync command. Also the volume is mounting by a directory and this method requires to find its volume name. To solve such a complication, CCI supports new method that flushes the system buffer associated to a logical drive through finding a volume{guid} which corresponds to a group of the configuration file. This method does not depend on mounted point, so that it is possible to flush the volume mounted by a directory. This method is supported to be specified a group to the "**raidscan -find sync**" command.

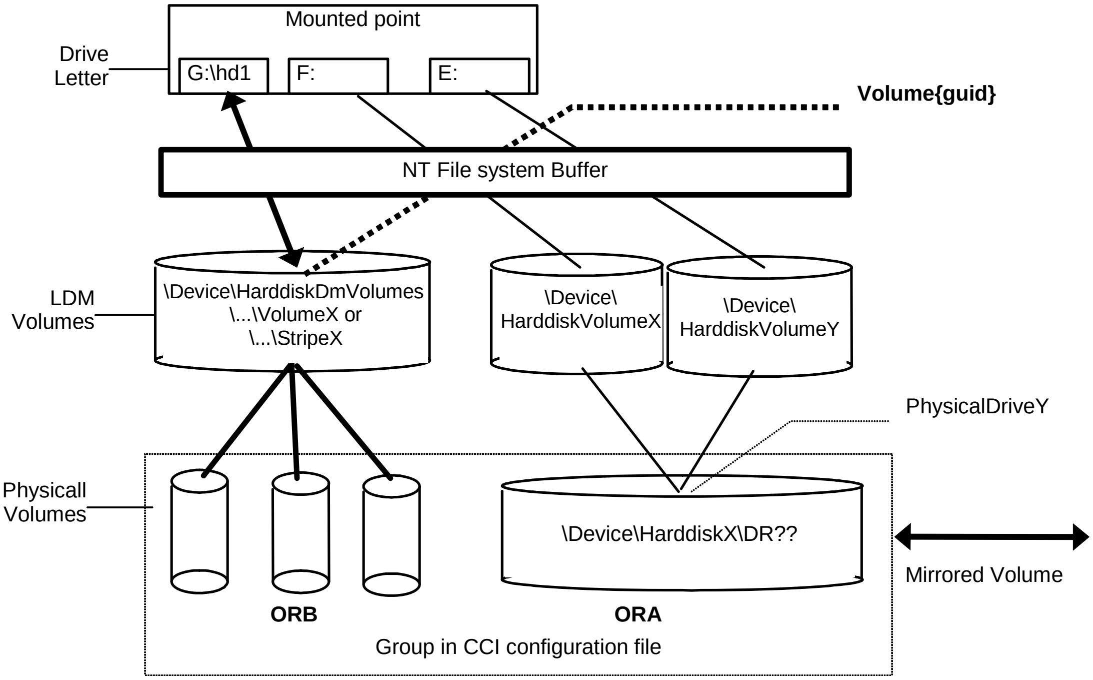


Figure 4.77 LDM Volume Flushing

The following example flushes the system buffer associated to ORB group through **$Volume**.

```
raidscan -pi $Volume -find sync -g ORB
[SYNC] : ORB ORB_000[-] -> \Dmt1\Dsk1 : Volume{bf48a395-0ef6-11d5-8d69-00c00d003b1e}
[SYNC] : ORB ORB_001[-] -> \Dmt1\Dsk2 : Volume{bf48a395-0ef6-11d5-8d69-00c00d003b1e}
[SYNC] : ORB ORB_002[-] -> \Dmt1\Dsk3 : Volume{bf48a395-0ef6-11d5-8d69-00c00d003b1e}
```

The following example flushes the system buffer associated to all groups for the local instance.

```
raidscan -pi $Volume -find sync
[SYNC] : ORA ORA_000[-] -> \Vol44\Dsk0 : Volume{56e4954a-28d5-4824-a408-3ff9a6521e5d}
[SYNC] : ORA ORA_000[-] -> \Vol45\Dsk0 : Volume{56e4954a-28d5-4824-a408-3ff9a6521e5e}
[SYNC] : ORB ORB_000[-] -> \Dmt1\Dsk1  : Volume{bf48a395-0ef6-11d5-8d69-00c00d003b1e}
[SYNC] : ORB ORB_001[-] -> \Dmt1\Dsk2  : Volume{bf48a395-0ef6-11d5-8d69-00c00d003b1e}
[SYNC] : ORB ORB_002[-] -> \Dmt1\Dsk3  : Volume{bf48a395-0ef6-11d5-8d69-00c00d003b1e}
```

Note: Windows NT does not support the LDM volume, so the user must specify **$LETALL** instead of **$Volume**.

1. **Offline backup used ‘raidscan-find sync’ for Windows NT file system:**
   ‘raidscan-find sync’ flushes the system buffer through finding a logical drive which corresponds to a group of the configuration file, so that the user will be able to use without using **-x mount** and **-x umount** command. The following is an example for group ORB.

P-VOL Side	S-VOL Side
Close all logical drives on the P-VOL by APP. ▪ **Flush** the system buffer for P-VOL using “raidscan -pi **$LETALL** -find sync -g ORB”. ▪ Split the paired volume using “pairsplit -g ORB” with r/w mode. ▪ Open all logical drives on the P-VOL by APP. ▪ Resynchronize the paired volume using “pairresync -g ORB”.	▪ Back up the SVOL data. ▪ **Flush** the system buffer for SVOL updates using “raidscan -pi **$LETALL** -find sync -g ORB” when the backup is finished.

2. **Offline backup used ‘raidscan-find sync’ for Windows 2008/2003/2000 file system:**
   ‘raidscan-find sync’ flushes the system buffer associated to a logical drive through finding a Volume{guid} which corresponds to a group of the configuration file so that the user will be able to use without using **-x mount** and **-x umount** commands. The following is an example for group ORB.

P-VOL Side	S-VOL Side
Close all logical drives on the P-VOL by APP. ▪ **Flush** the system buffer for P-VOL using “raidscan -pi **$Volume** -find sync -g ORB”. ▪ Split the paired volume using “pairsplit -g ORB” with r/w mode. ▪ Open all logical drives on the P-VOL by APP. ▪ Resynchronize the paired volume using “pairresync -g ORB”.	▪ **Flush** the system buffer for NEW S-VOL data using “raidscan -pi **$Volume** -find sync -g ORB”. ▪ Back up the SVOL data. ▪ **Flush** the system buffer for SVOL updates using “raidscan -pi **$Volume** -find sync -g ORB” when the backup is finished.

3. **Online backup used ‘raidscan-find sync’ for Windows NT file system:**
   ‘raidscan-find sync’ flushes the system buffer through finding a logical drive which corresponds to a group of the configuration file, so that the user will be able to use without using **-x mount** and **-x umount** commands. The following is an example for group ORB.

P-VOL Side	S-VOL Side
Freeze DB on opening PVOL by APP. ▪ **Flush** the system buffer for PVOL using the “raidscan -pi **$LETALL** -find sync -g ORB”. ▪ Splits the paired volume using “pairsplit -g ORB” with r/w mode. ▪ Unfreeze DB on opening PVOL by APP. ▪ Resynchronize the paired volume using “ pairresync -g ORB”.	▪ Back up the SVOL data. ▪ **Flush** the system buffer for SVOL updates using “raidscan -pi **$LETALL** -find sync -g ORB” when the backup is finished.

4. **Online backup used 'raidscan-find sync' for Windows 2008/2003/2000 file system: 'raidscan-find sync'** flushes the system buffer associated to a logical drive through finding a Volume{guid} which corresponds to a group of the configuration file so that the user will be able to use without using **-x mount** and **-x umount** commands. The following is an example for group ORB.

P-VOL Side	S-VOL Side
Freeze DB on opening PVOL by APP. ▪ **Flush** the system buffer for PVOL using "raidscan -pi **$Volume** -find sync -g ORB ". ▪ Splits the paired volume using "pairsplit -g ORB" with r/w mode. ▪ Unfreeze DB on opening PVOL by APP. ▪ Resynchronize the paired volume using " pairresync -g ORB".	▪ **Flush** the system buffer for NEW SVOL data using " raidscan -pi **$Volume** -find sync -g ORB ". ▪ Back up the SVOL data. ▪ **Flush** the system buffer for SVOL updates using " raidscan -pi **$Volume** -find sync -g ORB " when the backup is finished.

Notes:

- **PVOL side** must stop the "WRITE IO" to the logical drive which corresponds to a [-g name] before issuing the "raidscan -find sync" command.
- **SVOL side** must close the logical drive which corresponds to a [-g name] before issuing the "raidscan -find sync" command.

4.19 Special Facilities for Windows 2008/2003/2000 Systems

CCI provides the following special facilities for Windows 2008/2003/2000 systems:

- Signature changing facility (section 4.19.1)
- Directory mount facility (section 4.19.2)

4.19.1 Signature Changing Facility for Windows 2008/2003/2000 Systems

Consider the following Microsoft Cluster Server (MSCS) configuration in which a MSCS PVOL is shared from MSCS Node1 and Node2, and the copied volume of SVOL is used for backup on Node2. If the Node2 has reboot on standby state, then MSCS of Node2 has a problem to assign drive letter of SVOL with previous PVOL drive letter. This problem will happen on Node2 on MSCS environment as shown in Figure 4.78. The conditions are:

- Node1 is active.
- Node2 is standby state that PVOL on Node2 will be hidden by MSCS, and reboots the Node2.

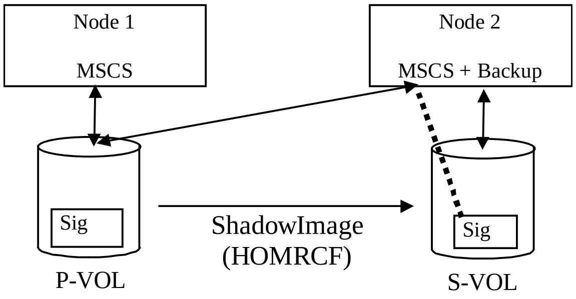


Figure 4.78 Configurations with MSCS and ShadowImage (HOMRCF)

MSCS on Node2 will misunderstand the SVOL as MSCS cluster resource, because the signature of SVOL and PVOL is the same due to copied. The reason is that MSCS cluster resources are managed with the signature only. Therefore SVOL of Node2 will unable to backup so that MSCS of Node2 carry away the SVOL. This is a problem of MSCS service because Windows system does change the signature through reboot if the same signature will be detected on NO MSCS service. MSCS will not accommodate LUNs with duplicate signatures and partition layout. The best way to avoid such problems is to transport to another host outside the cluster, but this enforces to set up a backup server, so CCI supports a facility to put back the signature as a second way.

The signature will be able to change by using "**dumpcfg.exe**" command attached to Windows resource kits, but if the SVOL is created with "Noread" option and the system is rebooted, then "**dumpcfg.exe**" command will fail to change the signature, because the system does not know the signature and volume layout information for SVOL.

CCI adopts the following way with this point in view:

- The user must save the signature and volume layout information to the system disk by using "**inqraid -gvinf**" command, after an SVOL has been set the signature and new partition by the Windows disk management.
- The user will be able to put back the signature by setting the signature and volume layout information to an SVOL that was saved to the system disk by using "**inqraid -svinf**" command, after splits the SVOL. If the SVOL is created with "Noread" option and the system is rebooted, then the system will not be able to create a device object (\Device\HarddiskVolume#) and Volume{guid} for SVOL, but "**-svinf**" option will create a Device object (\Device\HarddiskVolume#) and Volume{guid} without using the Windows disk management.

Note: The Cluster Disk Driver does not permit to use the "Noread" volume as "Device is not ready" at the boot time, since the Cluster Disk Driver is Non-Plug and Play Driver. The user will be able to verify this situation using inqraid command as follows:

```
inqraid $Phy -CLI
DEVICE_FILE     PORT    SERIAL  LDEV CTG  H/M/12  SSID R:Group PRODUCT_ID
Harddisk0       -           -     -    -      -       -      -    -
Harddisk1       -           -     -    -      -       -      -    -
```

In this case, you need to perform the following procedures to disable the Cluster Disk Driver:

1. In the Computer Management window, double-click System Tools, and then click Device Manager.
2. On the View menu, click Show Hidden Devices. Non-Plug and Play Drivers appear in the list in the right pane.
3. Open Non-Plug and Play Drivers, right-click Cluster Disk, and then click Disable. When you are prompted to confirm whether you want to disable the cluster disk, click Yes. When you are prompted to restart the computer, click Yes.
4. Verify that you can see the "Noread" volume using inqraid command as follows.

```
inqraid $Phy -CLI
DEVICE_FILE     PORT    SERIAL  LDEV CTG  H/M/12  SSID R:Group PRODUCT_ID
Harddisk0       CL2-K    61456   194   -  s/S/ss  0004 1:01-10 OPEN-3
Harddisk1       CL2-K    61456   256   -  s/S/ss  0005 1:01-11 OPEN-3
```

5. After starting up CCI and splitting the SVOL, put back the signature by using the "inqraid -svinf" command.
6. Again In the Computer Management window, Enable the Cluster Disk Driver, and restart the computer.

4.19.2 GPT disk for Windows 2003/2008

Windows 2003/2008 supports the basic disk called “GPT disk” used GUID partition instead of the Signature. The “GPT disk” also can be used as SVOL of the BC, So RAID Manager supports the way for saving/restoring the GUID DiskId of the GPT Basic disk to the inqraid command.

- **gvinfex** option (Only Windows 2003/2008)

  This option retrieves the LUN signature and volume layout information by way of a raw device file provided via STDIN or arguments, and saves it in a system disk file with the following format:

  `\WindowsDirectory\VOLssss_llll.ini`

  where ssss = serial#
  where llll = LDEV#

  Normally, this option is used to save the Disk signature/ GUID DiskId and volume layout information once, after it has been written on a potential (and before its paircreate). The user does not need to directly view these host files.

[For example] … saves the volume information for all physical drives

```
D:\HORCM\etc>inqraid $Phys -gvinfex -CLI
\\.\PhysicalDrive10:
# Harddisk10  -> [VOL61459_448_DA7C0D91] [OPEN-V          ]
\\.\PhysicalDrive11:
# Harddisk11   -> [VOL61459_449_D4CB5F17-2ADC-4FEE-8650-D3628379E8F5] [OPEN-
V          ]
\\.\PhysicalDrive12:
# Harddisk12   -> [VOL61459_450_9ABDCB73-3BA1-4048-9E94-22E3798C3B61] [OPEN-
V          ]
```

- **-svinfex[=PTN]** option (Only Windows 2003)

  This option writes LUN signature/GUID DiskId and volume layout information (that had previously been saved in a system disk file) by way of a raw device file provided via STDIN or arguments.

  This option gets a Serial# and LDEV# of the RAID storage system for the target device using SCSI Inquiry, and writes the signature/ GUID DiskId and volume layout information from the VOLssss_llll.ini file to the target device.

  This option will work correctly (even if Harddisk# changes due to configuration changes) because the signature/ GUID DiskId and volume layout information is associated the array Serial# and LDEV# (not Harddisk#).

  [=PTN]

  This option specifies a string pattern useable to select only the pertinent output lines being provide from STDIN. If used as shown, only the pairdisplay output lines containing “Harddisk” would be used to cause signature writing.

```
D:\HORCM\etc>pairdisplay -l -fd -g URA | inqraid -svinfex=Harddisk
[VOL61459_448_DA7C0D91] -> Harddisk10        [OPEN-V          ]
[VOL61459_449_D4CB5F17-2ADC-4FEE-8650-D3628379E8F5] -> Harddisk11     [OPEN-
V          ]
[VOL61459_450_9ABDCB73-3BA1-4048-9E94-22E3798C3B61] -> Harddisk12
[OPEN-V          ]
```

- **-gplbaex** option (Windows 2003 Only)

  This option is used for displaying usable LBA on a Physical drive in units of 512 bytes, and is used to specify [slba] [elba] options for raidvchkset command.

```
C:\HORCM\Tool>inqraid -CLI -gplbaex hd10,13
Harddisk10   : SLBA = 0x0000003f ELBA = 0x013fe5d9 PCNT = 1 [OPEN-V          ]
Harddisk11   : SLBA = 0x00000022 ELBA = 0x013fffdf PCNT = 2 [OPEN-V          ]
Harddisk12   : SLBA = 0x00000022 ELBA = 0x013fffdf PCNT = 3 [OPEN-V          ]
```

  - SLBA: displays usable starting LBA in units of 512 bytes
  - ELBA: displays usable ending LBA (ELBA -1) in units of 512 bytes
  - PCNT: displays the number of partitions

4.19.3 Directory Mount Facility for Windows Systems

The attached mountvol command into Windows (2008, 2003, or 2000) supports the directory mount, but it does not support the directory mount function that flushes the system buffer associated to a logical drive such as in UNIX systems. The directory mount structure on Windows is only symbolical link between a directory and Volume{guid}, illustrated in Figure 4.79 below. As such, CCI supports the function to discover the mounted volumes by a directory, and supports the operation to mount/umount with the subcommand option.

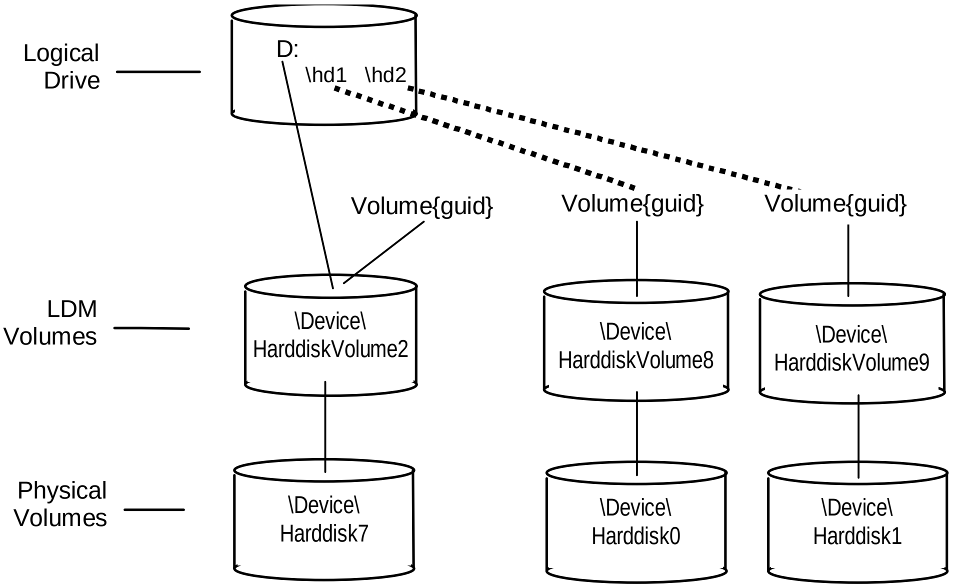


Figure 4.79 Directory Mount Structure

Volume discovery for directory mounted volume: CCI will be able to discover the directory mounted volume by using **$LETALL** that shows the relationship between logical drive and the physical volumes. The KEY WORD (**$LETALL**) can also be used with the **raidscan -find** and **mkconf**' commands.

```
D:\HORCM\etc>inqraid $LETALL -CLI
DEVICE_FILE     PORT    SERIAL  LDEV CTG  H/M/12  SSID R:Group PRODUCT_ID
D:\Vol2\Dsk7    -           -     -   -       -     -       - DDRS-34560D
D:\hd1\Vol8\Dsk0 CL2-F    61459   448   -  s/s/ss  0005 1:01-01 OPEN-3
D:\hd2\Vol9\Dsk1 CL2-F    61459   449   -  s/s/ss  0005 1:01-01 OPEN-3
G:\Dms1\Dsk2     CL2-K    61456   256   -  s/s/ss  0005 1:01-11 OPEN-3
G:\Dms1\Dsk3     CL2-K    61456   257   -  s/s/ss  0005 1:01-11 OPEN-3
G:\Dms1\Dsk4     CL2-K    61456   258   -  s/s/ss  0005 1:01-11 OPEN-3
```

Subcommand for directory mounted volume: CCI supports the directory mount with "-x mount,-x umount,-x sync" option so that the directory mount will be able to use for mount/umount of the SVOL.

Mount and Sync used Volume{GUID} for Windows 2008/2003/2000: RAID Manager supports the mount command option specified in the device object name, such as "\Device\Harddiskvolume X". Windows changes the device number for the device object name after recovering from a failure of the PhysicalDrive. As a result, the mount command specified in the device object name may be failed. Therefore, RAID Manager supports a mount command option that specifies a Volume{GUID} as well as the device object name.

- **Mount**
  - The mount command option will be able to specify a Volume{GUID} as well as the device object name.
  - If a Volume{GUID} is specified, then it will be executed by converting a Volume{GUID} to a device object name.
  - The user will be able to discover the Volume{GUID}s by using "inqraid $Volu -fv" command option.

  Examples:

```
C:\HORCM\etc>inqraid -CLI $Vol -fv
DEVICE_FILE                                   PORT    SERIAL  LDEV CTG  H/M/12  SSID
R:Group →PRODUCT_ID
Volume{cec25efe-d3b8-11d4-aead-00c00d003b1e}\Vol3\Dsk0       CL2-D    62496   256   -
-     -       - OPEN-3-CVS-CM
```

  [Mount used DefineDosDevice()]

  Note: This may forcibly dismount the mounted volume due to LOG-OFF of Windows 2008/2003/2000. For example:

```
C:\HORCM\etc>raidscan -x mount E: Volume{cec25efe-d3b8-11d4-aead-00c00d003b1e}
E: <+> HarddiskVolume3
```

  [Mount used Directory mount]

  Note: This prevents the forcible removal of a volume due to LOG-OFF of Windows 2008/2003/2000. For example:

```
C:\HORCM\etc>raidscan -x mount E:\ Volume{cec25efe-d3b8-11d4-aead-00c00d003b1e}
E:\ <+> HarddiskVolume3
```

- **sync**
  - The sync command option will also be able to specify a Volume{GUID} as well as the device object name.
  - If a Volume{GUID} is specified, then it will be executed by converting a Volume{GUID} to a device object name.

  Example:

```
C:\HORCM\etc>raidscan -x sync Volume{cec25efe-d3b8-11d4-aead-00c00d003b1e}
[SYNC] Volume{cec25efe-d3b8-11d4-aead-00c00d003b1e}
```

4.20 Host Group Control

The Hitachi RAID storage systems (9900V and later) have the defined host group in the port and are able to allocate Host LU every this host group. CCI does not use this host LU, and specifies by using absolute LUN in the port. Therefore, a user can become confused because LUN of the CCI notation does not correspond to LUN on the host view and Remote Console. Thus, CCI supports a way of specifying a host group and LUN on the host view.

4.20.1 Specifying a Host Group

(1) Defining the formats

The way what CCI has addition of argument for the host group to the **raidscan** command and the configuration file will not be able to maintain the compatibility with conventional CLI. Therefore, CCI adopts a way that supports in the form which specifies a host group in the port strings as follows.

- CL1-A-**GRP#** (GRP# are up to 127)
  - Specifying the host group for the **raidscan** command as follows:

```
raidscan -p CL1-A-5
```

  - Specifying the host group for the configuration file

```
#dev_group    dev_name     port#       TargetID     LU#   MU#
ORA           ORA_000      CL2-D-1            4       1     0
ORA           ORA_001      CL2-D-1            4       2     0
```

If the port including a host group is specified to the port name, then maximum of specifiable LUNs are up to 255.

(2) Specifiable port strings

As the result, CCI supports four kinds of forms in the port name.

- Specifying the Port name without a host group
  CL1-A
  CL1-A**n**   where **n** : unit ID for multiple RAID
- Specifying the Port name with a host group
  CL1-A-**g**   where **g** : host group
  CL1-A**n**-**g**   where **n**-**g** : host group=**g** on CL1-A in unit ID=**n**

4.20.2 Commands and Options Including a Host Group

(1) Specifiable command for host group

The following commands are able to specify a host group with the port strings:

- raidscan -p <port>, raidar -p <port>, raidvchkscan -p <port>

```
# raidscan -p CL2-D-1
PORT# /ALPA/C,TID#,LU#.Num(LDEV#....)...P/S, Status,Fence,LDEV#,P-Seq#,P-LDEV#
CL2-D-1 /da/ 0,  4,  0.1(256)..........SMPL  ----  ------ ----, -----  ----
CL2-D-1 /da/ 0,  4,  1.1(257)..........SMPL  ----  ------ ----, -----  ----
CL2-D-1 /da/ 0,  4,  2.1(258)..........SMPL  ----  ------ ----, -----  ----
```

(2) New option including a host group

CCI supports new option for the following commands in order to show a LUN on the host view by finding a host group via the specified device.

- **raidscan** -pd**g** **<device>**, **raidar** -pd**g** **<device>**, **raidvchkscan** -pd**g** **<device>**

```
# raidscan -pdg /dev/rdsk/c57t4d1
PORT# /ALPA/C,TID#,LU#.Num(LDEV#....)...P/S, Status,Fence,LDEV#,P-Seq#,P-LDEV#
CL2-D-1 /da/ 0,  4,  0.1(256)..........SMPL  ----  ------ ----, -----  ----
CL2-D-1 /da/ 0,  4,  1.1(257)..........SMPL  ----  ------ ----, -----  ----
CL2-D-1 /da/ 0,  4,  2.1(258)..........SMPL  ----  ------ ----, -----  ----
Specified device(hgrp=1) is LDEV# 0257
```

- **raidscan** -find**g**

```
# ls /dev/rdsk/c57* | raidscan -findg
DEVICE_FILE         UID  S/F PORT   TARG  LUN    SERIAL  LDEV  PRODUCT_ID
/dev/rdsk/c57t4d0    0    F  CL2-D-1   4    0     62500   256  OPEN3-CVS-CM
/dev/rdsk/c57t4d1    0    F  CL2-D-1   4    1     62500   257  OPEN3-CVS
/dev/rdsk/c57t4d2    0    F  CL2-D-1   4    2     62500   258  OPEN3-CVS
```

- **raidscan** -find**g** conf, **mkconf** -g**g**

```
# ls /dev/rdsk/c57* | raidscan -findg conf 0 -g ORA
HORCM_DEV
#dev_group         dev_name        port#     TargetID     LU#     MU#
# /dev/rdsk/c57t4d1    SER =    62500  LDEV =  257 [ FIBRE FCTBL = 4 ]
ORA                ORA_000         CL2-D-1          4       1       0
# /dev/rdsk/c57t4d2    SER =    62500  LDEV =  258 [ FIBRE FCTBL = 4 ]
ORA                ORA_001         CL2-D-1          4       2       0
```

- **inqraid** -f**g**

```
# ls /dev/rdsk/c57* | ./inqraid -CLI -fg
DEVICE_FILE     PORT    SERIAL  LDEV CTG  H/M/12  SSID R:Group PRODUCT_ID
c57t4d0         CL2-D-1  62500   256   -       -     -       - OPEN-3-CVS-CM
c57t4d1         CL2-D-1  62500   257   -  s/P/ss  0005 1:01-02 OPEN-3-CVS
c57t4d2         CL2-D-1  62500   258   -  s/P/ss  0005 1:01-02 OPEN-3-CVS
```

4.21 Using CCI SLPR Security

The Virtual Partition Manager (VPM) feature of the Hitachi RAID storage systems (USP V/VM and TagmaStore USP/NSC) supports Storage Logical Partitioning (SLPR), a feature that partitions the ports and volumes of the RAID storage system. If CCI does not have SLPR security, then it will be able to operate the target volumes crossing SLPR through the command device. The purpose of CCI SLPR security is to prevent CCI from operating the volumes on another SLPR (SLPR#N) through the command device from the SLPR (SLPR#M) that is assigned to its Host. You can use CCI SLPR Security by defining the command device through the Web console or the SVP-installed 'VPM' feature, so that CCI can protect the target volume.

The following example represents the SLPR protection facility.

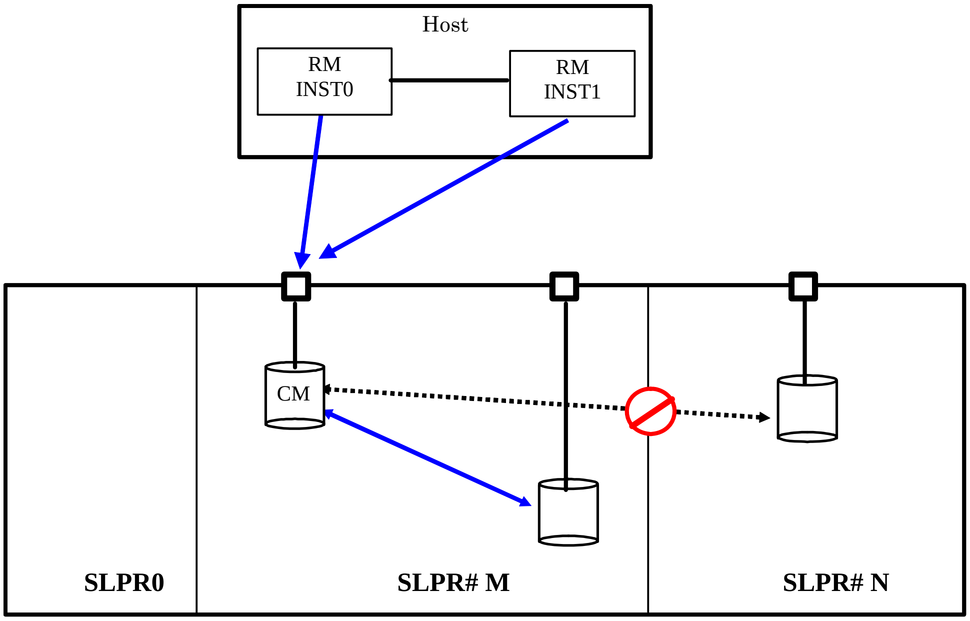


Figure 4.80 Protection of the command device that has the SLPR attribute

4.21.1 Specifying the SLPR Protection Facility

When you want to access certain SLPRs on a single Host, use the CCI protection facility so that the Host can access multiple SLPRs through a single command device. The following outline reviews the setup tasks for the SLPR protection facility.

1. **Setting SLPR on the command device**: The command device has a SLPR number and an associated bitmap so you can set multiple SLPRs. You accomplish this by sharing a command device (using ports connected to different SLPRs) by setting the command device through SLPR#0 (called Storage Administrator) on the Web console or SVP.

   For example, if the command device will be shared with the port on SLPR#1 and SLPR#2, then the command device will automatically set the bitmap corresponding to SLPR#1 and SLPR#2.

2. **Testing SLPR**: CCI verifies whether or not the command device can access a target within SLPR. So, if the command device belongs to SLPR#0, or CCI has no SLPR function, then the SLPR protection is ignored.

   However, if the command device will be shared with the port on SLPR#1 and SLPR#2, CCI allows you to operate the volume on SLPR#1 and SLPR#2.

3. **Rejecting commands**: If access is denied on the specified port (or target volume), CCI rejects the following commands and outputs an error code, EX_ESPERM:
   - Horctakeover, Paircurchk, Paircreate, Pairsplit, Pairresync, Pairvolchk, Pairevtwait, Pairsyncwait
   - raidscan (except “-find verify”, “-find inst”), raidar, pairdisplay
   - raidvchkset, raidvchkscan (except “-v jnl”), raidvchkdsp

```
[EX_ESPERM]       Permission  denied with the SLPR
[Cause ] : A specified command device does not have a permission to access other
SLPR.
[Action] : Please make the SLPR so that the target port and the command device
belongs to the same SLPR.
```

4.21.2 SLPR Configuration Examples

4.21.2.1 Single Host

Figure 4.81 provides an example of when control is denied to the paircreate and raidscan commands in the following cases:

- The volume described on RM INST1 is different from the SLPR of the command device, so the paircreate command cannot control the paired volume.
- The specified port is different from the SLPR of the command device, so the **raidscan -p CL3-A** command cannot scan any ports that are defined as SLPR#N.

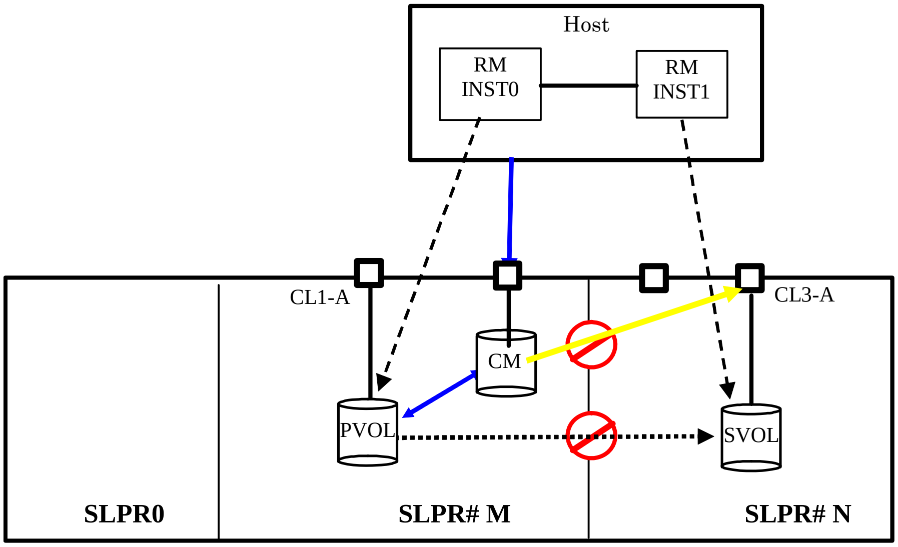


Figure 4.81 SLPR Configuration on a Single Host

To operate SLPR#N, assign the command device. If RM INST1 has a command device for SLPR#N, the paircreate command is permitted. However, the **raidscan -p CL3-A** command (via RMINST0) will be unable to scan a port, because the specified port is different than the SLPR of the command device. In this case, -p CL3-A must be operated via RMINST1, as shown in the following example.

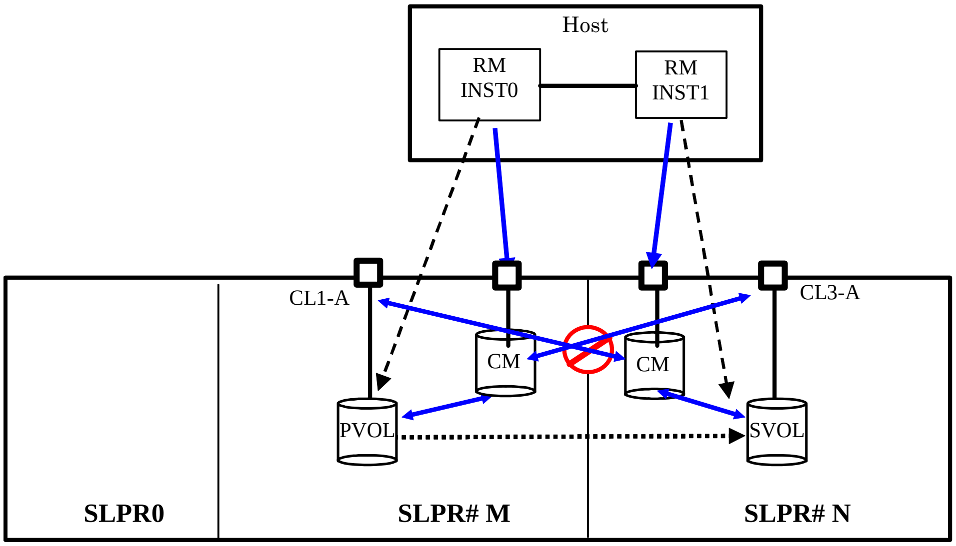


Figure 4.82 Operation Across SLPRs Using two Command Devices on a Single Host

To operate SLPR#N, share the command device. If RMINST1 has a shared command device for SLPR#N, the paircreate command is permitted. Additionally, the **raidscan -p CL3-A** command (via RMINST0), will be permitted to scan a port, because the shared command device has the Bitmap settings SLPR#M and SLPR#N.

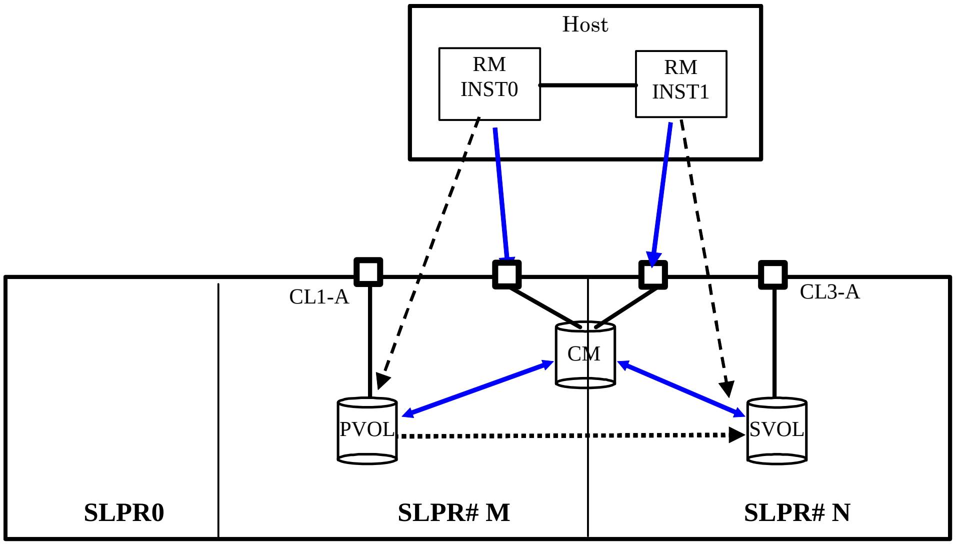


Figure 4.83 Operation Across SLPRs Using a Shared Command Device on a Single Host

4.21.2.2 Dual Hosts

In the following example, the paircreate command is unable to operate the paired volume because the volume described on HostB is different than the SLPR of the command device. Also, the **raidscan -p CL3-A** command (via both Hosts), will be unable to scan a port because the specified port is different than the SLPR of the command device.

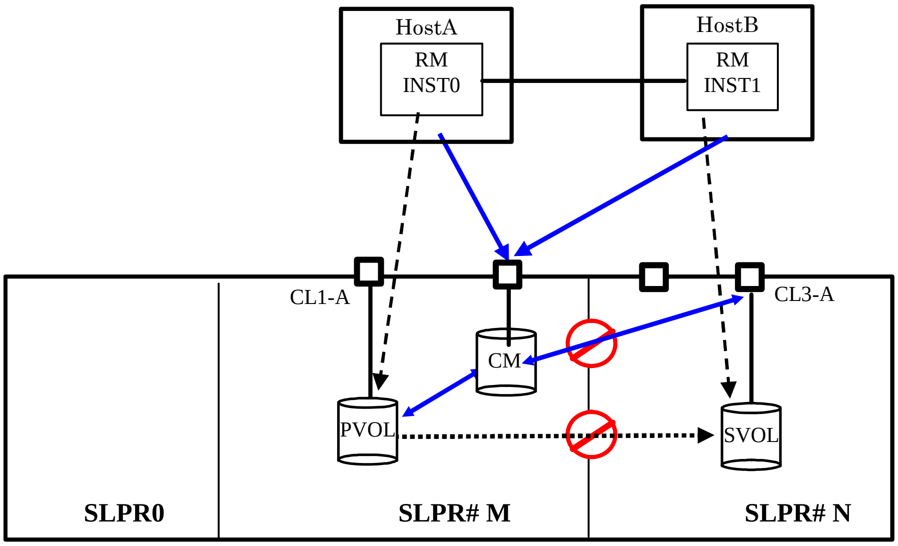


Figure 4.84 SLPR Configuration on Dual Hosts

To operate SLPR#N, assign the command device. If HostB has a command device for SLPR#N, the paircreate command will be permitted. However, the **raidscan -p CL3-A** command via HostA will be unable to scan a port because the specified port is different than the SLPR of the command device. In this case, **raidscan -p CL3-A** command must be operated via HostB.

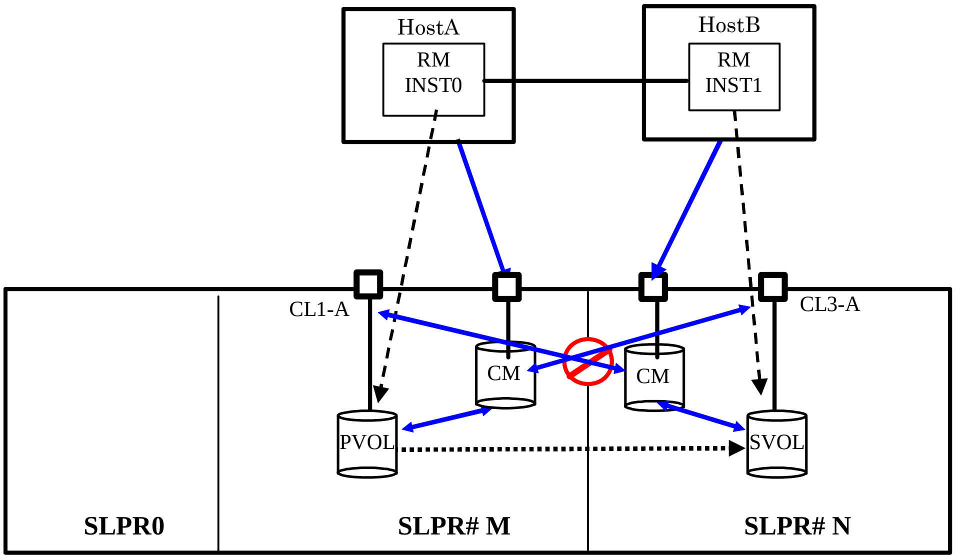


Figure 4.85 Operation Across SLPRs Using two Command Devices on Dual Hosts

To operate SLPR#N, share the command device. If HostB has a shared command device for SLPR#N, the paircreate command is permitted. Also, the **raidscan -p CL3-A** command (via HostA), will be allowed to scan a port because the shared command device has the Bitmap settings SLPR#M and SLPR#N.

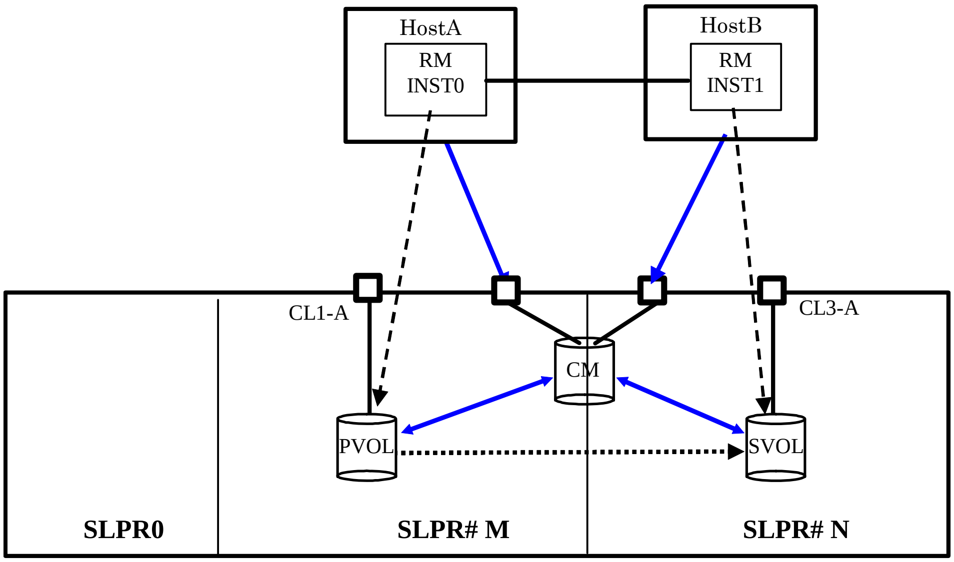


Figure 4.86 Operating SLPR#N by Sharing the Command Device

4.21.2.3 TrueCopy Using Dual Hosts

In the following example, the pair-operation command (except the -l option) determines whether the operation for paired volumes should be permitted at a remote site. The result is that the paircreate command is not allowed to operate the paired volume, because the volume described on HostB differs from the SLPR of the command device. Also, the **raidscan -p CL3-A** command (on HostB) will not be allowed to scan a port.

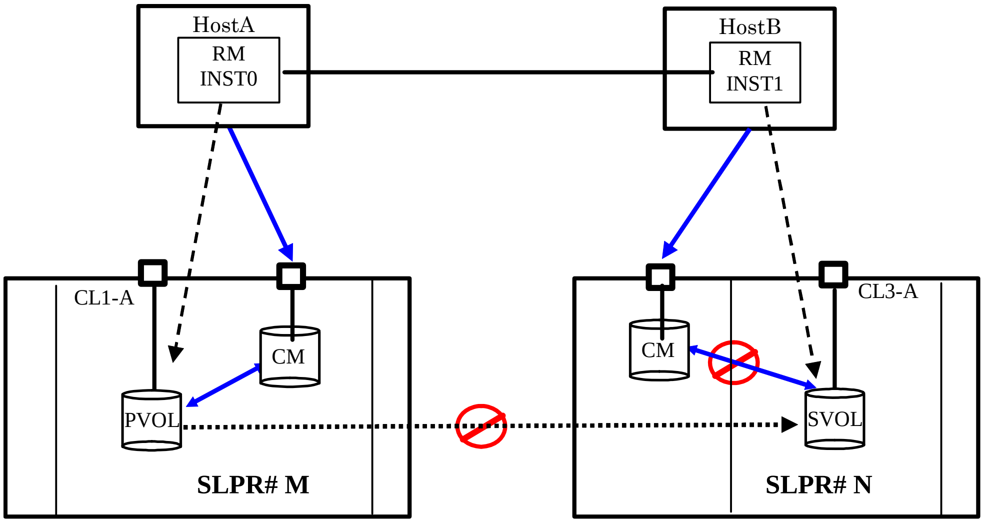


Figure 4.87 TrueCopy Operation using SLPR

4.22 Controlling Volume Migration

The volume migration including the external volume will be required to control using CLI in Data Lifecycle Management (DLCM) solution. It is possible to support the volume migration that cooperates with CC (Cruising Copy) and the external connection by operating the current ShadowImage and VDEV mapping of the external connection.

Also, it is important to consider the support of CC (Cruising Copy) on the compatibility based on the current CLI interface, because CCI is supporting ShadowImage and the external connection. For this purpose, CCI makes the CLI interface that works by minimum compatible of the APP by specifying the COPY mode for CC (Cruising Copy) to the CLI of CCI.

4.22.1 Specifications for Volume Migration

CCI is necessary to be mapped to the port for pooling of RAID in order to control the volume of the external connection. So the external volume need to be mapped previously to the port of RAID without connecting to the host. The following is the execution example of the volume migration executed for LDEV#18.

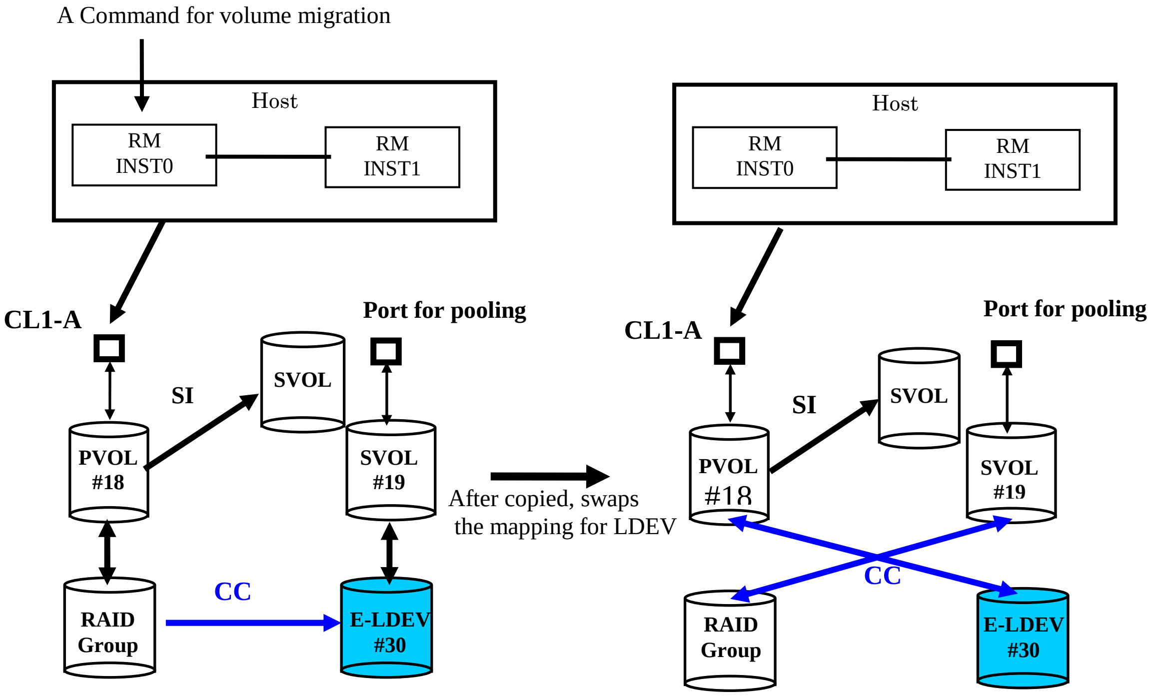


Figure 4.88 Volume Migration Configurations

(1) Command specification

CCI operates the volume migration by specifying to the horcm*.conf as same SI and TC, because the volume migration using CCI is necessary to be defined the mapping for the target volume.

MU# (of SMPL as SI) which is not used as SI is used for the operation for CC.

An original volume for the migration is defined as PVOL. A target volume for the migration is defined as SVOL. In other words, an original volume is migrated from PVOL to SVOL, and the mapping between LDEV and VDEV is swapped after copied.

(2) Mapping specification

The mapping between LUN and LDEV will be maintained for the replying of SCSI-Inquiry in order to make recognize as identical LUN through the host after mapping changes.

The way to know whether the mapping is changed or not is possible to use “-fe” option of pairdisplay and/or raidscan command that shows the connection for the external volumes.

Also LU of the external connection and LU of RAID Group intermingle on the port for pooling, but can confirm this with the above option of the **raidscan** command.

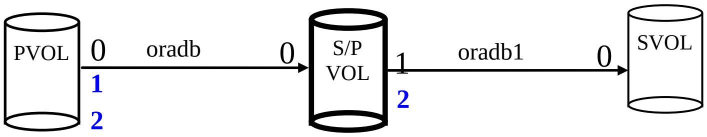
(3) Group operation

It is possible to execute the volume migration as group by describing to the horcm*.conf, however LU(LDEV) which was mapped to SVOL after command execution does not maintain the consistency as the group. In other words, the user must consider the volume mapped to SVOL after execution as the discarded volume.

When HORCM demon is KILLed or the host has crash during group operation, the group aborted the execution of the command has LUN mixed with the external connection and RAID Group as the group. In this case, CCI skips the executed LU and issues CC command to the un-executed LU, by the user issues an identical command once again.

(4) Using MU#

CCI manages the status of TC/SI using MU#, so CCI uses the empty MU# that is managed for SI. Therefore, the user need to execute the command of the volume migration in the environment for SI having HORCC_MRCF environment variable. An example is shown below.



It is possible to specify MU#1 or MU#2 for CC.

It is possible to specify MU#2 for CC.

(5) HORCM instance

It is possible to describe the original and target volume for the volume migration to MU# as another group in horcm*.conf for HORCM instance of SI and /or TC. Also, it is possible to define the original and target volume for the volume migration in the horcm*.conf as HORCM instance independent from SI/TC.

4.22.2 Commands to Control the Volume Migration

(1) Command for volume migration

CCI supports the volume migration by adding an option (**-m cc**) to the paircreate command.

paircreate -g <group> -d <pair vol> … -m <mode> -vl[r] -c <size>

-m <mode>
mode = cc (Specifiable by the HOMRCF only)

This option is used to specify the Cruising Copy mode for the volume migration.

Note: This option cannot be specified with "-split" option in the same command.

-vl[r]

The **-vl** option specifies "local", and copies from the local instance LU(PVOL) to the remote instance LU(SVOL), an original volume as the local instance LU is migrated from PVOL to SVOL, and the physical volume mapping between PVOL and SVOL is swapped after copied

The **-vr** option specifies "remote", and copies from the remote instance LU(PVOL) to the local instance LU(SVOL), an original volume as the remote instance LU is migrated from PVOL to SVOL, and the physical volume mapping between PVOL and SVOL is swapped after copied.

-c <size>

This option is used to specify a track size of the case which copies paired volume at 1-15 extents. When omits specification of this option, it uses a default value (3) for a track size.

(2) Command for discovering an external volume

It is possible to discover the external volumes by using "-fe" option of the **raidscan** command.

raidscan -p <port> -fe

-fe

This option is used to display the serial# and LDEV# of the external LUNs only mapped to the LDEV.

If the external LUN mapped to the LDEV on a specified port does not exist, then this option will do nothing. Also if this option is specified, **-f[f][g][d]** option is not allowed.

[Display example]

```
# raidscan -p cl1-a-0 -fe -CLI
PORT# /ALPA/C TID#  LU# Seq#   Num  LDEV# P/S  Status Fence  E-Seq#  E-LDEV#
CL1-A-0  ef  0   0    8 62496     1    19 SMPL  -     -       30053      30
CL1-A-0  ef  0   0    9 62496     1    21 SMPL  -     -       30053      32
CL1-A-0  ef  0   0   10 62496     1    22 SMPL  -     -       30053      33
```

E-Seq#: Displays the production (serial) number of the external LUN.
E-LDEV#: Displays the LDEV# of the external LUN.

(3) Command for confirming the status

It is possible to confirm the status for CC by using “-fe” option of the pairdisplay command.

pairdisplay -g <group> -fe

-fe

This option is used to display the serial# and LDEV# of the external LUNs mapped to the LDEV and additional information for the pair volume.

This option displays the information above by adding to last column, and then ignores the format of 80 column.

This option will be invalid if the cascade options (-m all,-m cas) are specified.

Display example:

[Before execution of CC command]

```
# pairdisplay -g horc0 -fe
Group ...  Seq#,LDEV#.P/S,Status, Seq#,P-LDEV# M CTG CM EM E-Seq# E-LDEV#
horc0 ... 62496    18.SMPL ----,-----   ----  -  -  -  -      -       -
horc0 ... 62496    19.SMPL ----,-----   ----  -  -  -  H  30053      30

# paircreate -g horc0 -vl -m cc
```

[During execution of CC command, the progress is displayed in the copy %]

```
# pairdisplay -g horc0 -fe
Group ...  Seq#,LDEV#.P/S,Status, Seq#,P-LDEV# M CTG CM EM E-Seq# E-LDEV#
horc0 ... 62496    18.P-VOL COPY,62496      19 -  -  C  -      -       -
horc0 ... 62496    19.S-VOL COPY,-----      18 -  -  C  H  30053      30
```

[After completion of CC command]

```
# pairdisplay -g horc0 -fe
Group ...  Seq#,LDEV#.P/S,Status, Seq#,P-LDEV# M CTG CM EM E-Seq# E-LDEV#
horc0 ... 62496    18.P-VOL PSUS,62496      19 -  -  C  V  30053      30
horc0 ... 62496    19.S-VOL SSUS,-----      18 -  -  C  -      -       -
```

CM: Displays the Copy mode
  N → Non SnapShot
  S → SnapShot.
    For SMPL state, this shows that pair-volume will be created as SnapShot.
  C → **Cruising Copy**

EM: Displays the external connection mode
  H → Mapped E-lun as hidden from the host.
  V → Mapped E-lun as visible to the host
  ‘ - ‘→ Unmapped to the E-lun
  BH → Mapped E-lun as hidden from the host, but LDEV blockading.
  BV → Mapped E-lun as visible to the host, but LDEV blockading
  B → Unmapped to the E-lun, but LDEV blockading

E-Seq#: Displays the production (serial) number of the external LUN. ‘Unknown’ will be shown as ‘-’.

E-LDEV#: Displays the LDEV# of the external LUN. ‘Unknown’ will be shown as ‘-’.

(4) Command for discovering an external volume via the device file

It is possible to discover the external volumes by using the inqraid command.

Example in Linux:

```
# ls /dev/sd* | ./inqraid -CLI
DEVICE_FILE      PORT   SERIAL   LDEV  CTG   H/M/12   SSID  R:Group  PRODUCT_ID
sdh             CL2-G    63528  15360    -   s/s/ss   0100  5:01-09  OPEN-V
sdu             CL2-G    63528   2755    -   s/s/ss   000B  S:00001  OPEN-0V
sdv             CL2-G    63528   2768    -   s/s/ss   000B  U:00000  OPEN-0V
sdw             CL2-G    63528   2769    -   s/s/ss   000B  E:16384  OPEN-V
```

- **R:Group**: This displays the physical position of an LDEV according to mapping of LDEV in the RAID storage system.

LDEV mapping	R:	Group
RAID Group	RAID Level 1 → RAID1 5 → RAID5 6→ RAID6	RAID Group number - Sub number
SnapShot SVOL	S	PoolID number
Unmapped	U	00000
External LUN	E	External Group number

Example in Linux:

```
# ls /dev/sd* | ./inqraid
/dev/sdh -> CHNO =   0 TID =   1 LUN =   1
            [SQ] CL2-G Ser =   63528 LDEV =15360 [HITACHI ] [OPEN-V          ]
            HORC = SMPL  HOMRCF[MU#0 = SMPL MU#1 = SMPL MU#2 = SMPL]
            RAID5[Group  1- 9] SSID = 0x0100
/dev/sdu -> CHNO =   0 TID =   1 LUN =  14
            [SQ] CL2-G Ser =   63528 LDEV =2755 [HITACHI ] [OPEN-V          ]
            HORC = SMPL  HOMRCF[MU#0 = SMPL MU#1 = SMPL MU#2 = SMPL]
            E-LUN[Group 00001] SSID = 0x000B
            SNAPS[PoolID 0001] SSID = 0x000B
/dev/sdv -> CHNO =   0 TID =   1 LUN =  15
            [SQ] CL2-G Ser =   63528 LDEV =2768 [HITACHI ] [OPEN-V          ]
            HORC = SMPL  HOMRCF[MU#0 = SMPL MU#1 = SMPL MU#2 = SMPL]
            E-LUN[Group 08191] SSID = 0x000B
            UNMAP[Group 00000] SSID = 0x000B
/dev/sdw -> CHNO =   0 TID =   1 LUN =  16
            [SQ] CL2-G Ser =   63528 LDEV =2769 [HITACHI ] [OPEN-V          ]
            HORC = SMPL  HOMRCF[MU#0 = SMPL MU#1 = SMPL MU#2 = SMPL]
            E-LUN[Group 16384] SSID = 0x000B
            E-LUN[Group 16384] SSID = 0x000B
```

- **Group**: This item shows physical position of an LDEV according to mapping of LDEV in the RAID storage system.

LDEV Mapping	Display Formats
RAID Group	RAID1[Group Group number - Sub number] RAID5[Group Group number - Sub number] RAID6[Group Group number - Sub number]
SnapShot SVOL	SNAPS[PoolID poolID number]
Unmapped	UNMAP[Group 00000]
External LUN	E-LUN[Group External Group number]

4.22.3 Relations between “cc” Command Issues and Status

The migration volumes can be handled by issuing the CCI commands (pair creation and pair splitting commands). The validity of the specified operation is checked according to the status of the paired volume (primary volume).

Table 4.52 shows the relations between the migration volume statuses and command acceptances.

Table 4.52 Command Issues and Pairing Status Transition

Command:	Pair Creation	Pair Splitting
Pairing Status CC:	-m cc	Simlex -S
① SMPL	Accepted ②→③ ②→④	Acceptable
② COPY ↓	Acceptable	Accepted
③ PSUS	▨	Accepted ①
④ PSUE PDUB	▨	Accepted ①

Explanation of terms in Table 4.52:

- **Accepted**: A command is accepted and executed. When the command execution succeeds, the status changes to that of the shown number.
- **Acceptable**: No operation is executed, though a command is accepted.
- **Shaded portions**: Command execution is rejected and the operation terminates abnormally.

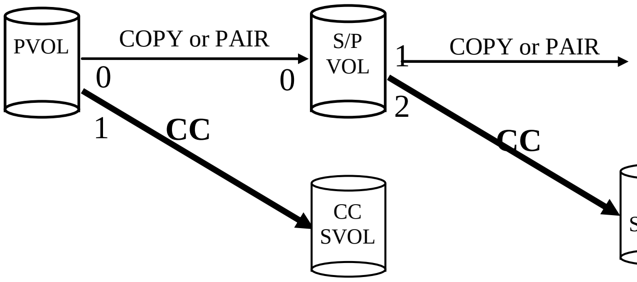
Notes:

- Other commands and option (e.g., pairresync…) for operating a paired-volume are rejected.
- The “-m cc” option cannot be specified with “-split” option in the same command.

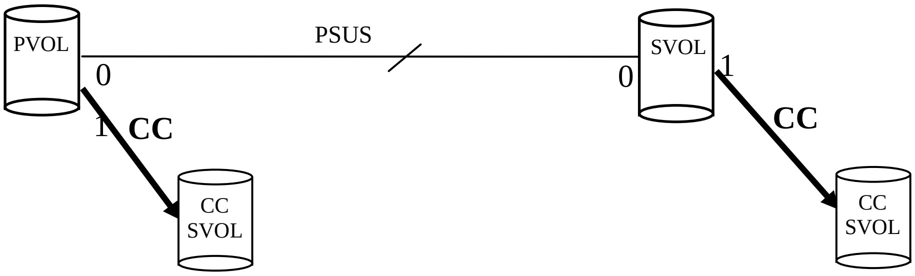
4.22.4 Restrictions for Volume Migration

Volume migration must be used within the following restrictions:

- **ShadowImage (HOMRCF).** The operation for the volume migration must be operated at the “SMPL” or “PAIR” or “COPY” state. If not, “paircreate -m cc” command will be rejected with EX_CMDRJE or EX_CMDIOE. Also HOMRCF can not be operated to CC_SVOL moving in Cruising Copy. In copying CC_SVOL, the copy operation for the volume migration will be stopped, if pairsplit command for of HOMRCF will be executed.



- **TrueCopy (HORC).** The operation for the volume migration must be operated at the “SMPL” or “PSUS” state. If not, “paircreate -m cc” command will be rejected with EX_CMDRJE or EX_CMDIOE. Also HORC can not be operated to CC_SVOL copying in Cruising Copy. On one hand, in copying CC_SVOL, the copy operation for the volume migration will be stopped, if pairresync command for of HORC will be executed.



- **LDEV type for CC.** The volume of the external connection for the volume migration must be mapped to an LDEV as OPEN-V.

Chapter 5 Troubleshooting

This chapter contains the following resources to address issues that you may encounter while working with the CCI software:

- General Troubleshooting (section 5.1)
- Changing IO way of the command device for AIX (section 5.2)
- Error Reporting (section 5.3)
- Calling the Hitachi Data Systems Support Center (section 5.4)

5.1 General Troubleshooting

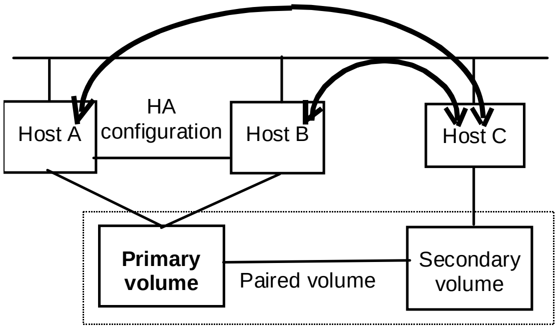
If you have a problem with the CCI software, first make sure that the problem is not being caused by the UNIX/PC server hardware or software, and try restarting the server. Table 5.1 provides operational notes and restrictions for CCI operations.

For maintenance of Hitachi TrueCopy and ShadowImage volumes, if a failure occurs, it is important to find the failure in the paired volumes, recover the volumes, and continue operation in the original system. When a CCI (HORCM), Hitachi TrueCopy, or ShadowImage failure is detected, please collect the data in the error log file and trace data (all files in HORCM_LOG directory), and report the failure to your Hitachi Data Systems representative.

If you need to call the Hitachi Data Systems Support Center, please refer to section 5.4 for instructions. *Note:* Use the **FD Dump Tool** or **FDCOPY** function (refer to the *Storage Navigator User's Guide* for the storage system) to copy the Storage Navigator configuration information onto diskette, and give the diskette(s) to the Hitachi Data Systems service personnel. The *Storage Navigator Error Codes* document for the storage system provides a list of the error codes displayed by Storage Navigator.

Table 5.1 Operational Notes for CCI Operations

Condition	Recommended Action
Startup/shutdown restrictions	When the server starts up, the secondary volume may be updated by the primary volume's server. The secondary volume must not be mounted automatically in the startup sequence. If the secondary volume is used by the LVM, the volume group of the LVM must be deactivated. The secondary volume must be mounted in the split state or in the simplex mode. When the server starts up, the secondary volume can be activated without confirming, when can be guaranteed that the secondary volume has been PSUS (R/W enable) or in the SMPL state by server shutdown sequence.
Hot standby operations	Hitachi TrueCopy commands cannot execute hot standby operations between the primary and secondary volumes. Use the takeover command intended for the HA configuration to execute the hot standby operation. In hot standby operation, two servers are used, and the active (primary) and standby (secondary) server programs are run alternately in each server in case of failure in one server. Follow these precautions: ▪ **Operation across volumes**. Since each Hitachi TrueCopy command causes the server software to handle the volume by volume, a single volume should not be partitioned to prevent it from being used by some servers. ▪ **Using LVM and Hitachi TrueCopy together**. When constructing the LVM on the paired volume in the mutual hot standby configuration, the LVM logical volumes must be constructed in units of volume to prevent the volumes from being mounted by the LVM.
Coexistence of LVM mirror and Hitachi TrueCopy	When the LVM mirror and Hitachi TrueCopy volumes are used together, the LVM mirror handles write errors and changes the volumes. Thus, the fence level of the volumes used by the LVM mirror must be set to **data**.
Using paired volume in a single host	When constructing paired volume in a single host, it is necessary to activate two or more CCI instances. To activate two or more CCI instances, instance numbers must be assigned using the environmental variable **HORCMINST**. The HORCM and Hitachi TrueCopy/ShadowImage commands must possess this environmental variable. A configuration definition file and a log directory must be set for each instance. The command device described in the configuration definition file must be established in a way to be following either every instance. If using a command device between different instances on the same SCSI port, the maximum number of instances per command device is 16. If this number is exceeded, the use a different SCSI path for each instance.

Condition	Recommended Action
Sharing volumes in a hot standby configuration	When paired volume is used for the disk shared by the hosts in hot standby configuration using HA software, use the primary volume as the shared disk and describe the corresponding hosts using the paired volume in the configuration definition file as shown below. In the HA configuration, if a TrueCopy command issued by host C fails in host B (because host B has gone down and/or IO_ERROR of the command device), host A is connected and the command execution is retried. 
Linkage with HA software	The HORC Manager must not be an object of the process monitoring by the HA software (cluster manager), because HORCM should run in the same level as the cluster manager. Cooperation with HA software is done by activating the takeover command from the shell script activated by the cluster manager in units of the package software. *Note:* Cannot use a pair volume for the cluster lock disk which HA software uses for election.
Maintenance	Restart of HORCM is required if the storage system configuration is changed (e.g., microcode exchange, cache memory install/uninstall). Hitachi TrueCopy only: In case of an error (e.g., single error in cache memory) which made the pair volume is accompanied by maintenance work, the pairresync command or paircreate command cannot execute copy rejection.
Command device	Each Hitachi TrueCopy/ShadowImage command is executed by issuing a command to the command device. The Hitachi TrueCopy/ShadowImage command is read or written from/into the specific block area of the command device. Therefore, the command device cannot be used by the user. In addition, this device must not belong to an LVM volume group. For Windows systems, do not assign a drive letter to the command device to prevent utilization by general users.
SCSI alternate path restrictions	If the P-VOL and S-VOL are on the same server, alternate path from P-VOL to S-VOL cannot be used. Use of SCSI alternate path to a volume pair is limited to among primary (secondary) volumes. Alternate path using Hitachi Path Manager (Safe Path) is limited to primary volumes.
Horctakeover (Swap-Takeover)	When executing horctakeover on a standby server manually, I/O on the active server must be stopped. When the package software goes for a standby server a failover by HA software, the HA software must guarantee an I/O insulation of the active server.
HORCM failure to activate	After a new system has been constructed, a failure to activate HORCM may occur due to improper environmental setting and/or configuration definition by the user. Refer to the HORCM activation log, and correct the setting(s).
Abnormal termination of command	Refer to the command log file and HORCM log file to identify the cause of the error. If a command terminates abnormally because of a remote server failure, recover the server from the failure, then re-execute the command. If HORCM has shut down, restart HORCM. If an unrecoverable error occurs, obtain the log files (see Table A.2) and contact the Hitachi Data Systems Support Center.

Condition	Recommended Action
Error in paired volume operation	Hitachi TrueCopy only: If an error occurs in duplicated writing in paired volumes (i.e., pair suspension), the server software using the volumes may detect the error by means of the fence level of the paired volume. In such a case, check the error notification command or syslog file to identify a failed paired volume. The system administrator can confirm that duplicated writing in a paired volume is suspended due to a failure and the system runs in regressed state using the error notification command of the Hitachi TrueCopy. HORCM monitors failures in paired volumes at regular intervals. When it detects a failure, it outputs it to the host's syslog file. Thus, the system administrator can detect the failure by checking the syslog file. Concerning the operation of the RAID storage system, the failure can also be found on the Remote Console PC (or SVP) provided. Issue the Hitachi TrueCopy commands manually to the identified failed paired volume to try to recover it. If the secondary volume is proved to be the failed volume, issue the pair resynchronization command to recover it. If the primary volume fails, delete the paired volume (pair splitting simplex) and use the secondary volume as the substitute volume.
About "/var(usr)/tmp" directory	CCI uses "/var/tmp" or "/usr/tmp" as the directory for UNIX domain socket for IPC (Inter Process Communication), and makes the directory and files as "/var/tmp/.lcm*" in CCI version 01-16-06 or before. *Caution:* This "/var/tmp/.lcm*" should not be removed while HORCM is running. In case of Red Hat Linux, Cron executes the following "/etc/cron.daily/tmpwatch" file as default:

About "/var(usr)/tmp" directory

```
------------------------------------------------------------
/usr/sbin/tmpwatch 240 /tmp
/usr/sbin/tmpwatch 720 /var/tmp
for d in /var/{cache/man,catman}/{cat?,X11R6/cat?,local/cat?}; do
    if [ -d "$d" ]; then
            /usr/sbin/tmpwatch -f 720 $d
    fi
done
------------------------------------------------------------
```

The command of second line will remove "/var/tmp/.lcm*" directory after 720 Hr from HORCM start-up, even though CCI command is used.

Action: So administrator needs to add the following command in order to avoid this problem:

```
------------------------------------------------------------
/bin/touch -c /var/tmp/.lcm* 2>/dev/null
/usr/sbin/tmpwatch 240 /tmp
/usr/sbin/tmpwatch 720 /var/tmp
for d in /var/{cache/man,catman}/{cat?,X11R6/cat?,local/cat?}; do
    if [ -d "$d" ]; then
            /usr/sbin/tmpwatch -f 720 $d
    fi
done
------------------------------------------------------------
```

5.1.1 About Linux Kernel 2.6.9.XX supported ioctl(SG_IO)

The RAID Manager currently uses the ioctl(SCSI_IOCTL_SEND_COMMAND) for sending the control command to the command device. However, in RHEL 4.0 using kernel 2.6.9.XX, the following messages are output to syslog file (/var/log/messages) with every ioctl().

```
program horcmgr is using a deprecated SCSI ioctl, please convert it to SG_IO
```

This seems to originate from the following kernel code in drivers/scsi/scsi_ioctl.c as way of warning that ioctl(SCSI_IOCTL_…) of kernel 2.6.9.XX does not handle rightly an error of the HBA driver.

```
-------------------------------------------------------------------------------------------
/* Check for deprecated ioctls ... all the ioctls which don't follow the new unique
numbering scheme are deprecated */
        switch (cmd) {
        case SCSI_IOCTL_SEND_COMMAND:
        case SCSI_IOCTL_TEST_UNIT_READY:
        case SCSI_IOCTL_BENCHMARK_COMMAND:
        case SCSI_IOCTL_SYNC:
        case SCSI_IOCTL_START_UNIT:
        case SCSI_IOCTL_STOP_UNIT:
                printk(KERN_WARNING "program %s is using a deprecated SCSI "
                       "ioctl, please convert it to SG_IO\n", current->comm);
-------------------------------------------------------------------------------------------
```

Thus, RAID Manager supports a way to change to the ioctl(SG_IO) automatically, if Linux kernel supports the ioctl(SG_IO) for horcmgr and inqraid command. However, in the customer site, RAID Manager may encounter to Lilux kernel which does not support the ioctl(SG_IO) fully. After this consideration, RAID Manager also supports by defining either following environment variable or "/HORCM/etc/USE_OLD_IOCTL" file (size=0) that uses the ioctl(SCSI_IOCTL_SEND_COMMAND) forcibly.

For Example:

```
export USE_OLD_IOCTL=1
horcmstart.sh 10
```

```
HORCM/etc:
-rw-r--r--  1 root root      0 Nov 11 11:12 USE_OLD_IOCTL
-r--r--r--  1 root sys   32651 Nov 10 20:02 horcm.conf
-r-xr--r--  1 root sys  282713 Nov 10 20:02 horcmgr
```

5.2 Changing IO Way of the Command Device for AIX

RAID Manager tries to use `ioctl(DK_PASSTHRU)` or `SCSI_Path_thru` as much as possible, if it fails, changes to `RAW_IO` follows conventional ways. Even so, RAID Manager may encounter to AIX FCP driver which does not support the `ioctl(DK_PASSTHRU)` fully in the customer site. After this consideration, RAID Manager also supports by defining either following environment variable or `/HORCM/etc/USE_OLD_IOCTLfile(size=0)` that uses the RAW_IO forcibly.

For Example:

```
export USE_OLD_IOCTL=1
horcmstart.sh 10

HORCM/etc:
-rw-r--r--  1 root root      0 Nov 11 11:12 USE_OLD_IOCT
-r--r--r--  1 root sys   32651 Nov 10 20:02 horcm.conf
-r-xr--r--  1 root sys  282713 Nov 10 20:02 horcmgr
```

5.3 Error Reporting

Table 5.2 lists and describes the HORCM system log messages and provides guidelines for resolving the error conditions. Table 5.3 lists and describes the command error messages and their return values and also provides guidelines for resolving the error conditions. Table 5.4 and Table 5.5 list the generic error codes. Table 5.6 lists the specific error codes.

Table 5.2 System Log Messages

Message ID	Condition	Cause	Recommended Action
HORCM_001	The HORCM log file cannot be opened.	The file cannot be created in the HORCM directory.	Create space on the disk on which the root directory resides.
HORCM_002	The HORCM trace file cannot be opened.	The file cannot be created in the HORCM directory.	Create space on the disk on which the root directory resides.
HORCM_003	The HORCM daemon process cannot create a child process due to an error.	HORCM daemon attempted to create more processes than the maximum allowable number.	Terminate unnecessary programs or daemon processes running simultaneously.
HORCM_004	HORCM assertion failed, resulting in a fatal internal error in the HORCM.	An internal error which could not be identified by the HORCM occurred.	Restart the system, and call the Hitachi Data Systems support center.
HORCM_005	The CCI software failed to create the end point for remote communication.	HORCM failed to create a socket, or an error exists in the HORCM configuration file ($HORCM_CONF).	Refer to the HORCM startup log to identify the cause of the error.
HORCM_006	HORCM memory allocation failed.	HORCM memory could not be secured.	Increase the system virtual memory, or close any unnecessary programs.
HORCM_007	An error exists in the HORCM setup file.	An error exists in the HORCM setup file.	Refer to the startup log and reset the parameters.
HORCM_008	HORCM configuration file parameters could not be read.	An error exists in the format or parameters of the HORCM configuration file ($HORCM_CONF).	Refer to the HORCM startup log to identify the cause of the error.
HORCM_009	HORC/HOMRCF connection to the CCI software failed.	System devices are improperly connected, or an error exists in the HORCM configuration file.	Refer to the HORCM startup log to identify the cause of the error.
HORCM_101	HORC/HOMRCF and the CCI software communication fails.	A system I/O error occurred or an error exists in the HORCM configuration file ($HORCM_CONF).	Refer to the HORCM startup log to identify the cause of the error.
HORCM_102	The volume is suspended.	The pair status was suspended due to code XXXX.	Call the Hitachi Data Systems support center.
HORCM_103	Detected a validation check error on this volume (xxxx unit#x,ldev#x) : CfEC=n, MNEC=n, SCEC=n, BNEC=n	A validation error occurs on the database volume, or validation parameters for this volume are illegal.	Please confirm the following items, and use raidvchkdsp -v <op> command for verifying the validation parameters. (1) Check if the block size (-vs <size>) is an appropriate size. (2) Check if the type for checking (-vt <type>) is an appropriate type. (3) Check if the data validations are disabled for LVM configuration changes. (4) Check if the data validations are not used based on file system. (5) Check if the redo log and data file are separated among the volumes.

Table 5.3 Command Error Messages

Error Code	Error Message	Condition	Recommended Action	Value
EX_COMERR	Can't be communicated with HORC Manager	This command failed to communicate with the CCI software.	Verify that HORCM is running by using UNIX commands [ps - ef | grep horcm].	255
EX_REQARG	Required Arg list	An option or arguments of an option are not sufficient.	Please designate the correct option using the -h option.	254
EX_INVARG	Invalid argument	An option or arguments of an option are incorrect.	Please designate the correct option using the -h option.	253
EX_UNWOPT	Unknown option	Designated an unknown option.	Please designate the correct option using the -h option.	252
EX_ATTHOR	Can't be attached to HORC Manager	Could not connect with HORCM.	Please verify that HORCM is running and/or that HORCMINST is set correctly.	251
EX_ATTDBG	Can't be attached to a Debug layer	Failed to communicate with HORCM, or cannot make a log directory file.	Verify that HORCM is running by using UNIX commands [ps - ef | grep horcm].	250
EX_INVNAM	Invalid name of option	The name specified in an argument of an option is not appropriate.	Please designate the correct option using the -h option.	249
EX_OPTINV	A specified option is invalid	Detected contradiction in information which RAID reported.	Call the Hitachi Data Systems Support Center.	248
EX_ENOENT	No such device or group	The designated device or group name does not exist in the configuration file.	Verify the device or group name and add it to the configuration file of the remote and local hosts.	247
EX_ENODEV	No such device	The designated device name does not exist in the configuration file.	Verify the device name and add it to the configuration file of the remote and local hosts.	246
EX_ENOUNT	No such RAID unit	The designated RAID unit ID does not exist in the configuration file.	Verify the RAID unit ID and add it to the configuration file of the remote and local hosts.	219
EX_ENQSER	Unmatched Serial# vs RAID unitID	The group designated by ShadowImage paircreate does not have the same RAID unit, or the unitID is not identical to the unit ID in the same RAID serial# (Seq#).	Please confirm serial# (Seq#) using the pairdisplay command, or confirm serial# (Seq#) of the RAID storage system using the **raidqry -r** command	218
EX_ENOMEM	Not enough core	Insufficient memory exists.	Increase the virtual memory capacity of the system, or close any unnecessary programs and/or daemon processes.	245
EX_ERANGE	Result too large	Tried to use arguments for an option beyond the maximum allowed, or a result beyond the maximum was created.	Please refer to the error message, and designate an appropriate value.	244
EX_ENAMLG	File name too long	Undefined error.	Call the Hitachi Data Systems Support Center.	243
EX_ENORMT	No remote host alive for remote commands or remote HORCM might be blocked (sleeping) on an existing I/O	A timeout occurred on remote communication, and HORC Manager failed to re-execute.	Please confirm that the HORC Manager in the remote host is running, and then increase the value of the timeout in the configuration file.	242
EX_INVMOD	Invalid RAID command mode	Detected a contradiction for a command.	Call the Hitachi Data Systems Support Center.	241

Error Code	Error Message	Condition	Recommended Action	Value
EX_INVCMD	Invalid RAID command	Detected a contradiction for a command.	Call the Hitachi Data Systems Support Center.	240
EX_ENOGRP	No such group	The designated device or group name does not exist in the configuration file, or the network address for remote communication does not exist.	Verify the device or group name and add it to the configuration file of the remote and local hosts.	239
EX_UNWCOD	Unknown function code	Detected a contradiction for a command.	Call the Hitachi Data Systems Support Center.	238
EX_CMDIOE	Control command I/O error	A read/write to the command device failed with an I/O error.	Refer to the host syslog file, and investigate the cause of the error. If the problem persists, call the Hitachi Data Systems Support Center.	237

EX_CMDRJE	An order to the control/command device was rejected	The request to the command device failed or was rejected.
		Note: This error code is sometimes caused by the operating system and reported as EX_CMDIOE instead of EX_CMDRJE (see next row).
			Verify Hitachi TrueCopy/ShadowImage functions are installed.
			Verify ports (RCP, LCP, etc.) are set.
			Verify CU paths have been established.
			Verify that the target volume is available.
			CCI displays "SSB" in the output of the commands so a service representative can identify the cause of EX_CMDRJE (except for Tru64, DYNIX).
			Example:
			`# paircreate -g G1 -f never -vl -nocopy`
			`paircreate: [EX_CMDRJE] An order to the control/command device was rejected`
			`Refer to the command log (/HORCM/log10/horcc_u1-1.log) for details.`
			`It was rejected due to SKEY=0x05, ASC=0x26, SSB=0xB9BF,0xB9C7 on Serial#(63502).`
				221

EX_CMDIOE	Control command I/O error or rejected	A read/write to the command device failed with an I/O error or was rejected.	Refer to the host syslog file, and investigate the cause of the error. If the cause is "Illegal Request (0x05)" Sense Key, please confirm the following items. If the problem persists, call the Hitachi Data Systems Support Center. Verify Hitachi TrueCopy/ShadowImage functions are installed. Verify ports (RCP, LCP, etc.) are set. Verify CU paths have been established. Verify that the target volume is available	237
EX_ENQVOL	Unmatched volume status within the group	The volume attribute or the fence level within a group is not identical.	Confirm status using the pairdisplay command. Make sure all volumes in the group have the same fence level and volume attributes.	236
EX_EVOLCE	Pair Volume combination error	Combination of a volume is unsuitable between the remote and local host.	Confirm volume status using the pairdisplay command, and change the combination of volumes properly.	235
EX_EWSUSE	Pair suspended at WAIT state	Detected a suspended status (PSUE) for the paired volume, before it made it to the designated status.	Please issue the pairresync command manually to the identified failed paired volume to try to recover it. If the trouble persists, call the Hitachi Data Systems Support Center.	234

Error Code	Error Message	Condition	Recommended Action	Value
EX_EWSTOT	Timeout waiting for specified status	Detected a time out, before it made it to the designated status.	Please increase the value of the timeout using the -t option.	233
EX_EWSLTO	Timeout waiting for specified status on the local host	Timeout error because the remote did not notify about expected status in time.	Please confirm that HORC Manager on the remote host is running.	232
EX_ESTMON	HORCM Monitor stopped	HORC Manager monitoring was refused.	Please confirm the value of “poll” in the configuration file.	231
EX_UNWCMD	Unknown command	An unknown command was attempted.	Please confirm the command name.	230
EX_INCSTG	Inconsistent status in group	The pair status of a volume within a group is not identical to the status of the other volumes in the group.	Please confirm the pair status using the pairdisplay command.	229
EX_INVSTP	Invalid pair status	The pair status of the target volume is not appropriate.	Please confirm the pair status using the pairdisplay command.	228
EX_INVVOL	Invalid volume status	The volume status of the target volume is not appropriate.	Please confirm the pair status using the pairdisplay -l command.	222
EX_INVMUN	Invalid mu# with HORC or HOMRCF	The MU# of the volume to be operated is not appropriate.	Please confirm the MU# for the specified group using the pairdisplay command. MU #1/2 cannot be used for Hitachi TrueCopy, and MU #1/2 must be P-VOL for ShadowImage.	220
EX_ENLDEV	No such LDEV within the RAID	A device defined in the configuration file does not have a mapping to a real LUN and target ID within the RAID storage system.	Please confirm that the Port, Target ID, LUN are defined correctly under HORCM_DEV in the configuration file.	227
EX_INVRCD	Invalid return code	Wrong return code.	Call the Hitachi Data Systems Support Center.	226
EX_VOLCUR	S-Vol currency error	Currency check error for S-VOL. Cannot guarantee identical data on S-VOL.	Check the volume list to see if an operation was directed to the wrong S-VOL.	225
EX_VOLCUE	Local volume currency error	The volume specified with the SVOL-takeover command is not the same as the P-VOL.	Please confirm the pair status of the local volume.	224
EX_VOLCRE	Local and remote vol. currency error	The combination of the volumes specified with Swap-takeover is unsuitable.	Please confirm the pair status of remote and local volumes using the pairdisplay command.	223
EX_UNWERR	Unknown error code.	Wrong error code.	Call the Hitachi Data Systems Support Center.	--
EX_ENOCTG	Not enough CT groups in the RAID	CTGID could not be registered due to being beyond the max number of CT groups (0-255 for USP V/VM, 0-255 for USP/NSC, 0-127 for 9900V, 0-63 for 9900, 0-15 for 7700E) for an async volume.	Choose an existing CTGID (use pairvolchk to display CTGIDs). Use the ‘-f async <CTGID>‘ option of the paircreate command to force the pair into a pre-existing CTGID.	217
EX_EXTCTG	Extended CT group across RAIDs	A Hitachi TrueCopy Async or ShadowImage volume is defined in the configuration file (HORCM_CONF) as a group that extends across storage systems.	Please confirm the serial # of the volumes by using the pairdisplay command to verify that the CT group is contained completely within one RAID storage system.	216

Error Code	Error Message	Condition	Recommended Action	Value
EX_ENXCTG	No CT groups left for OPEN Vol use.	An available CT group for OPEN Volume does not exist (TrueCopy Async or ShadowImage).	Please confirm whether all CT groups are already used by mainframe volumes (TC and TC390 Async, SI and SI390).	215
EX_ENQCTG	Unmatched CTGID within the group	The CT group references within a group do not have an identical CTGID.	Please confirm the CTGID using the pairvolchk command and/or confirm that group references within the configuration file (HORCM_CONF) refer to the same CT group.	214
EX_ENPERM	Permission denied with the LDEV	A device mentioned in the configuration file does not have a permission for a pair-operation.	Please confirm if a device which a pair-operation was permitted by using the pairdisplay or 'raidscan -find verify' command.	213
EX_ENQSIZ	Unmatched volume size for pairing	Size of a volume is unsuitable between the remote and local volume.	Please confirm volume size or number of LUSE volume using the 'raidscan -f' command, and make sure the volume sizes are identical.	212
EX_ERPERM	Permission denied with the RAID	A storage system (RAID) mentioned in the configuration file does not have a permission for CCI.	Please confirm if the type of storage system is permitted for a CCI by using the 'inqraid -CLI' and 'raidqry -h' commands.	211
EX_ESVOLD	SVOL denied due to be disabling	A target volume for SVOL is denied to become SVOL via LDEV guarding.	Please confirm whether a target volume is setting to SVOL disabling by using 'inqraid -fl' or 'raidvchkscan -v gflag' command.	209
EX_ENOSUP	Micro code not supported	The storage system does not support a function for CCI.	Please confirm the microcode version by using the 'raidqry -l' command.	210
EX_EPRORT	Mode changes denied due to retention time	A target volume is denied to be changing due to retention time via LDEV guarding.	Please confirm the retention time for a target volume using 'raidvchkscan -v gflag' command.	208
EX_ESPERM	Permission denied with the SLPR	A specified command device does not have a permission to access other SLPR.	Please make the SLPR so that the target port and the command device belongs to the same SLPR.	207
EX_ENOPOL	Not enough Pool in RAID	Could not retain the pool for executing a command due to be exceeded the threshold rate.	Please deletes unnecessary/earlier generations paired volume, or re-synchronizes unnecessary/earlier generations split volume.	206

The codes in Table 5.4 indicate generic errors returned by the following commands: **horctakeover**, **paircurchk**, **paircreate**, **pairsplit**, **pairresync**, **pairevtwait**, **pairvolchk**, **pairsyncwait**, **pairdisplay**. Unrecoverable error should be done without re-execute by handling of an error code. Recoverable error can re-execute by handling of an error code.

Table 5.4 **Generic Error Codes** (horctakeover, paircurchk, paircreate, pairsplit, pairresync, pairevtwait, pairvolchk, pairsyncwait, pairdisplay)

Category	Error Code	Error Message	Value
Syntax for Argument	EX_REQARG	Required Arg list	254
	EX_INVARG	Invalid argument	253
	EX_INVNAM	Invalid name of option	249
	EX_UNWOPT	Unknown option	252
	EX_UNWCOD	Unknown function code	238
	EX_UNWCMD	Unknown command	230
	EX_ERANGE	Result too large	244
	EX_ENAMLG	File name too long	243
Unrecoverable	EX_INVRCD	Invalid return code	226
Configuration	EX_ENOGRP	No such group	239
	EX_ENOENT	No such device or group	247
	EX_ENODEV	No such device	246
	EX_ENLDEV	No such LDEV within the RAID	227
	EX_ENOUNT	No such RAID unit	219
	EX_INVMUN	Invalid mu# with HORC or HOMRCF	220
	EX_ENQSER	Unmatched Serial# vs RAID unitID	218
	EX_EXTCTG	Extended CTgroup across RAIDs	216
	EX_ENQCTG	Unmatched CTGID within the group	214
	EX_ENPERM	Permission denied with the LDEV	213
	EX_ERPERM	Permission denied with the RAID	211
Unrecoverable	EX_ESPERM	Permission denied with the SLPR	207
Command I/O to RAID	EX_CMDRJE	An order to the control/command was rejected	221
	EX_CMDIOE	Control command I/O error, or rejected	237
	EX_OPTINV	A specified option is invalid	248
	EX_INVMOD	Invalid RAID command mode	241
Recoverable	EX_INVCMD	Invalid RAID command	240
Communication for HORCM	EX_ATTHOR	Cannot attached to HORC manager	251
	EX_ATTDBG	Cannot attached to a Debug layer	250
	EX_COMERR	Cannot communicate with HORC manager	255
Recoverable	EX_ENORMT	No remote host alive for remote commands, or Remote CCI might be blocked (sleeping) on an existing I/O.	242
Resource Unrecoverable	EX_ENOMEM	Not enough core	245

The codes in Table 5.5 are generic error returned by the following commands: **raidscan**, **raidqry**, **raidar**, **horcctl**. Unrecoverable error should be done without re-execute by handling of an error code. Recoverable error can re-execute by handling an error code.

Table 5.5 Generic Error Codes (raidscan, raidqry, raidar, horcctl)

Category	Error Code	Error Message	Value
Syntax for Argument	EX_REQARG	Required Arg list	254
	EX_INVARG	Invalid argument	253
	EX_INVNAM	Invalid name of option	249
	EX_UNWOPT	Unknown option	252
	EX_UNWCOD	Unknown function code	238
	EX_UNWCMD	Unknown command	230
	EX_ERANGE	Result too large	244
	EX_ENAMLG	File name too long	243
Unrecoverable	EX_INVRCD	Invalid return code	226
Configuration	EX_ENLDEV	No such LDEV within the RAID	227
	EX_ENOUNT	No such RAID unit	219
	EX_INVMUN	Invalid mu# with HORC or HOMRCF	220
	EX_ERPERM	Permission denied with the RAID	211
	EX_ENOSUP	Micro code not supported	210
Unrecoverable	EX_ESPERM	Permission denied with the SLPR	207
Command I/O to RAID	EX_CMDIOE	Control command I/O error	237
	EX_OPTINV	A specified option is invalid	248
	EX_INVMOD	Invalid RAID command mode	241
Recoverable	EX_INVCMD	Invalid RAID command	240
Communication for HORCM	EX_ATTHOR	Can’t be attached to HORC manager	251
	EX_ATTDBG	Can’t be attached to a Debug layer	250
Recoverable	EX_COMERR	Can’t be communicated with HORC manager	255
Resource Unrecoverable	EX_ENOMEM	Not enough core	245

The codes in Table 5.6 are specific error returned by the following commands: horctakeover, paircurchk, paircreate, pairsplit, pairresync, pairevtwait, pairvolchk, pairsyncwait, raidvchkset. Unrecoverable error should be done without re-execute by handling of an error code. Recoverable error can re-execute (except for EX_EWSTOT of the horctakeover) by handling an error code.

Refer to Chapter 4 for information on possible error code(s) for each command.

Table 5.6 Specific Error Codes

Category	Error Code	Error Message	Value
Volume Status	EX_ENQVOL	Unmatched volume status within the group	236
	EX_INCSTG	Inconsistent status in group	229
	EX_INVVOL	Invalid volume status	222
	EX_EVOLCE	Pair Volume combination error	235
	EX_INVSTP	Invalid pair status	228
	EX_VOLCUR	S-VOL currency error	225
	EX_VOLCUE	Local Volume currency error	224
	EX_VOLCRE	Local and Remote Volume currency error	223
	EX_EWSUSE	Pair suspended at WAIT state	234
	EX_ENQSIZ	Unmatched volume size for pairing	212
	EX_ESVOLD	SVOL denied due to be disabling	209
Unrecoverable	EX_EPRORT	Mode changes denied due to retention time	208
Timer	EX_EWSTOT	Timeout waiting for specified status	233
Recoverable	EX_EWSLTO	Timeout waiting for specified status on the local host	232
Resource	EX_ENOCTG	Not enough CT groups in the RAID	217
	EX_ENXCTG	No CT groups left for OPEN Vol use.	215
Unrecoverable	EX_ENOPOL	Not enough Pool in RAID	206

5.4 Calling the Hitachi Data Systems Support Center

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

- The Storage Navigator configuration information saved on diskette using the **FD Dump Tool** or **FDCOPY** function (see the *Storage Navigator User's Guide* for the storage system.
- The circumstances surrounding the error or failure.
- The exact content of any error messages displayed on the host system(s).
- The remote service information messages (R-SIMs) logged by Storage Navigator and the reference codes and severity levels of the recent R-SIMs.

The Hitachi Data Systems customer support staff is available 24 hours/day, seven days a week. If you need technical support, please call:

- United States: (800) 446-0744
- Outside the United States: (858) 547-4526

Appendix A Maintenance Logs and Tracing Functions

A.1 Log Files

The CCI software (HORCM) and Hitachi TrueCopy/ShadowImage commands maintain internal logs and traces which can be used to identify the causes of errors and keep records of the status transition history of paired volumes. Figure A.1 shows the CCI logs and traces.

HORCM logs are classified into start-up logs and execution logs. The start-up logs contain data on errors which occur before the HORCM becomes ready to provide services. Thus, if the HORCM fails to start up due to improper environment setting, users should refer to the start-up logs to resolve the problem. The HORCM execution logs (error log, trace, and core files) contain data on errors which are caused by software or hardware problems. These logs contain internal error data which does not apply to any user settings, and so users do not need to refer to the HORCM execution logs. When an error occurs in execution of a command, data on the error is collected in the command log file. Users may refer to the command log file if a command execution error occurs.

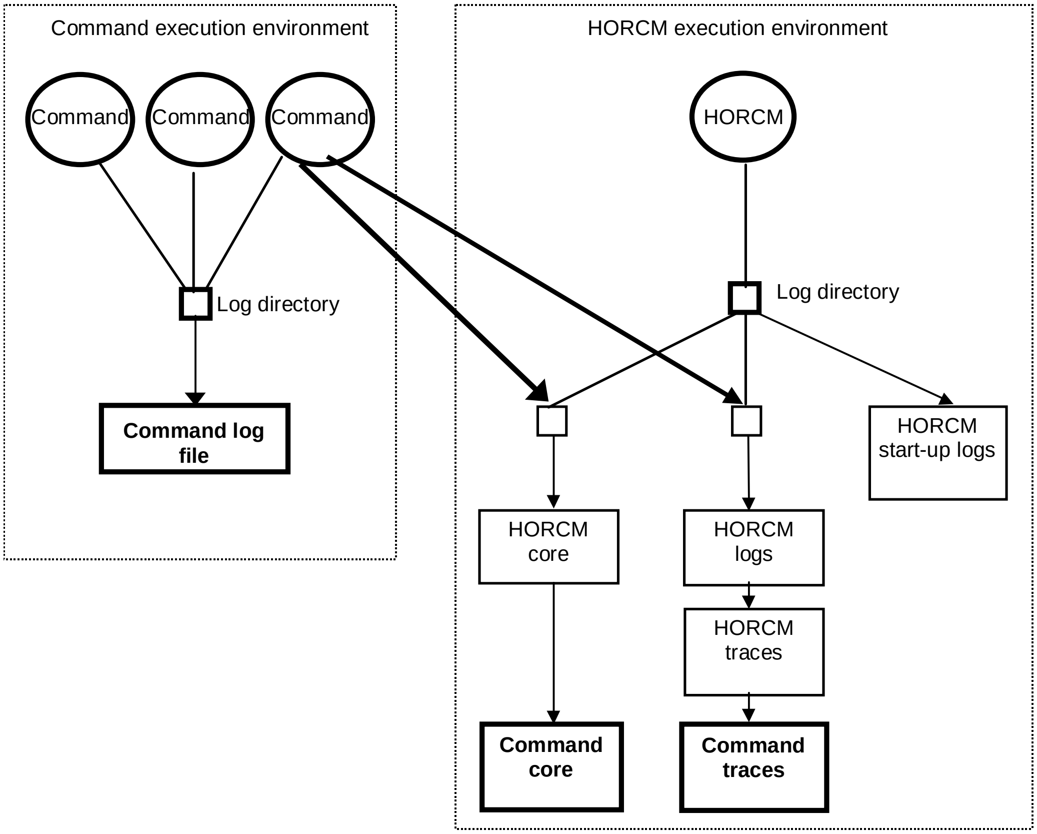


Figure A.1 Logs and Traces

The start-up log, error log, trace, and core files are stored as shown in Table A.1. The user should specify the directories for the HORCM and command log files using the HORCM_LOG and HORCC_LOG environmental variables as shown in Table A.2. If it is not possible to create the log files, or if an error occurs before the log files are created, the error logs are output in the system log file. If the HORCM activation fails, the system administrator should check the system log file, identify the error cause, and take the proper action. Chapter 5 lists and describes the messages output to the system log file and provides recommended actions for resolving the error conditions. The system log file for UNIX-based systems is the syslog file. The system log file for Windows-based systems is the event log file.

Table A.1 Log Files

File	UNIX-Based Systems	Windows-Based Systems
Start-up log	HORCM start-up log: $HORCM_LOG/horcm_HOST.log Command log: $HORCC_LOG/horcc_HOST.log $HORCC_LOG/horcc_HOST.oldlog	HORCM start-up log: $HORCM_LOG\horcm_HOST_log.txt Command log: $HORCC_LOG\horcc_HOST_log.txt $HORCC_LOG\horcc_HOST_oldlog.txt
Error log	HORCM error log: $HORCM_LOG/horcmlog_HOST/horcm.log	HORCM error log: $HORCM_LOG\horcmlog_HOST\horcm_log.txt
Trace	HORCM trace: $HORCM_LOG/horcmlog_HOST/horcm_PID.trc Command trace: $HORCM_LOG/horcmlog_HOST/horcc_PID.trc	HORCM trace: $HORCM_LOG\horcmlog_HOST\horcm_PID_trc.txt Command trace: $HORCM_LOG\horcmlog_HOST\horcc_PID_trc.txt
Core	HORCM core: $HORCM_LOG/core_HOST_PID/core Command core: $HORCM_LOG/core_HOST_PID/core	HORCM core: $HORCM_LOG\core_HOST_PID\core Command core: $HORCM_LOG\core_HOST_PID\core

Note: HOST denotes the host name of the corresponding machine. PID denotes the process ID of that machine.

The location of the directory which contains the log file depends on the user's command execution environment and the HORCM execution environment. The command trace file and core file reside together under the directory specified in the HORCM execution environment. A directory specified using the environmental variable HORCM_LOG is used as the log directory in the HORCM execution environment. If no directory is specified, the directory **/tmp** is used. A directory specified using the environmental variable HORCC_LOG is used as the log directory in the command execution environment. If no directory is specified, the directory **/HORCM/log*** is used (* = instance number). A nonexistent directory may be specified as a log directory using the environmental variable.

Table A.2 Log Directories

Directory Name	Definition
$HORCM LOG	A directory specified using the environmental variable HORCM_LOG. The HORCM log file, trace file, and core file as well as the command trace file and core file are stored in this directory. If no environmental variable is specified, "/HORCM/log/curlog" is used.
$HORCC LOG	A directory specified using the environmental variable HORCC_LOG. The command log file is stored in this directory. If no environmental variable is specified, the directory "/HORCM/log*" is used (* is the instance number). While the HORCM is running, the log files are stored in the $HORCM_LOG directory shown in (a). When the HORCM starts up, the log files created in the operation are stored automatically in the $HORCM_LOGS directory shown in (b). a. HORCM log file directory in operation $HORCM_LOG = /HORCM/log*/curlog (* is instance number) b. HORCM log file directory for automatic storing $HORCM_LOGS = /HORCM/log*/tmplog (* is instance number)

A.2 Trace Files

The command trace file is used for maintenance aiming at troubleshooting. It is not created normally. If a cause of an error cannot be identified using the log file, the environmental variables or trace control commands with trace control parameters are issued to start tracing and the trace file is created. The trace control parameters include trace level, file size, mode, etc. More detailed tracing is enabled by increasing the trace level. Tracing is made in wraparound within the range of the file size. HORCM makes the trace file according to the trace level specified in the HORCM start-up shell script set to activate the HORCM.

A.3 Trace Control Command

The trace control command (one of the HORCM control commands) sets or changes the trace control parameters. This command is used for troubleshooting and maintenance. If no trace control parameters can be specified using the environmental variables in the user's command execution environment, it is possible to change the trace control parameters into the global parameters using this command. Table A.3 lists and describes the parameters of the trace control command.

Table A.3 Trace Command Parameters

Parameter	Function
Trace level parameter	Specifies the trace level, range = 0 to 15.
Trace size parameter	Specifies the trace file size in KB.
Trace mode parameter	Specifies the buffer mode or non-buffer mode for writing data in the trace file.
Trace type parameter	Specifies the trace type defined internally.
Trace change instruction	Specifies either the command or the HORCM (CCI instance) for which the trace control parameters are changed.

A.4 Logging Commands for Audit

RAID Manager supports the command error logging only, so this logging function will not be able to use for auditing the script issuing the command. Thus RAID Manager supports the function logging the result of the command executions by expanding the current logging.

This function has the following control parameter.

- $HORCC_LOGSZ variable

  This variable is used to specify a maximum size (in units of KB) and normal logging for the current command.
  '/HORCM/log*/horcc_HOST.log' file is moved to '/HORCM/log*/horcc_HOST.oldlog' file when reaching in the specified maximum size. If this variable is not specified or specified as 0, it is same as the current logging for only command error.

  This variable is able to define to the environment variable and/or 'horcc_HOST.conf' as discussed below.

  For Example setting 2MB size:

  ```
  HORCC_LOGSZ=2048
  Export HORCC_LOGSZ
  ```

- /HORCM/log*/horcc_HOST.conf file

  This file is used to describe 'HORCC_LOGSZ' variable and the masking variable for logging. If the 'HORCC_LOGSZ' as the environment variable is not specified, then 'HORCC_LOGSZ' variable of this file is used. If both variable is not specified, then it is same as the current logging for only command error.

- HORCC_LOGSZ variable

  This variable must be described as below format.

  For Example

  ```
  HORCC_LOGSZ=2048
  ```

- The masking variable

  This variable is used to mask (disable) the logging by specifying a condition of the command and exit code (except inqraid or EX_xxx error code). This variable is valid for NORMAL exit.

  If the user is executing the pairvolchk repeatedly at every interval (i.e., 30 sec).they may not be wanted to be logged its command. So they can mask it by specifying HORCC_LOGSZ=0 as below, however they need to change their scripts if the tracing is ON.

  - For example masking pairvolchk on the script

    ```
    Export HORCC_LOGSZ=0
    Pairvolchk -g xxx -s
    Unset HORCC_LOGSZ
    ```

The masking feature is to enable the tracing without changing their scripts. And this feature is available for all RM commands (except inqraid or EX_xxx error code).

For example, if you want to mask pairvolchk (returns 22) and raidqry, you can specify as below.

pairvolchk=22
raidqry=0

The user will be able to track the performing of their scripts, and then they will decide to mask by auditing the command logging file as needed.

Relationship between an environment variable and Horcc_HOST.conf

The performing of logging has being depended on $HORCC_LOGSZ environment variable and/or the HORCC_HOST.conf file as shown below.

$HORCC_LOGSZ	HORCC_HOST.conf	Performing
=value	Don't care	Tracing within this APP
=0		NO tracing within this APP
Unspecified	HORCC_LOGSZ=value	Global Tracing within this RM instance
	HORCC_LOGSZ=0	Global NO tracing within this RM instance
	Unspecified or Nonexistent	Use the default value (0) The same as the current logging for only command error

- /HORCM/log* directory

```
[root@raidmanager log9]#  ls -l
total 16
drwxr-xr-x  3 root root    4096 Oct 27 17:33 curlog
-rw-r--r--  1 root root    3936 Oct 27 17:36 horcc_raidmanager.log
-rw-r--r--  1 root root 2097452 Oct 27 17:29 horcc_raidmanager.oldlog
-rw-r--r--  1 root root      46 Oct 27 17:19 horcc_raidmanager.conf
drwxr-xr-x  3 root root    4096 Oct 27 17:19 tmplog
```

- /HORCM/log*/horcc_HOST.log file

```
COMMAND NORMAL : EUserId for HORC : root (0)  Tue Nov  1 12:21:53 2005
CMDLINE : pairvolchk -ss -g URA
12:21:54-2d27f-10090- [pairvolchk][exit(32)]
COMMAND NORMAL : EUserId for HORC : root (0)  Thu Oct 27 17:36:32 2005
CMDLINE : raidqry -l
17:36:32-3d83c-17539- [raidqry][exit(0)]
COMMAND ERROR  : EUserId for HORC : root (0)  Thu Oct 27 17:31:28 2005
CMDLINE : pairdisplay -g UR
17:31:28-9a206-17514- ERROR:cm_sndrcv[rc < 0 from HORCM]
17:31:28-9b0a3-17514- [pairdisplay][exit(239)]
[EX_ENOGRP] No such group
[Cause ]:The group name which was designated or the device name doesn't exist in the
configuration file, or the network address for remote communication doesn't exist.
[Action]:Please confirm if the group name exists in the configuration file of the local and
remote host
```

- /HORCM/log*/horcc_HOST.conf file

```
# For Example
HORCC_LOGSZ=2048
#The masking variable
#This variable is used to disable the logging by the command and exit code.
#For masking below log pairvolchk returned '32'(status is SVOL_COPY)
#COMMAND NORMAL : EUserId for HORC : root (0)  Tue Nov  1 12:21:53 2005
#CMDLINE : pairvolchk -ss -g URA
#12:21:54-2d27f-10090- [pairvolchk][exit(32)]
pairvolchk=32
pairvolchk=22
```

Appendix B Updating and Uninstalling CCI

B.1 Uninstalling UNIX CCI Software

After verifying that the CCI software is not running, you can uninstall the CCI software. If the CCI software is still running when you want to uninstall, shut down the CCI software using the horcmshutdown.sh command to ensure a normal end to all TrueCopy/ShadowImage functions.

Caution: Before uninstalling CCI, make sure that all device pairs are in simplex status.

To uninstall the CCI software from a root directory (see Figure B.1): Issue the uninstall command, go to the root directory, and delete the HORCM directory.

To uninstall the CCI software from a non-root directory (see Figure B.2): Issue the uninstall command, go to the root directory, delete the HORCM link, and delete the HORCM directory.

```
#/HORCM/horcmuninstall.sh                               ← Issue the uninstall command.
#cd  /                                                  ← Change directories.
#rm -rf /HORCM                                          ← Delete the CCI directory.
```

Figure B.1 Uninstalling the CCI Software from a Root Directory

```
#/HORCM/horcmuninstall.sh                               ← Issue the uninstall command.
#cd  /                                                  ← Change directories.
#rm    /HORCM                                           ← Delete the CCI link.
#rm  -rf   /non-root_directory_name/HORCM               ← Delete the CCI directory.
```

Figure B.2 Uninstalling the CCI Software from a Non-Root Directory

B.2 Upgrading UNIX CCI Software

After verifying that CCI is not running, you can upgrade the CCI software. If CCI is still running when you want to upgrade software versions, shut down the CCI software using the horcmshutdown.sh command to ensure a normal end to all Hitachi TrueCopy/ShadowImage functions. To upgrade the CCI software in a UNIX environment follow the installation instructions provided in Chapter 3.

B.3 Uninstalling Windows CCI Software

After verifying that the CCI software is not running, you can uninstall the CCI software. If the CCI software is still running when you want to uninstall, shut down the CCI software using the horcmshutdown command to ensure a normal end to all TrueCopy/ShadowImage functions.

Caution: Before uninstalling the CCI software, make sure that all device pairs are in simplex mode.

To uninstall the CCI software:

1. On the **Control** panel select the **Add/Remove** programs option.
2. When the Add/Remove Program Properties panel opens, choose the **Install/Uninstall** tab and select **CCI/HORC** from the program products list.
3. Click **Add/Remove** to remove the CCI software.

B.4 Upgrading Windows CCI Software

After verifying that the CCI software is not running, you can upgrade the CCI software. If the CCI software is still running when you want to upgrade software versions, shut down the CCI software using the horcmshutdown command to ensure a normal end to all Hitachi TrueCopy and/or ShadowImage functions. To upgrade the CCI software:

1. On the **Control** panel select the **Add/Remove** programs option.
2. When the Add/Remove Program Properties panel opens, choose the **Install/Uninstall** tab and select **CCI/HORC** from the program products list.
3. Click **Add/Remove** to remove the CCI software.
4. Insert the program product cd or floppy disk into the server and on the **Start** menu choose the **Run** command.
5. The Run window opens, enter **A:\Setup.exe** (where A: is floppy or CD drive) in the **Open** pull down list box.
6. An InstallShield will open. Follow the on screen instructions to install the CCI software.
7. Reboot the Windows server, and verify that the correct version of the CCI software is running on your system by executing the **raidqry -h** command.

Appendix C Fibre-to-SCSI Address Conversion

Disks connected with Fibre channel display as SCSI disks on UNIX hosts. Disks connected with Fibre channel connections can be fully utilized.

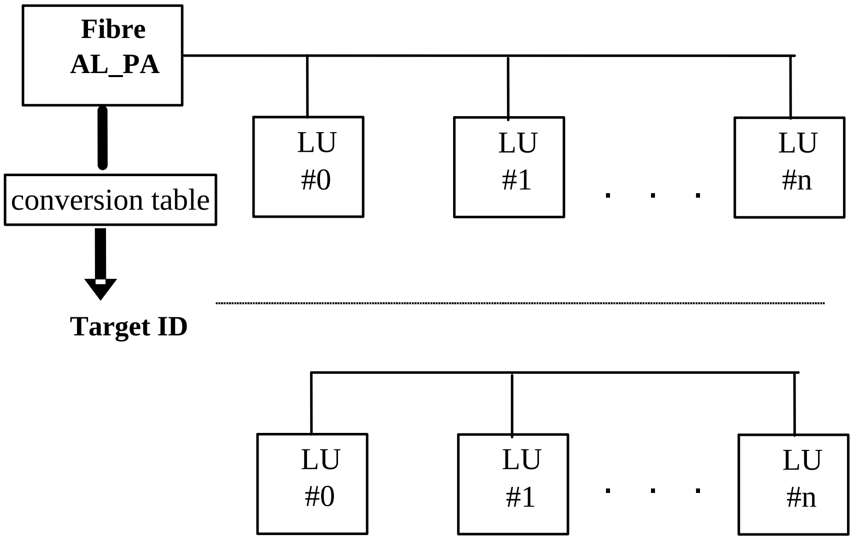


Figure C.1 Example Fibre Address Conversion

Note: Use fixed address AL_PA (0xEF) when using iSCSI.

CCI converts fibre-channel physical addresses to SCSI target IDs (TIDs) using a conversion table (see Figure C.2). Table C.1 shows the current limits for SCSI TIDs and LUNs on various operating systems.

Table C.1 Limits for Target IDs and LUNs

	HP-UX, other Systems		Solaris, IRIX Systems		Windows Systems	
Port	TID	LUN	TID	LUN	TID	LUN
Fibre/ iSCSI	0 to 15	0 to 1023	0 to 125	0 to 1023	0 to 31	0 to 1023
SCSI	0 to 15	0 to 7	0 to 15	0 to 7	0 to 15	0 to 7

Conversion table for Windows. The conversion table for Windows is based on conversion by an Emulex driver. If the fibre-channel adapter is different (e.g., Qlogic, HP), the target ID which is indicated by the **raidscan** command may be different from the target ID on the Windows host.

Figure C.1 shows an example of using the **raidscan** command to display the TID and LUN of Harddisk6 (HP driver). *Note:* You must start HORCM without the descriptions of HORCM_DEV or HORCM_INST in the configuration definition file because of the unknown TIDs and LUNs.

```
C:\>raidscan -pd hd6 -x drivescan hd6
Harddisk 6... Port[ 2] PhId[ 4] TId[ 3] Lun[  5] [HITACHI     ] [OPEN-3         ]
              Port[CL1-J] Ser#[   30053] LDEV#[  14(0x00E)]
              HORC = SMPL  HOMRCF[MU#0 = SMPL MU#1 = SMPL MU#2 = SMPL]
              RAID5[Group  1- 2] SSID = 0x0004
PORT# /ALPA/C,TID#,LU#.Num(LDEV#....)...P/S, Status,Fence,LDEV#,P-Seq#,P-LDEV#
CL1-J /  e2/4,  29,  0.1(9)............SMPL  ----  ------ ----, -----  ----
CL1-J /  e2/4,  29,  1.1(10)...........SMPL  ----  ------ ----, -----  ----
CL1-J /  e2/4,  29,  2.1(11)...........SMPL  ----  ------ ----, -----  ----
CL1-J /  e2/4,  29,  3.1(12)...........SMPL  ----  ------ ----, -----  ----
CL1-J /  e2/4,  29,  4.1(13)...........SMPL  ----  ------ ----, -----  ----
CL1-J /  e2/4,  29,  5.1(14)...........SMPL  ----  ------ ----, -----  ----
CL1-J /  e2/4,  29,  6.1(15)...........SMPL  ----  ------ ----, -----  ----
Specified device is LDEV# 0014
```

Figure C.2 Using Raidscan to Display TID and LUN for Fibre-Channel Devices

In this case, the target ID indicated by the **raidscan** command must be used in the configuration definition file. This can be accomplished using either of the following two methods:

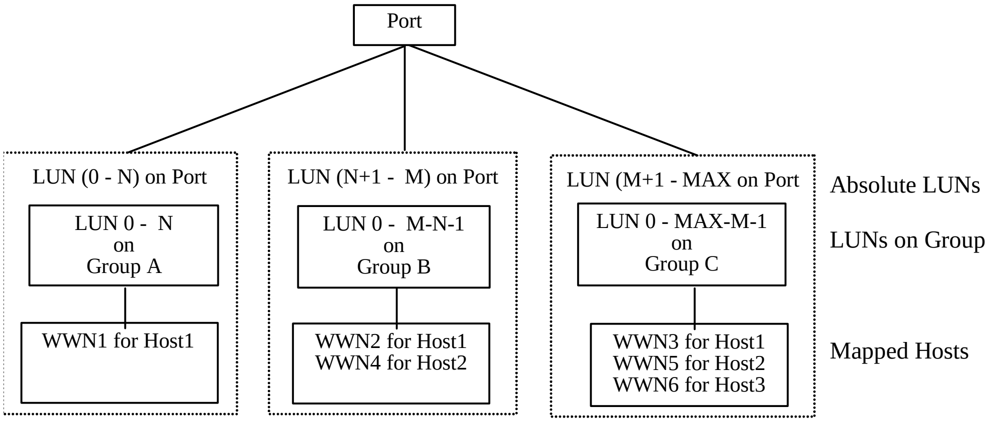
- **Using default conversion table**. Use the TID# and LU# indicated by the **raidscan** command in the HORCM configuration definition file (TID=29 LUN=5 in Figure C.2).
- **Changing default conversion table**. Change the default conversion table using the HORCMFCTBL environmental variable (see Figure C.3) (TID=3 LUN=5 in Figure C.3).

```
C:\> set HORCMFCTBL=X                  ← 'X' is fibre conversion table number.
C:\> horcmstart ...                    ← Start of HORCM.
:
:
Result of "set HORCMFCTBL=X" command:

C:\>raidscan -pd hd6 -x drivescan hd6
Harddisk 6... Port[ 2] PhId[ 4] TId[ 3] Lun[  5] [HITACHI     ] [OPEN-3         ]
              Port[CL1-J] Ser#[   30053] LDEV#[  14(0x00E)]
              HORC = SMPL  HOMRCF[MU#0 = SMPL MU#1 = SMPL MU#2 = SMPL]
              RAID5[Group  1- 2] SSID = 0x0004
PORT# /ALPA/C,TID#,LU#.Num(LDEV#....)...P/S,Status,Fence,LDEV#,P-Seq#,P-LDEV#
CL1-J /  e2/0,   3,  0.1(9)............SMPL  ----  ------ ----, -----  ----
CL1-J /  e2/0,   3,  1.1(10)...........SMPL  ----  ------ ----, -----  ----
CL1-J /  e2/0,   3,  2.1(11)...........SMPL  ----  ------ ----, -----  ----
CL1-J /  e2/0,   3,  3.1(12)...........SMPL  ----  ------ ----, -----  ----
CL1-J /  e2/0,   3,  4.1(13)...........SMPL  ----  ------ ----, -----  ----
CL1-J /  e2/0,   3,  5.1(14)...........SMPL  ----  ------ ----, -----  ----
CL1-J /  e2/0,   3,  6.1(15)...........SMPL  ----  ------ ----, -----  ----
Specified device is LDEV# 0014
```

Figure C.3 Using HORCMFCTBL to Change the Default Fibre Conversion Table

C.1 LUN Configurations on the RAID Storage Systems

The Hitachi RAID storage systems (9900V and later) manage the LUN configuration on a port through the LUN security as shown in Figure C.4.



Explanation of terms:

Group: A Group name registered by LUN security configuration on the port.
WWN: WWN list on a Group registered by LUN security configuration on the port.
MAX: The maximum LUN. 2048 for USP V/VM, 2048 for USP/NSC, 512 for 9900V.

Figure C.4 LUN Configuration

CCI uses absolute LUNs to scan a port, whereas the LUNs on a Group are mapped for the host system so that the target ID & LUN which is indicated by the **raidscan** command will be different from the target ID & LUN shown by the host system. In this case, the target ID & LUN indicated by the **raidscan** command should be used.

In this case, you must start HORCM without a description for HORCM_DEV and HORCM_INST because target ID & LUN are unknown. Use the port, target ID, and LUN displayed by the **raidscan -find** or **raidscan -find conf** command for HORCM_DEV (see Figure C.5).

Note: For details on LUN discovery based on a host group, see section 4.20.

```
# ls /dev/rdsk/* | raidscan -find
DEVICE_FILE     UID  S/F PORT   TARG  LUN    SERIAL  LDEV  PRODUCT_ID
/dev/rdsk/c0t0d4  0   S  CL1-M     0    4     31168   216  OPEN-3-CVS-CM
/dev/rdsk/c0t0d1  0   S  CL1-M     0    1     31168   117  OPEN-3-CVS
/dev/rdsk/c1t0d1  -   -  CL1-M     -    -     31170   121  OPEN-3-CVS
```

Figure C.5 Displaying the Port, TID, and LUN Using raidscan

UID: displays the UnitID for multiple RAID configuration. If UID is displayed as '-' then the command device for HORCM_CMD is not found.
S/F: displays that a PORT is SCSI or fibre.
PORT: displays the RAID storage system port number.
TARG: displays the target ID (converted by the fibre conversion table, see next section).
LUN: displays the Logical Unit Number (converted by the fibre conversion table).
SERIAL: displays the production number (serial#) of the RAID storage system.
LDEV: displays the LDEV# within the RAID storage system.
PRODUCT_ID: displays product-id field in the STD inquiry page.

C.2 Fibre Address Conversion Tables

Table C.2, Table C.3, and Table C.4 show the fibre address conversion tables:

- Table number 0 = HP-UX systems (see Table C.2)
- Table number 1 = Solaris and IRIX systems (see Table C.3)
- Table number 2 = Windows systems (see Table C.4)

  Note: The conversion table for Windows systems is based on the Emulex driver. If a different fibre-channel adapter is used, the target ID indicated by the **raidscan** command may be different than the target ID indicated by the Windows system.

Note on Table 3 for other Platforms: Table 3 is used to indicate the LUN without Target ID for unknown FC_AL conversion table or fibre-channel fabric (fibre-channel world wide name). In this case, the Target ID is always zero, thus Table 3 is not described in this document. Table 3 is used as the default for platforms other than those listed above. If the host will use the WWN notation for the device files, then this table number should be changed by using the **$HORCMFCTBL** variable.

Note: If the TID displayed on the system is different than the TID indicated in the fibre address conversion table, you must use the TID (and LU#) returned by the **raidscan** command to specify the device(s).

Table C.2 Fibre Address Conversion Table for HP-UX Systems (Table 0)

C0		C1		C2		C3		C4		C5		C6		C7	
AL-PA	TID	AL-PA	TID	AL-PA	TID	AL-PA	TID	AL-PA	TID	AL-PA	TID	AL-PA	TID	AL-PA	TID
EF	0	CD	0	B2	0	98	0	72	0	55	0	3A	0	25	0
E8	1	CC	1	B1	1	97	1	71	1	54	1	39	1	23	1
E4	2	CB	2	AE	2	90	2	6E	2	53	2	36	2	1F	2
E2	3	CA	3	AD	3	8F	3	6D	3	52	3	35	3	1E	3
E1	4	C9	4	AC	4	88	4	6C	4	51	4	34	4	1D	4
E0	5	C7	5	AB	5	84	5	6B	5	4E	5	33	5	1B	5
DC	6	C6	6	AA	6	82	6	6A	6	4D	6	32	6	18	6
DA	7	C5	7	A9	7	81	7	69	7	4C	7	31	7	17	7
D9	8	C3	8	A7	8	80	8	67	8	4B	8	2E	8	10	8
D6	9	BC	9	A6	9	7C	9	66	9	4A	9	2D	9	0F	9
D5	10	BA	10	A5	10	7A	10	65	10	49	10	2C	10	08	10
D4	11	B9	11	A3	11	79	11	63	11	47	11	2B	11	04	11
D3	12	B6	12	9F	12	76	12	5C	12	46	12	2A	12	02	12
D2	13	B5	13	9E	13	75	13	5A	13	45	13	29	13	01	13
D1	14	B4	14	9D	14	74	14	59	14	43	14	27	14		
CE	15	B3	15	9B	15	73	15	56	15	3C	15	26	15		

Table C.3 Fibre Address Conversion Table for Solaris and IRIX Systems (Table 1)

C0		C1		C2		C3		C4		C5		C6		C7	
AL-PA	TID	AL-PA	TID	AL-PA	TID	AL-PA	TID	AL-PA	TID	AL-PA	TID	AL-PA	TID	AL-PA	TID
EF	0	CD	16	B2	32	98	48	72	64	55	80	3A	96	25	112
E8	1	CC	17	B1	33	97	49	71	65	54	81	39	97	23	113
E4	2	CB	18	AE	34	90	50	6E	66	53	82	36	98	1F	114
E2	3	CA	19	AD	35	8F	51	6D	67	52	83	35	99	1E	115
E1	4	C9	20	AC	36	88	52	6C	68	51	84	34	100	1D	116
E0	5	C7	21	AB	37	84	53	6B	69	4E	85	33	101	1B	117
DC	6	C6	22	AA	38	82	54	6A	70	4D	86	32	101	18	118
DA	7	C5	23	A9	39	81	55	69	71	4C	87	31	103	17	119
D9	8	C3	24	A7	40	80	56	67	72	4B	88	2E	104	10	120
D6	9	BC	25	A6	41	7C	57	66	73	4A	89	2D	105	0F	121
D5	10	BA	26	A5	42	7A	58	65	74	49	90	2C	106	08	122
D4	11	B9	27	A3	43	79	59	63	75	47	91	2B	107	04	123
D3	12	B6	28	9F	44	76	60	5C	76	46	92	2A	108	02	124
D2	13	B5	29	9E	45	75	61	5A	77	45	93	29	109	01	125
D1	14	B4	30	9D	46	74	62	59	78	43	94	27	110		
CE	15	B3	31	9B	47	73	63	56	79	3C	95	26	111		

Table C.4 Fibre Address Conversion Table for Windows Systems (Table 2)

C5 (PhId5)		C4 (PhId4)				C3 (PhId3)				C2 (PhId2)				C1 (PhId1)			
AL-PA	TID	AL-PA	TID	AL-PA	TID	AL-PA	TID	AL-PA	TID	AL-PA	TID	AL-PA	TID	AL-PA	TID	AL-PA	TID
				CC	15			98	15			56	15			27	15
		E4	30	CB	14	B1	30	97	14	72	30	55	14	3C	30	26	14
		E2	29	CA	13	AE	29	90	13	71	29	54	13	3A	29	25	13
		E1	28	C9	12	AD	28	8F	12	6E	28	53	12	39	28	23	12
		E0	27	C7	11	AC	27	88	11	6D	27	52	11	36	27	1F	11
		DC	26	C6	10	AB	26	84	10	6C	26	51	10	35	26	1E	10
		DA	25	C5	9	AA	25	82	9	6B	25	4E	9	34	25	1D	9
		D9	24	C3	8	A9	24	81	8	6A	24	4D	8	33	24	1B	8
		D6	23	BC	7	A7	23	80	7	69	23	4C	7	32	23	18	7
		D5	22	BA	6	A6	22	7C	6	67	22	4B	6	31	22	17	6
		D4	21	B9	5	A5	21	7A	5	66	21	4A	5	2E	21	10	5
		D3	20	B6	4	A3	20	79	4	65	20	49	4	2D	20	0F	4
		D2	19	B5	3	9F	19	76	3	63	19	47	3	2C	19	08	3
		D1	18	B4	2	9E	18	75	2	5C	18	46	2	2B	18	04	2
EF	1	CE	17	B3	1	9D	17	74	1	5A	17	45	1	2A	17	02	1
E8	0	CD	16	B2	0	9B	16	73	0	59	16	43	0	29	16	01	1

Acronyms and Abbreviations

3DC	three-data-center
AL-PA	arbitrated loop-physical address
AOU	allocation on use (another name for Hitachi Dynamic Provisioning)
BMP	bitmap
C RTL	C Run-Time Library
CCI	Command Control Interface
CD-ROM	compact disk – read-only memory
CLPR	Cache Logical Partition
CM	Cluster Manager
COW	Copy-on-Write
CTGID	consistency group ID
CU	control unit
CVS	custom volume size
DB	database
DFW	DASD fast write
DRU	Data Retention Utility
ELBA	ending logical block address
ESCON	Enterprise System Connection (IBM trademark for optical channels)
FC	fibre-channel
FCP	fibre-channel protocol
FIFO	first in, first out
GB	gigabyte
GUI	graphical user interface
HA	high availability
HACMP	High Availability Cluster Multiprocessing
HARD	Hardware Assisted Resilient Data
hdisk	hard disk
HDLM	Hitachi Dynamic Link Manager
HDP	Hitachi Dynamic Provisioning
HOMRCF	Hitachi Open Multi-RAID Coupling Feature (old name for ShadowImage)
HORC	Hitachi Open Remote Copy (old name for TrueCopy)
HORCM	HORC Manager
HRX	Hitachi RapidXchange
HWM	high water mark
I/O	input / output
INST	instance number
KB, KB	kilobytes

LBA	logical block address
LCP	local control port
LDEV	logical device
LDKC	logical disk controller (used for USP V/VM)
LDM	Logical Disk Manager
LU	logical unit
LUN	logical unit number
LUSE	Logical Unit Size Expansion
LV	logical volume
LVM	logical volume manager
MB	megabytes
MCU	main control unit (Hitachi TrueCopy only)
MRCF	Multi-RAID Coupling Feature (refers to ShadowImage)
MSCS	Microsoft Cluster Server
MU	mirrored unit
NSC	Hitachi TagmaStore Network Storage Controller
OPS	Oracle Parallel Server
OS	operating system
PB	petabyte
PC	personal computer system
PCSI	PolyCenter Software Installation
PnP	Plug-and-Play
PV	physical volume
P-VOL	primary volume
RAID600, R600	factory model number for the Universal Storage Platform V/VM
RAID500, R500	factory model number for the TagmaStore USP/NSC
RAID450, R450	factory model number for the Lightning 9900V
RAID400, R400	factory model number for the Lightning 9900
R/W, RD/WR	read/write
RCP	remote control port (used for Hitachi TrueCopy)
RCU	remote control unit (used for Hitachi TrueCopy)
RD	read
RM	RAID Manager (another name for CCI)
S/W	software
SCSI	small computer system interface
SF	sidefile
SI	ShadowImage
SLPR	Storage Logical Partition
SVC	service console
S-VOL	secondary volume
SVP	service processor
TB	terabyte
TC	TrueCopy

TID	target ID
UR	Hitachi Universal Replicator
USP	Universal Storage Platform
VPM	Virtual Partition Manager
V-VOL	virtual volume
VxVM	VERITAS Volume Manager
WR	write