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Hitachi AMS 2000 Family Command Control Interface (CCI) User's Guide

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Hitachi Data Systems

MK-97DF8123-08

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Preface

This document describes and provides instructions for performing Command Control Interface (CCI) software operations on the Adaptable Modular Storage (AMS) array. The CCI software enables the user to issue Copy-on-write SnapShot (hereafter called *SnapShot*), ShadowImage in-system replication (hereafter called *ShadowImage*), TrueCopy remote replication (hereafter called TrueCopy), and/or TrueCopy Extended Distance (hereafter called TCE) commands to the AMS array from the open-systems host (UNIX®-based or PC server host).

This preface includes the following information:

Intended audience

This document is intended for system administrators, Hitachi Data Systems representatives, and Authorized Service Providers who are involved in installing, configuring, and/or operating the AMS.

This document assumes the following:

- The user has a background in data processing and understands RAID storage arrays and their basic functions.
- The user is familiar with the AMS array.
- The user is familiar with the functionality of the ShadowImage/ SnapShot features.
- The user is familiar with the functionality of the TrueCopy/TCE features.
- The user has read and understands the *ShadowImage in-system replication User's Guide*.
- The user has read and understands the *Copy-on-write SnapShot User's Guide*.
- The user has read and understands the *TrueCopy remote replication User's Guide*.
- The user has read and understands the *TrueCopy Extended Distance User's Guide*.

Product version

This document revision applies to CCI software version 01-23-03/08 or later, and AMS 2000 Family firmware version 0890/A or later.

Release notes and readme

Read the release notes and readme file before installing and using this product. They may contain requirements or restrictions that are not fully described in this document and/or updates or corrections to this document.

Document revision level

Revision	Date	Description
MK-97DF8123-01	October 2008	Initial Release
MK-97DF8123-02	December 2008	This release supersedes release 01.
MK-97DF8123-03	March 2009	This release supersedes release 02.
MK-97DF8123-04	June 2009	This release supersedes release 03.
MK-97DF8123-05	August 2009	This release supersedes release 04.
MK-97DF8123-06	November 2009	This release supersedes release 05.
MK-97DF8123-07	January 2010	This revision supersedes revision 06.
MK-97DF8123-08	April 2010	This revision supersedes revision 07.

Changes in this revision

- Under Restrictions on Hyper-V (page 2-95), revised the sections Restrictions on the LU assigned to the pair (page 2-95) and added the new section Restrictions about the cluster shared volume (page 2-95).
- Under Dynamic disk and copy function (page 4-9), revised the reason why you cannot use pair volumes as a dynamic disk.
- Under Restrictions on VSS configurations (page 5-6), revised the note.

Document organization

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

Chapter	Description
Chapter 1, Overview of copy solutions	Provides information about Hitachi copy solutions.
Chapter 2, Overview of CCI operations	Provides details of CCI functionality.
Chapter 3, Fibre-to-SCSI address conversion	Provides information for converting fibre channel to SCSI.
Chapter 4, CCI operations on Windows Server 2000/ 2003/2008	Provides information on LDM Volume Search and Flush, and Dynamic Disk and Copy Function
Chapter 5, RM Shadow Copy Provider for VSS	Provides information on RM Shadow Copy Provider for VSS.
Chapter 6, Consistency groups, CCI groups	Discusses the differences between groups defined in the CCI definition file and consistency groups.

Applicable platforms

This document applies to the following platforms:

Vendor	Operating System
SUN	Solaris 8 (SPARC)
	Solaris 9 (SPARC)
	Solaris 10 (SPARC)
	Solaris 10 (x86)
	Solaris 10 (x64)

Vendor	Operating System
Microsoft	Windows 2000
	Windows Server 2003 (IA32)
	Windows Server 2008 (IA32)
	Windows Server 2003 (x64)
	Windows Server 2008 (x64)
	Windows Server 2003 (IA64)
	Windows Server 2008 (IA64)
Red Hat	Red Hat Linux AS 2.1 (IA32)
	Red Hat Linux AS/ES 3.0 (IA32)
	Red Hat Linux AS/ES 4.0 (IA32)
	Red Hat Linux AS/ES 5.0 (IA32)
	Red Hat Linux AS/ES 3.0 (AMD64/EM64T)
	Red Hat Linux AS/ES 4.0 (AMD64/EM64T)
	Red Hat Linux AS/ES 5.0 (AMD64/EM64T)
	Red Hat Linux AS/ES 3.0 (IA64)
	Red Hat Linux AS/ES 4.0 (IA64) See note.
HP	HP-UX 11i V1.0 (PA-RISC)
	HP-UX 11i V2.0 (PA-RISC)
	HP-UX 11i V3.0 (PA-RISC)
	HP-UX 11i V2.0 (IPF)
	HP-UX 11i V3.0 (IPF)
	Tru64 UNIX 5.1
IBM	AIX 5.1
	AIX 5.2
	AIX 5.3
SGI	IRIX 6.5.x

NOTE: To execute the CCI command when Red Hat Linux® AS4.0 is used in the IPF environment (IA64), it is required to install all the 32-bit compatible packages for IA-32EL (Execution Layer). When you install the IA-32EL, install all the 32-bit compatible packages (except CCI for Linux/ IA64).

Virtual OS applies to the following platforms:

Vendor	Host Operating System	Guest Operating System
VMware (IA32)	VMware ESX Server 3.0	Windows 2000
		Windows Server 2003
		Red Hat Linux AS3.0
		Red Hat Linux AS4.0
Microsoft	Windows Server 2008 Hyper-V	Windows Server 2003 SP2
		Windows Server 2008

The following table shows the IPv6 supported platforms.

Vendor	Operating System	IPv4 Mapped IPv6
Microsoft	Windows Server 2003 + IPv6 install (IA32)	N/A
	Windows Server 2008 (IA32)	N/A
	Windows Server 2003 + IPv6 install (x64)	N/A
	Windows Server 2008 (x64)	N/A
	Windows Server 2003 + IPv6 install (IA64)	N/A
	Windows Server 2008 (IA64)	N/A
SUN	Solaris 8 (SPARC)	
	Solaris 9 (SPARC)	
	Solaris 10 (SPARC)	
	Solaris 10 (x86)	
	Solaris 10 (x64)	
IBM	AIX 5.1	
	AIX 5.2	
	AIX 5.3	
Red Hat	Red Hat Linux AS/ES 2.1 (IA32)	
	Red Hat Linux AS/ES 3.0 (IA32)	
	Red Hat Linux AS/ES 4.0 (IA32)	
	Red Hat Linux AS/ES 5.0 (IA32)	
	Red Hat Linux AS/ES 3.0 (AMD64/EM64T)	
	Red Hat Linux AS/ES 4.0 (AMD64/EM64T)	
	Red Hat Linux AS/ES 5.0 (AMD64/EM64T)	
	Red Hat Linux AS/ES 3.0 (IA64)	
	Red Hat Linux AS/ES 4.0 (IA64)	
HP	HP-UX 11i V2.0 (PA-RISC)	
	HP-UX 11i V3.0 (PA-RISC)	
	HP-UX 11i V2.0 (IPF)	
	HP-UX 11i V3.0 (IPF)	

Document conventions

This document uses the following symbols to draw attention to important safety and operational information.

Symbol	Meaning	Description
	Tip	Tips provide helpful information, guidelines, or suggestions for performing tasks more effectively.
	Note	Notes emphasize or supplement important points of the main text.
	Caution	Cautions indicate that failure to take a specified action could result in damage to the software or hardware.

The following typographic conventions are used in this document.

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

Convention for storage capacity values

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

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

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

Logical capaciy unit	Value
1 block	512 bytes
1 KB	1,024 (2^{10}) bytes
1 MB	1,024 KB or 1024^2 bytes
1 GB	1,024 MB or 1024^3 bytes
1 TB	1,024 GB or 1024^4 bytes
1 PB	1,024 TB or 1024^5 bytes
1 EB	1,024 PB or 1024^6 bytes

Accessing product documentation

The AMS 2000 Family user documentation is available on the Hitachi Data Systems Portal: https://portal.hds.com. Please check this site for the most current documentation, including important updates that may have been made after the release of the product.

This documentation set consists of the following documents.

Release notes

- Adaptable Modular Storage System Release Notes
- Storage Navigator Modular 2 Release Notes

Please read the release notes before installing and/or using this product. They may contain requirements and/or restrictions not fully described in this document, along with updates and/or corrections to this document.

Installation and getting started

The following documents provide instructions for installing an AMS 2000 Family storage system. They include rack information, safety information, site-preparation instructions, getting-started guides for experienced users, and host connectivity information. The symbol ☞ identifies documents that contain initial configuration information about Hitachi AMS 2000 Family storage systems.

☞ **AMS2100/2300 Getting Started Guide**, MK-98DF8152

Provides quick-start instructions for getting an AMS 2100 or AMS 2300 storage system up and running as quickly as possible.

☞ **AMS2500 Getting Started Guide**, MK-97DF8032

Provides quick-start instructions for getting an AMS 2500 storage system up and running as quickly as possible.

AMS 2000 Family Site Preparation Guide, MK-98DF8149

Contains initial site planning and pre-installation information for AMS 2000 Family storage systems, expansion units, and high-density expansion units. This document also covers safety precautions, rack information, and product specifications.

AMS 2000 Family Fibre Channel Host Installation Guide, MK-08DF8189

Describes how to prepare Hitachi AMS 2000 Family Fibre Channel storage systems for use with host servers running supported operating systems.

AMS 2000 Family iSCSI Host Installation Guide, MK-08DF8188

Describes how to prepare Hitachi AMS 2000 Family iSCSI storage systems for use with host servers running supported operating systems.

Storage and replication features

The following documents describe how to use Storage Navigator Modular 2 (Navigator 2) to perform storage and replication activities.

Storage Navigator 2 Advanced Settings User's Guide, MK-97DF8039

Contains advanced information about launching and using Navigator 2 in various operating systems, IP addresses and port numbers, server certificates and private keys, boot and restore options, outputting configuration information to a file, and collecting diagnostic information.

Storage Navigator Modular 2 User's Guide, MK-99DF8208

Describes how to use Navigator 2 to configure and manage storage on an AMS 2000 Family storage system.

AMS 2000 Family Dynamic Provisioning Configuration Guide, MK-09DF8201

Describes how to use virtual storage capabilities to simplify storage additions and administration.

Storage Navigator 2 Storage Features Reference Guide for AMS, MK-97DF8148

Contains concepts, preparation, and specifications for Account Authentication, Audit Logging, Cache Partition Manager, Cache Residency Manager, Data Retention Utility, LUN Manager, Performance Monitor, SNMP Agent, and Modular Volume Migration.

AMS 2000 Family Copy-on-write SnapShot User Guide, MK-97DF8124

Describes how to create point-in-time copies of data volumes in AMS 2100, AMS 2300, and AMS 2500 storage systems, without impacting host service and performance levels. Snapshot copies are fully read/write compatible with other hosts and can be used for rapid data restores, application testing and development, data mining and warehousing, and nondisruptive backup and maintenance procedures.

AMS 2000 Family ShadowImage In-system Replication User Guide, MK-97DF8129

Describes how to perform high-speed nondisruptive local mirroring to create a copy of mission-critical data in AMS 2100, AMS 2300, and AMS 2500 storage systems. ShadowImage keeps data RAID-protected and fully recoverable, without affecting service or performance levels. Replicated data volumes can be split from host applications and used for system backups, application testing, and data mining applications while business continues to operate at full capacity.

AMS 2000 Family TrueCopy Remote Replication User Guide, MK-97DF8052

Describes how to create and maintain multiple duplicate copies of user data across multiple AMS 2000 Family storage systems to enhance your disaster recovery strategy.

AMS 2000 Family TrueCopy Extended Distance User Guide, MK-97DF8054

Describes how to perform bi-directional remote data protection that copies data over any distance without interrupting applications, and provides failover and recovery capabilities.

AMS 2000 Data Retention Utility User's Guide, MK-97DF8019

Describes how to lock disk volumes as read-only for a certain period of time to ensure authorized-only access and facilitate immutable, tamper-proof record retention for storage-compliant environments. After data is written, it can be retrieved and read only by authorized applications or users, and cannot be changed or deleted during the specified retention period.

Storage Navigator Modular 2 online help

Provides topic and context-sensitive help information accessed through the Navigator 2 software.

Hardware maintenance and operation

The following documents describe how to operate, maintain, and administer an AMS 2000 Family storage system. They also provide a wide range of technical information and specifications for the AMS 2000 Family storage systems. The symbol ☞ identifies documents that contain initial configuration information about Hitachi AMS 2000 Family storage systems.

☞ **AMS 2100/2300 Storage System Hardware Guide**, MK-97DF8010

Provides detailed information about installing, configuring, and maintaining AMS 2100 and 2300 storage systems.

☞ **AMS 2500 Storage System Hardware Guide**, MK-97DF8007

Provides detailed information about installing, configuring, and maintaining an AMS 2500 storage system.

☞ **AMS 2000 Family Storage System Reference Guide**, MK-97DF8008

Contains specifications and technical information about power cables, system parameters, interfaces, logical blocks, RAID levels and configurations, and regulatory information about AMS 2100, AMS 2300, and AMS 2500 storage systems. This document also contains remote adapter specifications and regulatory information.

AMS 2000 Family Storage System Service and Upgrade Guide, MK-97DF8009

Provides information about servicing and upgrading AMS 2100, AMS 2300, and AMS 2500 storage systems.

AMS 2000 Family Power Savings User Guide, MK-97DF8045

Describes how to spin down volumes in selected RAID groups when they are not being accessed by business applications to decrease energy consumption and significantly reduce the cost of storing and delivering information.

Command and Control (CCI)

The following documents describe how to install the Hitachi AMS 2000 Family Command Control Interface (CCI) and use it to perform TrueCopy and ShadowImage operations.

AMS 2000 Family Command Control Interface (CCI) Installation Guide, MK-97DF8122

Describes how to install CCI software on open-system hosts.

AMS 2000 Family Command Control Interface (CCI) Reference Guide, MK-97DF8121

Contains reference, troubleshooting, and maintenance information related to CCI operations on AMS 2100, AMS 2300, and AMS 2500 storage systems.

AMS 2000 Family Command Control Interface (CCI) User's Guide, MK-97DF8123 — this document

Describes how to use CCI to perform TrueCopy and ShadowImage operations on AMS 2100, AMS 2300, and AMS 2500 storage systems.

Command Line Interface (CLI)

The following documents describe how to use Hitachi Storage Navigator Modular 2 to perform management and replication activities from a command line.

Storage Navigator Modular 2 Command Line Interface (CLI) Unified Reference Guide, MK-97DF8089

Describes how to interact with all Navigator 2 bundled and optional software modules by typing commands at a command line.

Storage Navigator 2 Command Line Interface Replication Reference Guide for AMS, MK-97DF8153

Describes how to interact with Navigator 2 to perform replication activities by typing commands at a command line.

Dynamic Replicator documentation

The following documents describe how to install, configure, and use Hitachi Dynamic Replicator to provide AMS Family storage systems with continuous data protection, remote replication, and application failover in a single, easy-to-deploy and manage platform.

Dynamic Replicator - Scout Release Notes, RN-99DF8211

Dynamic Replicator - Scout Host Administration Guide, MK-98DF8212

Dynamic Replicator - Scout Installation and Configuration Guide, MK-

Dynamic Replicator - Scout Quick Start Guide, MK-98DF8214

Dynamic Replicator - Scout Host Troubleshooting Guide, MK-98DF8215

Dynamic Replicator DR-Scout ICAT Utility Guide, MK-98DF8216

Dynamic Replicator - Scout RX Server Deployment Guide, MK-98DF8217

Dynamic Replicator VX Solution for Oracle (Solaris), MK-98DF8218

Dynamic Replicator - Scout Solution for SharePoint 2007, MK-98DF8219

Dynamic Replicator - Scout Solution for MySQL (Windows), MK-98DF8220

Protecting Citrix XenServer Using Hitachi Dynamic Replicator - Scout, MK-98DF8221

Dynamic Replicator Quick Install/Upgrade Guide, MK-98DF8222

Dynamic Replicator - Scout Protecting MS SQL Server, MK-98DF8223

Dynamic Replicator - Scout - Protecting Microsoft Exchange Server, MK-98DF8224

Dynamic Replicator - Scout File Server Solution, MK-98DF8225

Dynamic Replicator - Scout ESX - Protecting ESX Server (RCLI), MK-99DF8226

Getting help

If you need to contact the Hitachi Data Systems support center, please provide as much information about the problem as possible, including:

- The circumstances surrounding the error or failure.
- The exact content of any messages displayed on the host system(s).
- The exact content of any messages displayed on Storage Navigator Modular 2.
- The Storage Navigator Modular 2 configuration information. This information is used by service personnel for troubleshooting purposes.

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

Comments

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

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

1

Overview of copy solutions

This chapter includes the following:

- Command Control Interface (CCI)
- ShadowImage
- SnapShot
- Synchronous/asynchronous remote copy feature (TrueCopy/ TCE)
- Cooperation between users and Hitachi personnel

Command Control Interface (CCI)

The Command Control Interface (CCI) software product provides command line control for ShadowImage, SnapShot, Synchronous Remote Copy (TrueCopy), and Asynchronous Remote Copy (TCE) operations on the AMS array by issuing commands from the system hosts to the AMS array. The CCI software interfaces with the system software and high-availability (HA) software on the system hosts as well as with the TrueCopy/TCE/ ShadowImage/SnapShot software on the array. For additional information on ShadowImage, SnapShot, TrueCopy, and TCE, please refer to:

- *ShadowImage In-system Replication User's Guide*
- *Copy-on-write SnapShot User's Guide*
- *TrueCopy remote replication User's Guide*
- *TrueCopy Extended Distance User's Guide*

CCI provides failover and operation commands which support mutual hot standby in conjunction with industry-standard failover products. CCI also supports a scripting function for defining multiple ShadowImage/SnapShot/ TrueCopy/TCE operations in a script (or text) file. Using CCI scripting, you can set up and execute a large number of ShadowImage/SnapShot/ TrueCopy/TCE commands in a short period of time.

ShadowImage operations involve primary and secondary volumes within one array. The ShadowImage P-VOLs contain the original data, and the S-VOLs are the internal duplicate volumes. ShadowImage allows up to eight S-VOLs to be created for each P-VOL. Each S-VOL is paired with the P-VOL independently, allowing each S-VOL to be maintained as an independent copy set.

SnapShot operations involve primary (P-VOL) and SnapShot Logical Units (V-VOLs) within one array. The SnapShot P-VOLs contain the original data, and the V-VOLs are the logical duplicate volumes. SnapShot allows one to thirty-two V-VOLs to be created for each P-VOL. Each V-VOL is paired with the P-VOL independently, allowing each V-VOL to be maintained as an independent copy set.

TrueCopy/TCE operations involve the primary (main) arrays and the secondary (remote) arrays. The primary arrays contain the TrueCopy/TCE primary volumes (P-VOLs), which are the original data volumes. The secondary arrays contain the TrueCopy/TCE secondary volumes (S-VOLs). When TrueCopy/TCE is performed using CCI, you need to reserve and configure one volume on each array as the CCI command device.

ShadowImage

The ShadowImage data duplication feature enables you to set up and maintain multiple copies of logical volumes within the same AMS array. ShadowImage operations for UNIX®/PC host-based data can be performed using ShadowImage software on the host where CCI software is installed.

The CCI software on the UNIX®/PC host displays ShadowImage information and allows you to perform ShadowImage operations by issuing commands from the UNIX®/PC command line or by executing a script file. The CCI software interfaces with the AMS array through a dedicated LU called a command device.

SnapShot

The SnapShot data duplication feature enables you to set up and maintain multiple copies of logical volumes within the same AMS array. SnapShot operations for UNIX®/PC host-based data can be performed using SnapShot software on the host where the CCI software is installed.

The CCI software on the UNIX®/PC host displays SnapShot information and allows you to perform SnapShot operations by issuing commands from the UNIX®/PC command line or by executing a script file. The CCI software interfaces with the AMS array through a dedicated LU called a command device.

Synchronous/asynchronous remote copy feature (TrueCopy/TCE)

TrueCopy/TCE is an optional function and can be installed on the array. The TrueCopy/TCE enables you to create and maintain remote copies of the data stored on the array for data backup and disaster recovery purposes.

TrueCopy/TCE operations can be performed using the Command Control Interface (CCI) software on the UNIX®/PC server host. The CCI software on the UNIX®/PC server displays TrueCopy/TCE information and allows you to perform TrueCopy/TCE operations from the UNIX® command line or via a script file. The CCI software interfaces with the array through a dedicated LU called a command device.

Read the following notices and follow them; otherwise, a remote path failure will occur.

- When turning on the array where a path has already been set, turn on the remote array, and turn on the local array after the array become READY.
  When turning off the array where a remote path has already been set, turn off the local array and turn off the remote array.
- A path blockage that occurred while using the TrueCopy/TCE function, even if the remote array was off, also occurs. The remote array is turned on, and automatically recovered when the remote array is READY (about 4 minutes).
  If a remote path blockage is not recovered, regardless of being READY, call the Hitachi maintenance personnel.

Cooperation between users and Hitachi personnel

If a ShadowImage/TrueCopy suspended-error occurs, the cause is usually due to a failure in the hardware (or when the user forcibly suspends the pair). To recover from a suspended status (PSUE), the hardware error and data must be recovered. To accomplish this task, cooperation between the user and Hitachi maintenance personnel is necessary.

There are two cases of suspend failure (PSUE failure) of SnapShot/TCE: The first is a result of a hardware failure. The second occurs when the free capacity of the data pool has run short. Recovery from the suspend failure caused by a hardware failure requires not only recovery from the hardware failure but also restoration of a pair. Therefore, it requires co-operation between the user and service personnel of Hitachi.

In order to prevent the suspend failure caused by a shortage of a free capacity of the data pool, check the free capacity of the data pool periodically and increase the data pool capacity when necessary.

For PSUE error, check the CCI system log first. If the error is not caused by user operation, please contact Hitachi maintenance personnel.

2

Overview of CCI operations

CCI allows you to perform ShadowImage, SnapShot, TrueCopy, and/or TCE operations by issuing ShadowImage/SnapShot/ TrueCopy/TCE commands from the UNIX®/PC host to the AMS array. ShadowImage operations are non-disruptive and allow the primary volume of each volume pair to remain online to all hosts for both read and write operations (except when a hardware error occurs or error occurs during reverse –resync in ShadowImage).

This chapter includes the following:

Features of paired volumes

Logical volumes, which are handled independently by host machines, can be combined or separated in volume pairs and handled uniformly by ShadowImage, SnapShot, TrueCopy, and/or TCE. ShadowImage, SnapShot, TrueCopy, and TCE regard those two volumes in a pair to be combined or separated as a unique paired logical volume used by the hosts. It is possible to handle paired volumes as groups by selecting them in units of host software or in units of the database and its attributes.

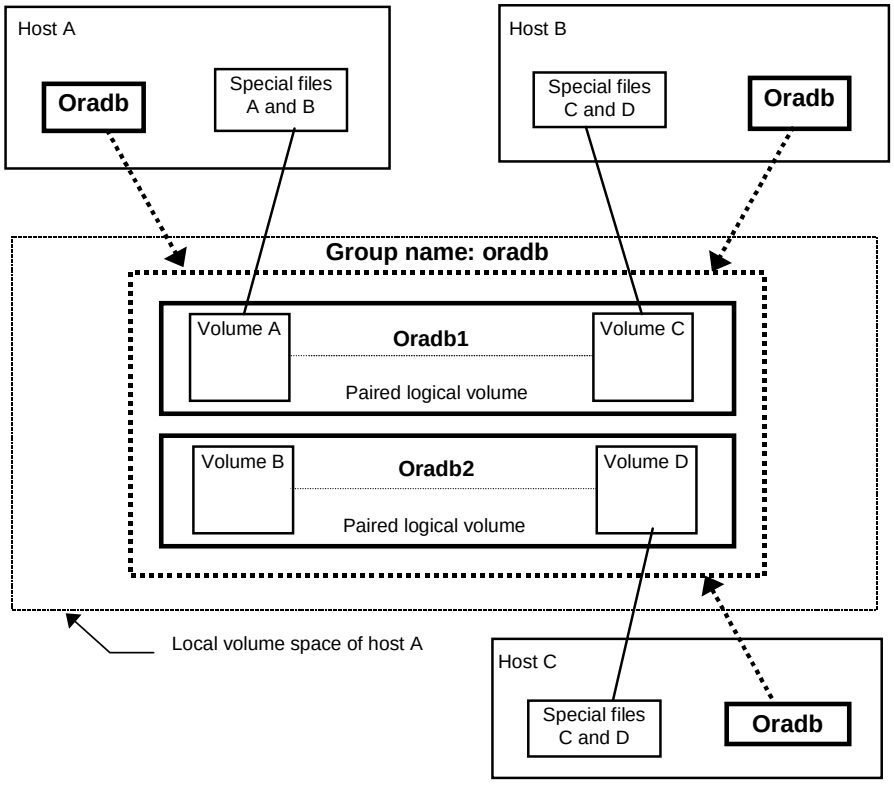


Figure 2-1: Paired Volumes

Addressing paired logical volumes: The I/O between paired logical volumes and physical volumes is defined by describing the intended paired logical volume names and group names in the configuration definition file of each host. Each paired logical volume must belong to a group in the configuration definition file. One group can contain logical volumes for one host, application, etc.

Specification of volumes by commands: CCI commands that specify a volume name must be given using the paired logical volume names or group names.

ShadowImage duplicated mirroring

Duplicated mirroring a single primary volume is possible using ShadowImage. The duplicated mirror volumes of the P-VOL are expressed as virtual volumes using the mirror descriptors (MU#0-7) in the configuration definition file as shown below. However, when one P-VOL is paired with the maximum eight S-VOLs, only one set can be in the PAIR, COPY, or PSUE(R) status.

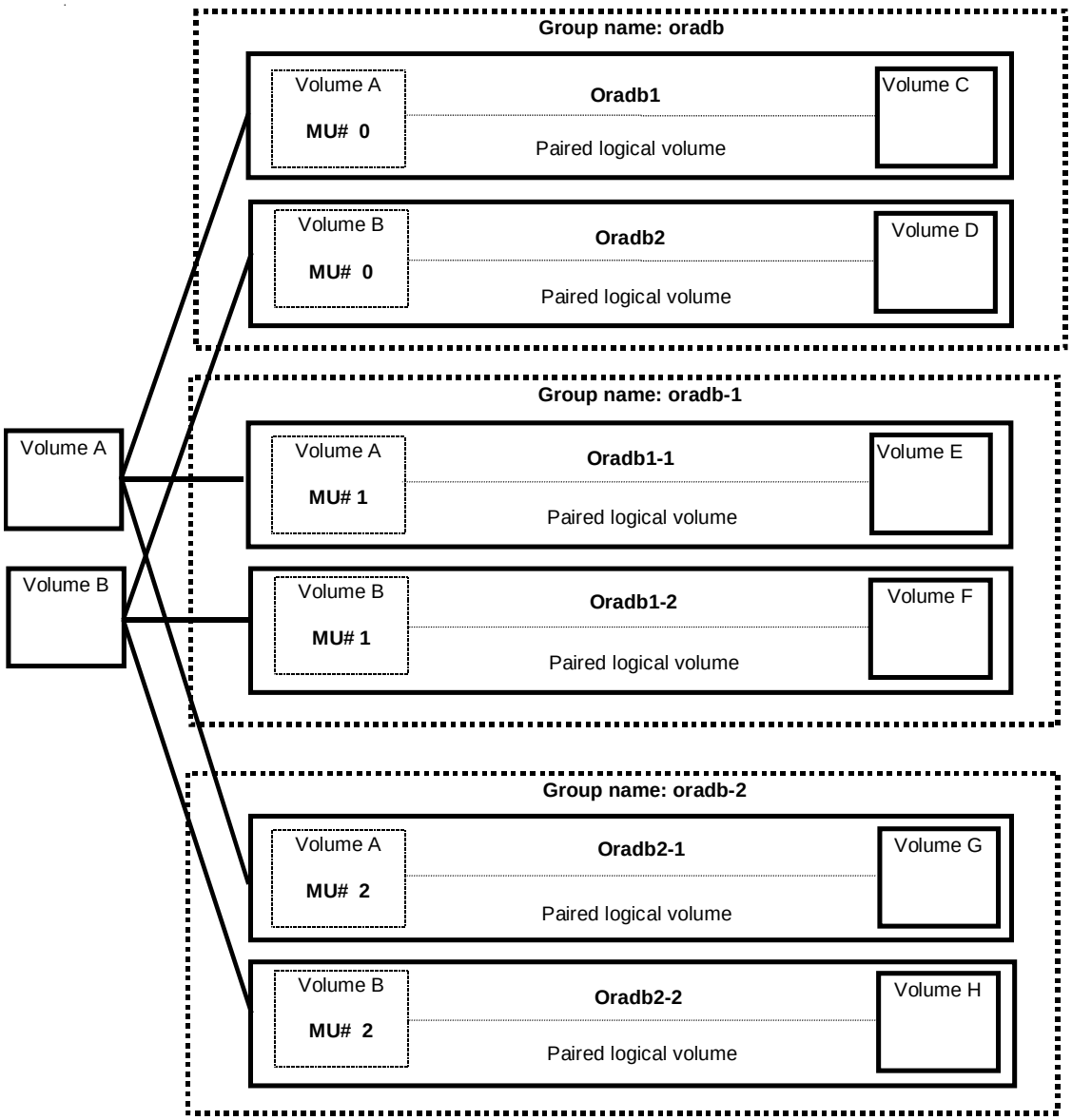


Figure 2-2: ShadowImage Duplicated Mirrors

SnapShot duplicated mirroring

Duplicated mirroring of a single primary volume is possible using SnapShot. The duplicated mirror volumes of the P-VOL are expressed as virtual volumes using the mirror descriptors (MU#0-31) in the configuration definition file as shown below.

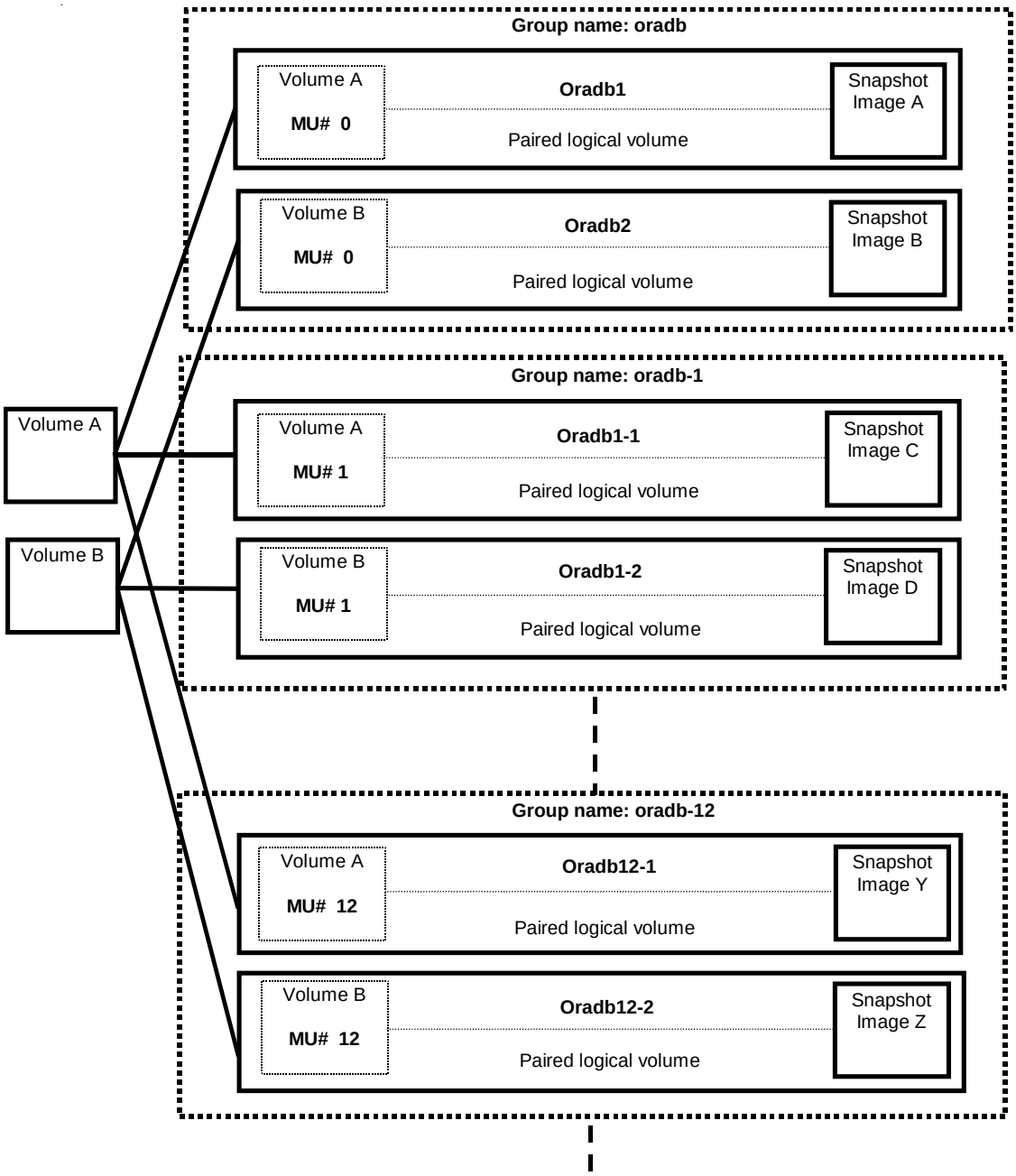


Figure 2-3: SnapShot Duplicated Mirrors

CCI operations for replication

This section provides descriptions of CCI's use with ShadowImage and SnapShot operations, TrueCopy takeover commands, and TrueCopy/TCE remote commands

ShadowImage operations

Figure 2-4 illustrates the ShadowImage configuration. The ShadowImage commands support a function, which links the system operation with the host system operation management to create a volume backup among UNIX®/PC hosts.

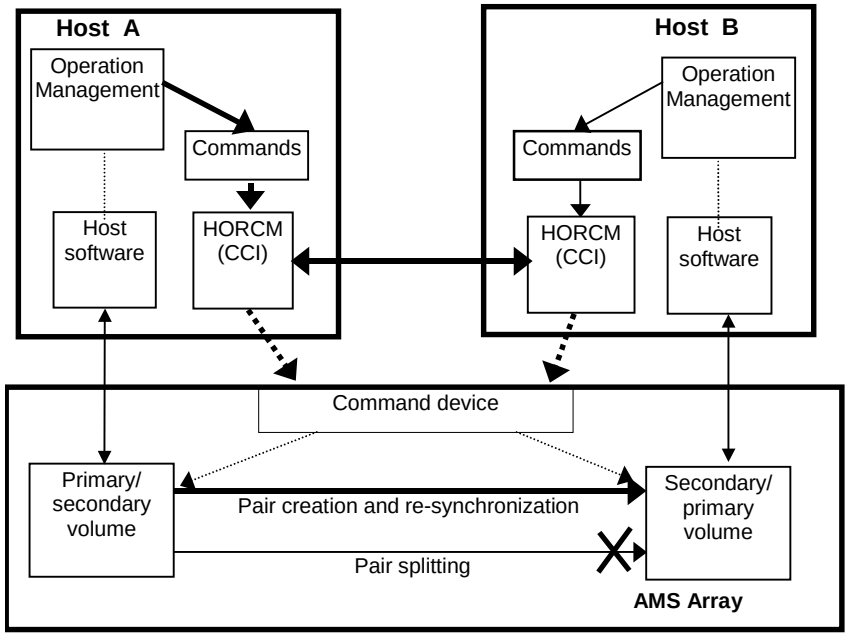


Figure 2-4: ShadowImage System Configuration

SnapShot operations

Figure 2-5 illustrates the SnapShot configuration. The SnapShot commands support a function, which links the system operation with the host system operation management to create a volume backup among UNIX®/PC hosts.

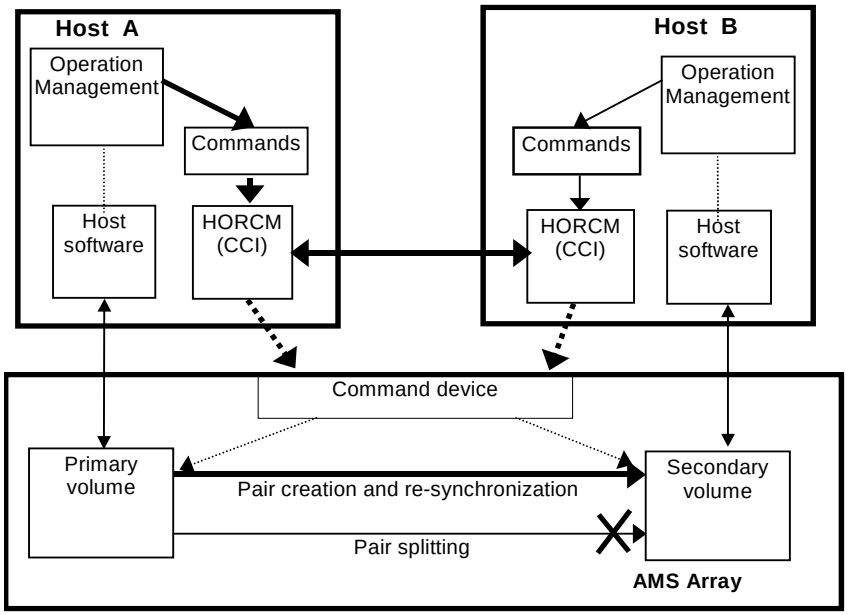


Figure 2-5: SnapShot System Configuration

TrueCopy takeover commands

CCI TrueCopy operates in conjunction with the software on the UNIX®/PC servers and the array TrueCopy functions. 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 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. See the *Hitachi Adaptable Modular Storage Command Control Interface (CCI) Reference Guide* for more details about the horctakeover command

Figure 2-6 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 TrueCopy are activated by the control HA script and execute the control needed for failover of the server.

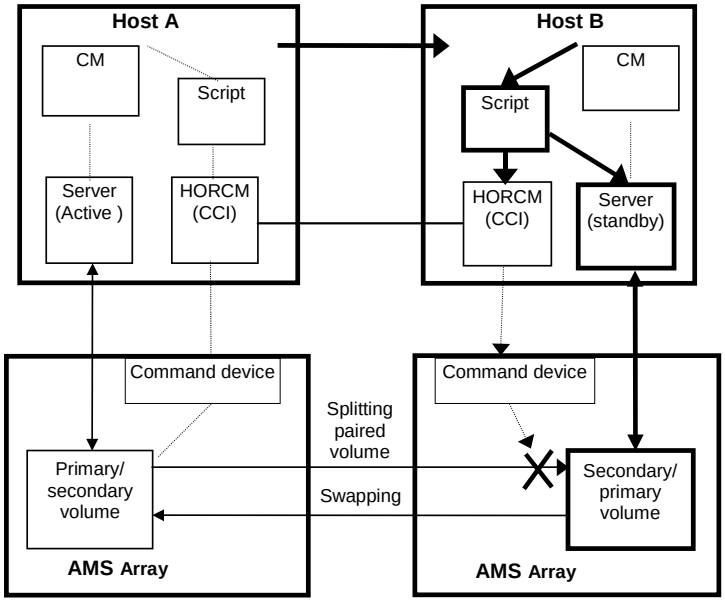


Figure 2-6: Server Failover System Configuration

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 2-7). However, if the operation is performed in an environment in which 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.

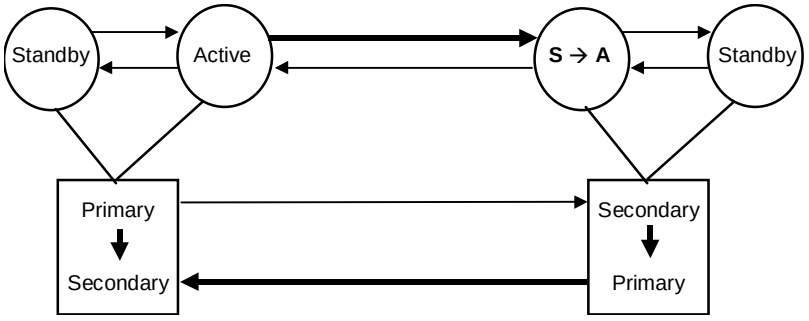


Figure 2-7: Package Transfer on High Availability (HA) Software

TrueCopy/TCE remote commands

Figure 2-8 illustrates a TrueCopy/TCE remote configuration. The TrueCopy/TCE 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 TrueCopy/TCE remote pair commands are also used to copy volumes in the failover configuration of the servers and to recover the volumes after the takeover.

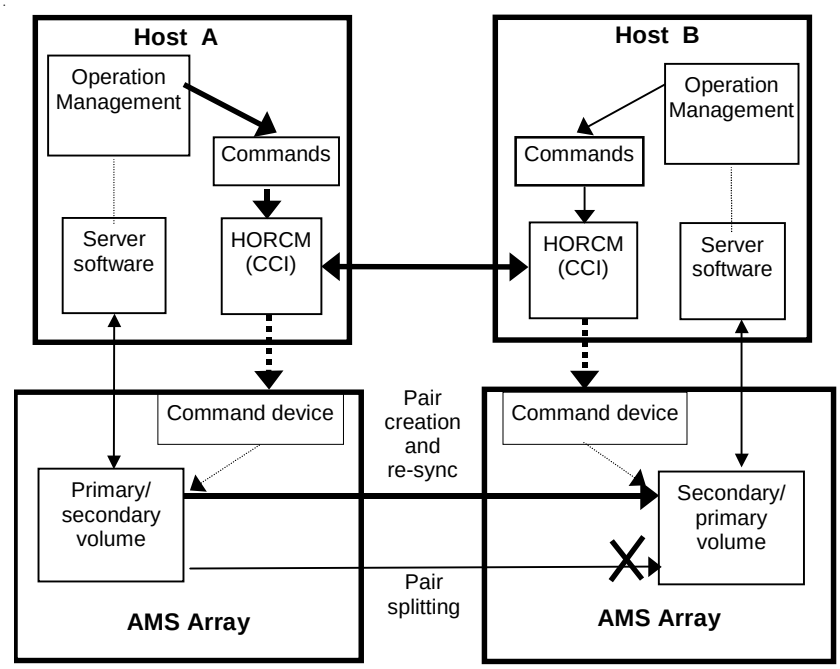


Figure 2-8: TrueCopy/TCE Remote System Configuration

Volume pairs

ShadowImage/SnapShot paired volumes can be created between the same volume sizes. ShadowImage commands allow you to create volume pairs consisting of one P-VOL and up to eight S-VOLs using the ShadowImage duplicate function. SnapShot commands allow you to create volume pairs consisting of one P-VOL and up to thirty-two V-VOLs using the SnapShot duplicate function. ShadowImage/SnapShot pairs are contained within the same AMS array and are maintained using asynchronous update copy operations.

TrueCopy/TCE commands allow you to create volume pairs consisting of one P-VOL and one S-VOL. The TrueCopy/TCE P-VOL and S-VOL must be in different arrays.

Each volume pair that you create must be registered in the CCI configuration file. ShadowImage/SnapShot volume pairs must include an MU (mirrored unit) number assigned to the S-VOL. The MU number indicates that the pair is a ShadowImage/SnapShot 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 ShadowImage/SnapShot/ TrueCopy/TCE volumes as individual volumes by specifying logical volume names with the ShadowImage/SnapShot/TrueCopy/TCE commands.

Table 2-1: Created Volume Pair Numbers

Equipment Type	TrueCopy	TCE	ShadowImage	SnapShot
AMS2100	2,046	1,022	1,023	1,022
AMS2300	4,094	2,046	2,047	2,046

ShadowImage volume status

Each ShadowImage pair consists of one P-VOL and one S-VOL. Table 2-2 lists and describes the 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 changes when a ShadowImage command is executed. The validity of the specified operation is checked according to the status of the volume (primary volume). The user must note the issued commands and the changes of the status so that appropriate action can be taken if an error occurs.

Table 2-2: ShadowImage Pair Status

Status	ShadowImage Pair Status	Primary	Secondary
SMPL	Unpaired volume.	Read/Write enabled.	Read/Write enabled.
PAIR	Paired volume. Initial copy is complete. Updates are processed asynchronously.	Read/Write enabled.	Read enabled*. (See ***Note 1***)
PAIR (IS)	Although the status displays as PAIR, the copy operation is in progress as same as COPY. The P-VOL and the S-VOL are not yet the same. The pair split in the PAIR(IS) status operates in Quick Mode even without specifying the option and changes to PSUS(SP).	Read/Write enabled.	Read enabled*. (See ***Note 1***)
COPY	In paired state, but initial copy, pairsplit, or resync operation is not complete. Includes COPY(PD), COPY(SP), and COPY(RS) status.	Read/Write enabled.	Read enabled*. (See ***Note 1***)
RCPY	In paired state, but reverse resync operation is not complete. Includes COPY(RS-R) status.	Read/Write enabled*.	Read enabled. (See ***Note 1***)
PSUS SSUS (split)	In paired state, but updates to the S-VOL data are suspended due to user-requested pairsplit. The AMS keeps track of P-VOL and S-VOL updates while the pair is split. The S-VOL status displays as SSUS.	Read/Write enabled.	Read/Write enabled when using write enable pairsplit option.
PSUS (SP) COPY	The pair status is maintained and the background copy is in progress. However, the update data to a new P-VOL is managed by difference and the update to the S-VOL is stopped. The pair in the PSUS(SP) status cannot be deleted. The S-VOL status displays as COPY.	Read/Write enabled.	Read/Write enabled.
PSUE (error)	In paired state, but updates to the S-VOL volume data are suspended due to an error condition. When a PSUE pair is resynced, the AMS copies the entire P-VOL to the S-VOL (same as initial copy).	Read/Write enabled if no error has occurred in the primary volume. (If the status transits from RCPY, all access is disabled.)	Read enabled*. (See ***Note 1***) (If the status transits from RCPY, all access is disabled.)
(S-VOL Switch)	This is a state in which a double failure of drives (triple failures for RAID 6) occurred in a P-VOL and the P-VOL was switched to an S-VOL internally. This state is displayed as PSUE with CCI. For details, refer to the *Hitachi AMS ShadowImage in-system replication User's Guide*.	Read/Write enabled.	Read/Write is impossible.

** Read is disabled when the **–m noread** option of paircreate command is specified.*

NOTE: Do not mount in this state. When a mount is performed, it is under data copy and the data may be changed (except for PSUE).

Table 2-3 shows the relationship between pair status and ShadowImage command acceptance.

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→④	Rejected	Rejected	Acceptable	Rejected
② COPY RCPY	Acceptable	Accepted *Note 3* ②→④	Accepted ⑤	Accepted *Note 3* ②→④	Accepted ①	Acceptable
③ PAIR	Acceptable	Accepted ④	Accepted ⑤	Accepted 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 1: If the P-VOL does not have Write in the PAIR state, then data identical with an S-VOL is guaranteed. Therefore, when using the S-VOL with the SMPL state, after stopping Write to the P-VOL, create a paired volume, and split the paired volume after confirming that the paired volume has PAIR status. In the PSUE state, ShadowImage does not manage differential data at the P-VOL or S-VOL. 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 2: When one P-VOL configures a pair with the maximum of eight S-VOLs, only a set of ShadowImage can be in the PAIR status, the COPY status or the PSUE(R) status.

Note 3: The status transition from ✍ to ✍ is valid only when the pair status is changed to COPY due to the pair creation. When the pair status is changed to COPY due to pair resynchronization, the command is accepted but it is executed as “no operation”. When the pair status is RCPY, the command is executed as “no operation”.

Example:

```
# 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-A , 3,  4-0 )85010061    28.P-VOL PSUS,  100     29  W
oradb   oradev3(R)  (CL2-A , 3,  5-0 )85010061    29.S-VOL COPY,   97     28  -
```

SnapShot volume status

Each SnapShot pair consists of one P-VOL and up to 32 S-VOLs (Snapshot image: V-VOL). Table 2-4 lists and describes the SnapShot 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 RCPY. Read and write requests from the host are accepted or rejected depending on the pair status of the volume.

The pair status changes when a SnapShot command is executed. The validity of the specified operation is checked according to the status of the volume (primary volume). The user must note the issued commands and the changes of the status so that appropriate action can be taken if an error occurs.

Table 2-4: SnapShot Pair Status

Pair Status	Description	P-VOL	V-VOL
SMPL	This is a state in which no volume is assigned to a SnapShot pair. The P-VOL in the SMPL status accepts I/O operations of Read/Write. The V-VOL does not accept any I/O operations of Read/Write.	Read and write.	Does not accepts I/O operations (Read/Write)
PAIR	The PAIR is a pseudo status that exists in order to give interchangeability with the command system of ShadowImage. The actual status is the same as the PSUS. Since this is a pseudo status used merely for updating data retained in the SnapShot pair, it is not recommended that long-time operations occur while this status exists.	Read and write.	Does not accepts I/O operations (Read/Write)
COPY (RS-R)	This is a status (COPY(RS-R)) in which the backup data retained in the V-VOL is being restored to the P-VOL. In this status, Read/Write I/O operations are accepted for the P-VOL as before (in the PSUS status). The V-VOL will not accept Read/Write I/O operations. The SnapShot instruction cannot be executed. The pair status will be returned to PAIR after the restoration is completed. When a failure occurs or a pair is split during the restoration, statuses of the V-VOLs correlated to the P-VOL and in the status other than SMPL being restored becomes PSUE.	Read and write.	Does not accepts I/O operations (Read/Write)
PSUS (SSUS)	This is a status (PSUS) in which the P-VOL data at the time of the SnapShot instruction is retained in the V-VOL. When a change of the P-VOL data occurs, the P-VOL data at the time of the SnapShot instruction is retained as the V-VOL data. The P-VOL and V-VOL in the PSUS status accept Read/Write I/O operations. However, the V-VOL does not accept any Read/Write instruction while the P-VOL is being restored.	Read and write.	Read and write. (A Read/Write instruction is not acceptable during the P-VOL is being restored.)

Table 2-4: SnapShot Pair Status (Continued)

Pair Status	Description	P-VOL	V-VOL
PFUS	This is a status (PFUS) when the used rate of POOL reaches the threshold of POOL. However, PFUS usually operates as PSUS. Only when -fc option is added in the pairdisplay command and -ss option is added in the pairvolchk command, you can recognize as PFUS. (pairvolchk is recognized as returned values.)	Read and write.	Read and write. (A Read/Write instruction is not acceptable during the P-VOL is being restored.)
PSUE (Error)	This is a status (PSUE) in which the P-VOL data at the time of the SnapShot instruction cannot be retained in the V-VOL because some failure has occurred in the AMS array. In this status, I/O operations of Read/Write concerning the P-VOL is accepted as before (in the PSUS status). However, when a failure occurs during restoration, the P-VOL does not accept any Read/Write instruction. The V-VOL data has been invalidated at this point of time. To resume the split pair, execute the SnapShot instruction (paircreate -split) again after splitting the pair (using the pairsplit -S) once. However, data of the V-VOL created is not same data that was invalidated but rather is the P-VOL data at the time of the new SnapShot instruction.	Read and write. (The P-VOL does not accept a Read/Write instruction either when the pair status is PSUE due to a failure that has occurred during the restoration.)	Does not accepts I/O operations (Read/Write)

Table 2-5 shows the relationship between pair status and SnapShot command acceptance.

Table 2-5: Pair Status versus SnapShot Commands

	SnapShot Command				
	Paircreate		Snapshot		Restore
Pair Status	No -split	-split	-C option	-S option	Resync -restore
① SMPL	Accepted ②	Accepted ②→④	Rejected	Acceptable	Rejected
② RCPY	Rejected	Rejected	Rejected	Accepted ①	Rejected
③ PAIR	Acceptable	Accepted ④	Accepted ④	Accepted ①	Acceptable
④ PSUS	Rejected	Rejected	Rejected	Accepted ①	Accepted ②
⑤ PSUE	Rejected	Rejected	Rejected	Accepted ①	Rejected

NOTE: In the PSUE state, SnapShot does not manage differential data at the P-VOL or V-VOL.

Example:

```
# 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-A , 3,  4-0 )85010061    28.P-VOL PSUS,  100     29  W
oradb   oradev3(R)  (CL2-A , 3,  5-0 )85010061    29.S-VOL COPY,   97     28  -
```

TrueCopy/TCE volume status

Each TrueCopy pair consists of one P-VOL and one S-VOL. Table 2-6 lists and describes the TrueCopy pair status terms. Table 2-7 lists and describes the TCE 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. Read and write requests from the host are accepted or rejected depending on the pair status of the volume.

The pair status changes when a TrueCopy/TCE command is executed. The validity of the specified operation is checked according to the status of the volume (primary volume). The user must keep track of the issued commands and the changes of status so that an appropriate response can be made if an error occurs.

Table 2-9 shows the relationship between pair status and TrueCopy command acceptance.

Table 2-10 shows the relationship between pair status and TCE command acceptance.

Table 2-6: TrueCopy Pair Status

Status	TrueCopy Pair Status	Primary	Secondary
SMPL	Unpaired volume.	Read/Write enabled.	Read/Write enabled.
PAIR	Paired volume. Initial copy is complete. Updates are processed asynchronously.	Read/Write enabled.	Read enabled*. (See ***Note 1***)
COPY	In paired state, but initial copy, pairsplit, or resync operation is not complete. Includes COPY(PD) and COPY(SP) status.	Read/Write enabled.	Read enabled*. (See ***Note 1***)
PSUS SSUS (split)	In paired state, but updates to the S-VOL data are suspended due to user-requested pairsplit. The array keeps track of P-VOL and S-VOL updates while the pair is split.	Read/Write enabled.	Read/Write enabled when using write enable pairsplit option.
PSUE (error)	In paired state, but updates to the S-VOL volume data are suspended due to an error condition. When a PSUE pair is resynced, the array copies the entire P-VOL to the S-VOL (same as initial copy).	Read/Write enabled if no error has occurred and when the fence level is set to **data** in the primary volume.	Read enabled*. (See ***Note 1***)

Table 2-7: TCE Pair Status

Status	TCE Pair Status	Primary	Secondary
SMPL	Unpaired volume.	Read/Write enabled.	Read/Write enabled.
PAIR	Paired volume. Initial copy is complete. Updates are processed asynchronously.	Read/Write enabled.	Read enabled*. (See *Note 1*)
COPY	In paired state, but initial copy, pairsplit, or resync operation is not complete.	Read/Write enabled.	Read enabled*. (See *Note 1*)
PSUS	In paired state, but updates to the S-VOL data are suspended due to user-requested pairsplit. The array keeps track of P-VOL updates while the pair is split.	Read/Write enabled.	Read/Write enabled when using write enable pairsplit option.
PSUS(N)	This is a status resulted from a failure of the SSWS process or an S-VOL hardware failure occurred during a copy operation. All the data are managed on the P-VOL basis through the utilization of the differential data.	Read/Write is impossible.	Read/Write is impossible.
SSWS	This is the status after the SVOL_Takeover operation was performed by the takeover command. The updated data is managed using the differential data of the S-VOL.	—	Read/Write enabled.
PFUS (See *Note 2*)	This is a state in which the available data pool capacity is insufficient (pool-over). The updated data is managed using the differential data of the P-VOL.	Read/Write enabled.	Read enabled*. (See *Note 1*)
PSUE (error)	In paired state, but updates to the S-VOL volume data are suspended due to an error condition. When a PSUE pair is resynced, the array copies the entire P-VOL to the S-VOL (same as initial copy).	Read/Write enabled.	Read enabled*. (See *Note 1*)

Note 1: In this state, though it is able to mount, it cannot write in. Moreover, since it is under data copy even if it is able to mount and read, the data may be changed (except for PSUE). Therefore, do not mount in this state.

Note 2: The state of the pool-over concerning TCE differs depending on the condition. Examples of failures and states are shown in Table 2-8.

Note 3: There may be a case where the status of the S-VOL becomes PSUS which does not allow Read/Write operation because of a failure that occurs in the S-VOL of the pair in the PAIR or SSWS status. In this status, it is impossible to perform the SVOL_Takeover operation by means of the horctakeover command. The P-VOL status is changed to PSUE and the pair resynchronization is required for the restoration.

Table 2-8: State of the Pool-Over Concerning TCE

Occasion that causes the PFUS/ PSUE status	Status	
	P-VOL	S-VOL
Pool-over of the primary array	PFUS	Keeps as before the occurrence of the pool-over.
Pool-over of the secondary array	PSUE	PFUS
Pool failure for the secondary array error	PSUE	PSUS R/W enabled. (See ***Note 3***)
Hardware error	PSUE	PSUE

Restore the pair status through the pair resynchronization operation after it is changed to the status described above.

Table 2-9: Pair Status versus TrueCopy Commands

	TrueCopy Command					
	Paircreate		Pairsplit			Pairresync
Pair Status	Copy	Nocopy	Suspend -r, -rw	Suspend -P	Simplex	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 1)
⑤ PSUE	Rejected	Rejected	Rejected	Rejected	Accepted ①	Accepted ② (see note 1)

NOTE: For the **SSWS** state after **SVOL-SSUS-takeover**, the pairresync command (from P-VOL to S-VOL) is rejected because the delta data for S-VOL becomes dominant, and its state expects to use **-swaps(p)** option of pairresync. If the pairresync command (from P-VOL to S-VOL) is rejected, verify this special state using the **-fc** option of the pairdisplay command.

Table 2-10: Pair Status versus TCE Commands

Pair Status	TCE Command: Paircreate		Pairsplit			Pairresync	Pairsplit (See note 3)
	Copy	Nocopy	Suspend -r, -rw	Simplex -R	Suspend -S	Resync	-mscas
① SMPL	Accepted ②	Accepted ③	Rejected	Acceptable	Acceptable	Rejected	Rejected
② COPY ↓	Acceptable	Acceptable	Accepted ④	Accepted ①	Accepted ①	Acceptable	
③ PAIR	Acceptable	Acceptable	Accepted ④	Accepted ①	Accepted ①	Acceptable	Accepted
④ PSUS	Rejected	Rejected	Acceptable	Accepted ①	Accepted ①	Accepted ②	Rejected
PSUS(N)	Rejected	Rejected	Acceptable	Accepted ①	Accepted ①	Accepted ②	Rejected
SSWS	Rejected	Rejected	Acceptable	Accepted ①	Accepted ①	(See note 1)	Rejected
⑤ PSUE	Rejected	Rejected	Rejected	Accepted ①	Accepted ①	Accepted ②	Rejected

Note 1: For the **SSWS** state after **SVOL-SSUS-takeover**, the pairresync command (from P-VOL to S-VOL) is rejected because the delta data for S-VOL becomes dominant. Perform the pair splitting and the pair creation in this status. If the pairresync command (from P-VOL to S-VOL) is rejected, verify this special state using the **-fc** option of the pairdisplay command.

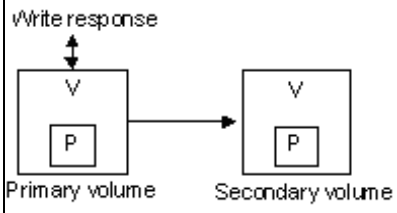
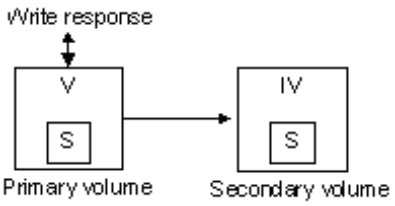
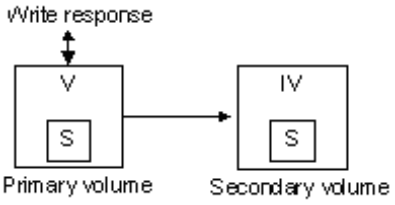
Note 2: When the fence level is async, the Suspend or Simplex operation is made to wait in the state in which the command is being executed the command until the synchronization of the S-VOL data is completed. The pairsplit -R command (Simplex operation) is responded immediately because no synchronization process is needed.

Note 3: Because the pairsplit -mscas is a command to split a SnapShot pair cascaded with a TCE S-VOL, the status of the TCE pair is not changed when the command is accepted. It is a command to be executed when the SnapShot pair is in the PSUS or PAIR status apart from the status of the TCE pair

TrueCopy/TCE fence-level settings

TrueCopy volume pairs are assigned a fence level for write I/Os to ensure the mirroring consistency of critical volumes. TrueCopy allows two kinds of fence levels, that is, **data** and **never** to be specified, whereas TCE allows the **async** only. 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 2-11 shows the relationship between TrueCopy pair status and fence level.

Table 2-11: Relationship between TrueCopy Pair Status and Fence Level

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

Note 1: When fence level is data, the P-VOL returns a write error whenever data consistency is lost, so mirroring consistency is assured. The S-VOL can continue operation, regardless of its status.

Note 2: When fence level is never, writing is enabled whenever data consistency is lost, whether or not the S-VOL status is updated. Thus, the currency of the S-VOL can be evaluated as follows:
S: The secondary volume is dubious.
P: 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

Setting fence level for TrueCopy

Figure 2-9 shows the relationship between redo log files (journal) and data files. If the S-VOL takes over from the P-VOL in the status shown in Figure 2-9 (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 is 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 when 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, Oracle creates multiple redo log files by itself (three by default). The fence level can be set to **data** when disk errors are permissible by creating multiple files.

Since most UNIX®-based 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) is detected (when one error occurs).

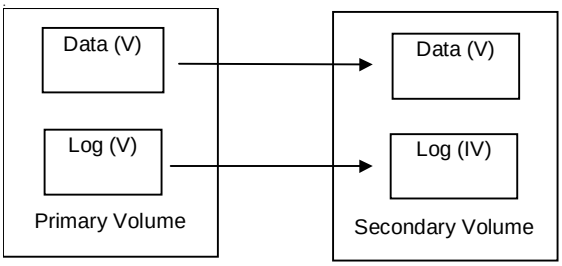


Figure 2-9: Relation Between Logs and Data in Paired Status

Applications of CCI commands

This section provides examples of tasks that can be performed using CCI commands.

TCE provides the command (pairsplit –mscas) that executes the remote backup leaving the pair status as PAIR by cascading the SnapShot pair with the S-VOL.

Backing up secondary volume in paired status

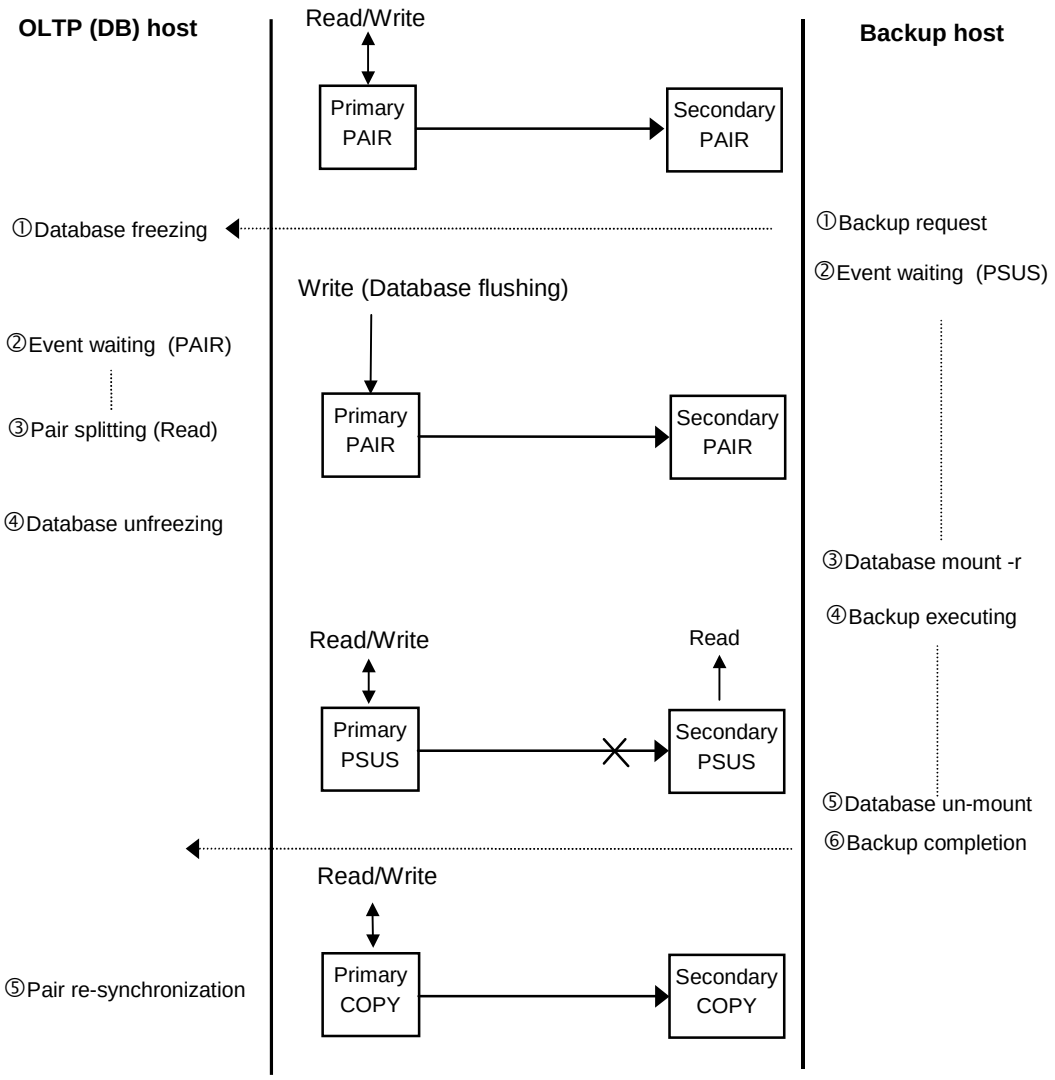


Figure 2-10: Backing Up S-VOL in Paired Status using ShadowImage

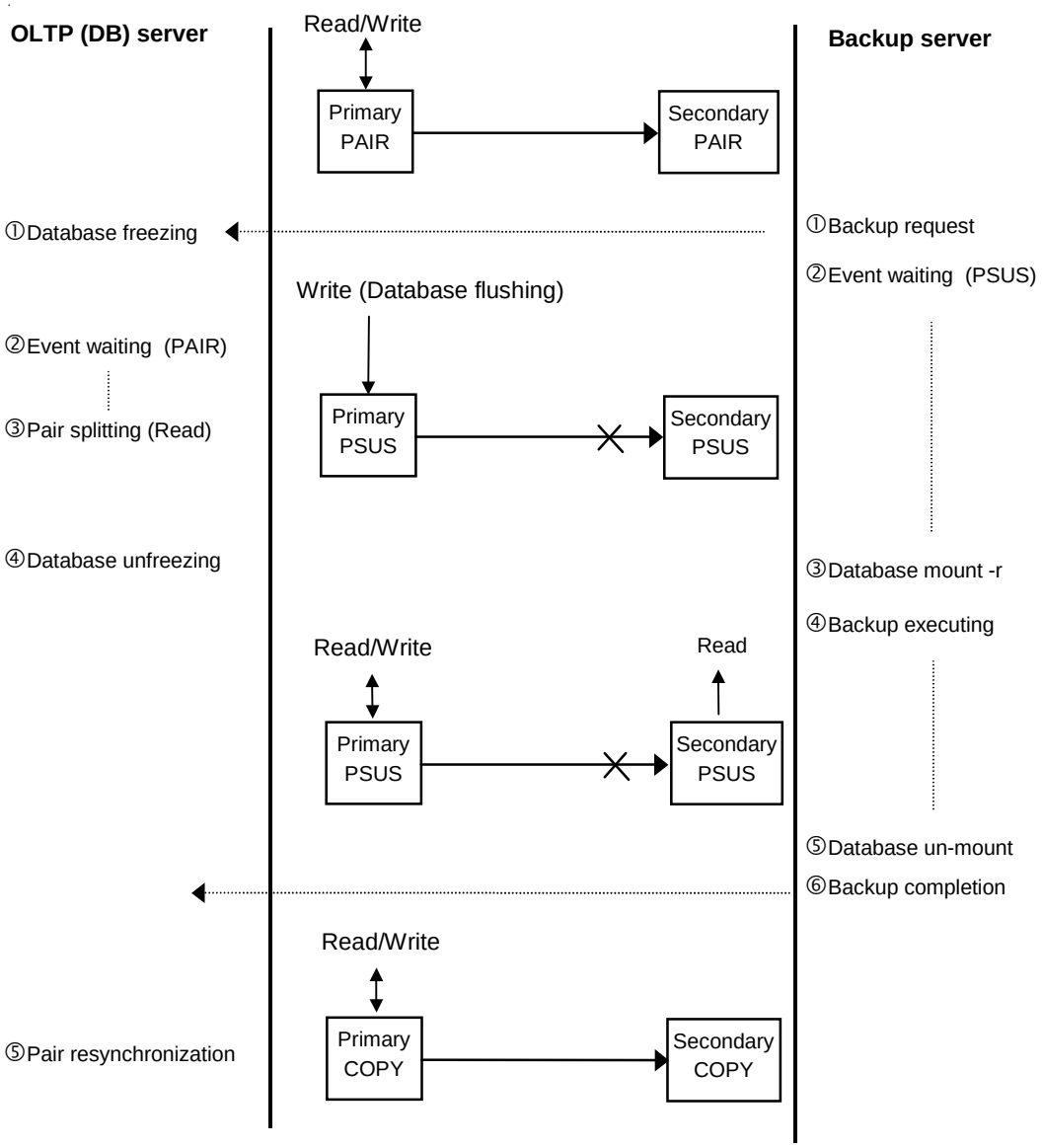


Figure 2-11: Backing Up S-VOL in Paired Status using TrueCopy/TCE

Restoring secondary volume to primary volume in split status

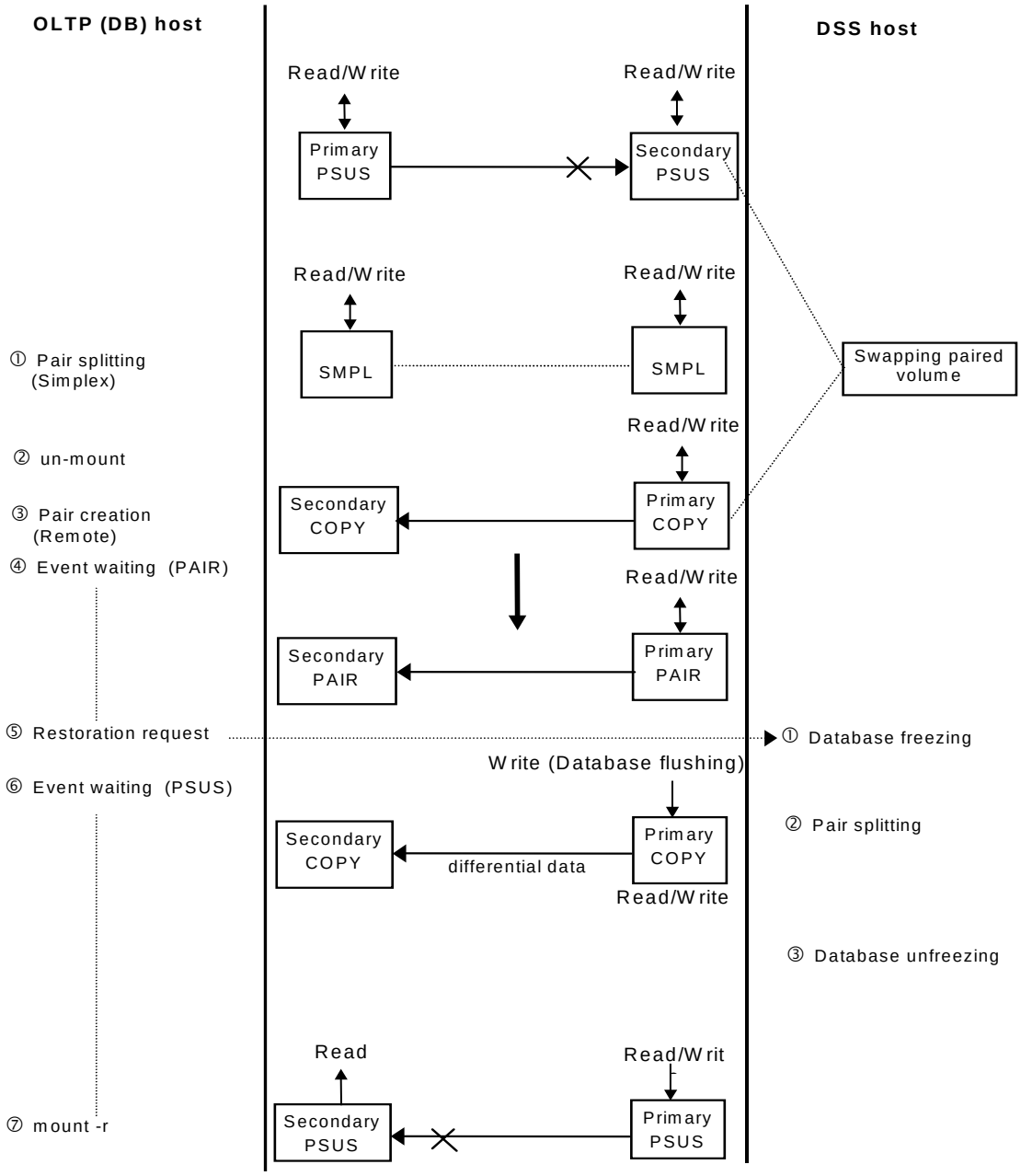


Figure 2-12: Restoring S-VOL to P-VOL in Split Status using ShadowImage

NOTE: The secondary status is “SSUS”.

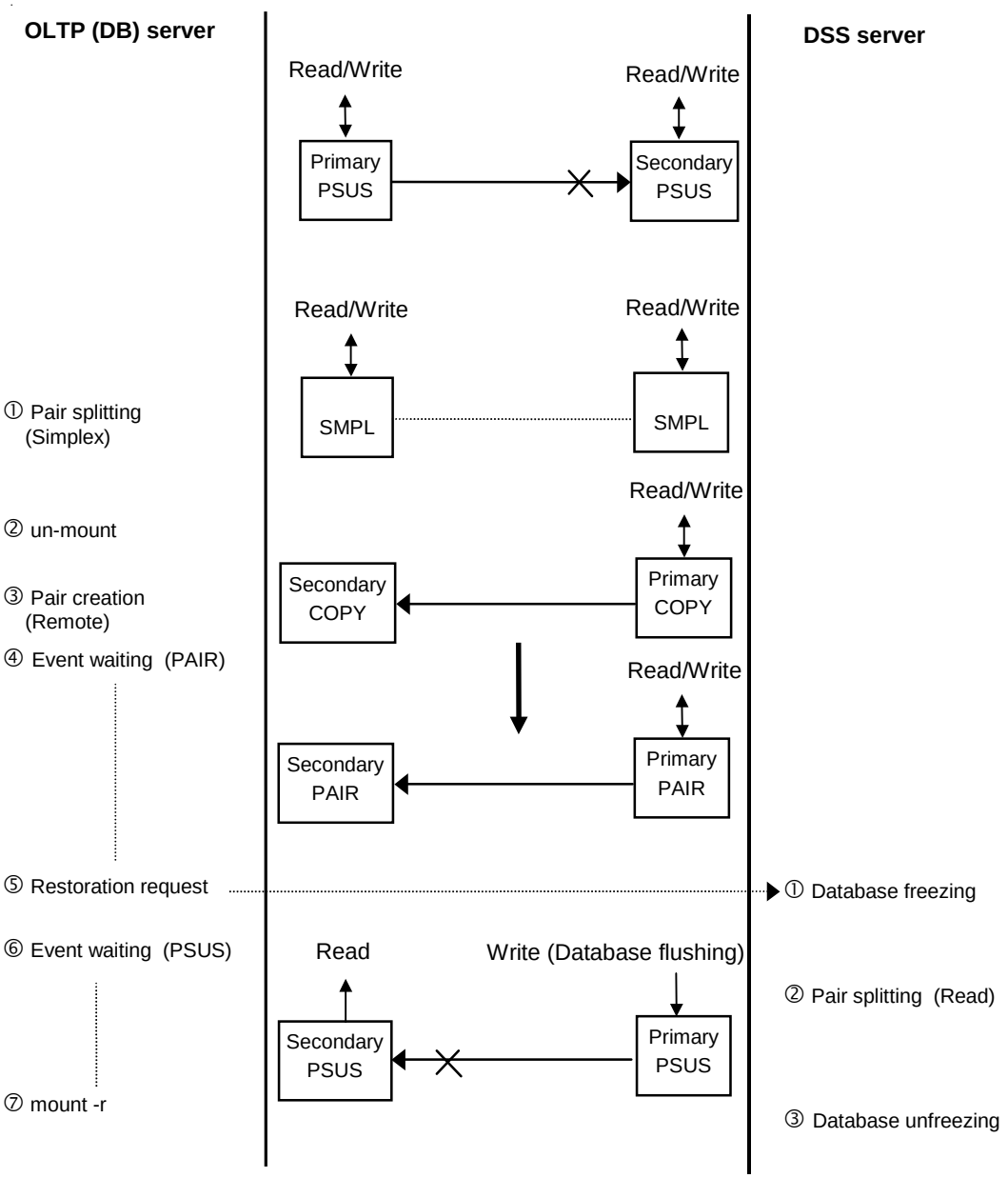


Figure 2-13: Restoring S-VOL to P-VOL in Split Status using TrueCopy/ TCE

Backing up secondary volume (V-VOL)

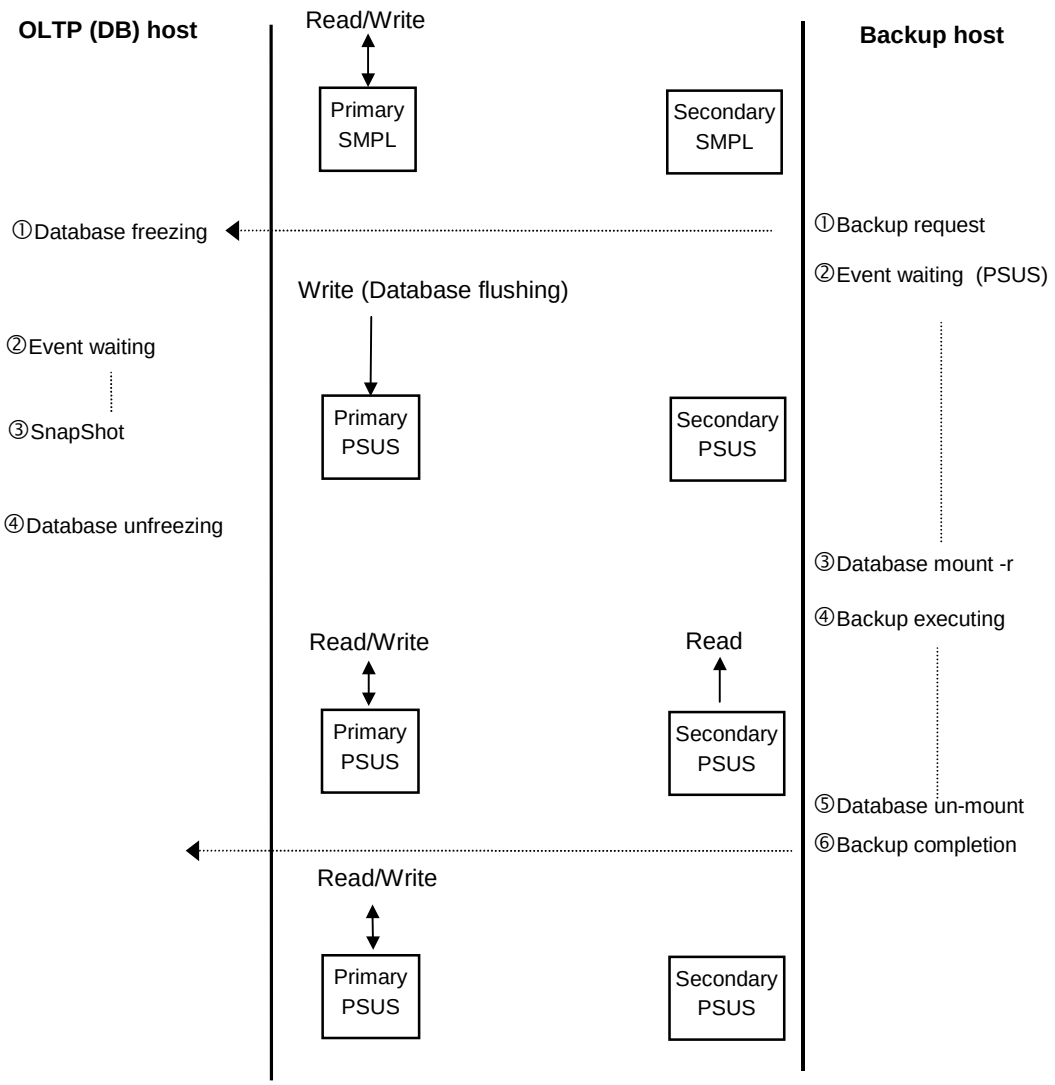


Figure 2-14: Backing Up Secondary Volume (V-VOL)

NOTE: The secondary status is “SSUS”.

Swapping paired volume for duplex operation

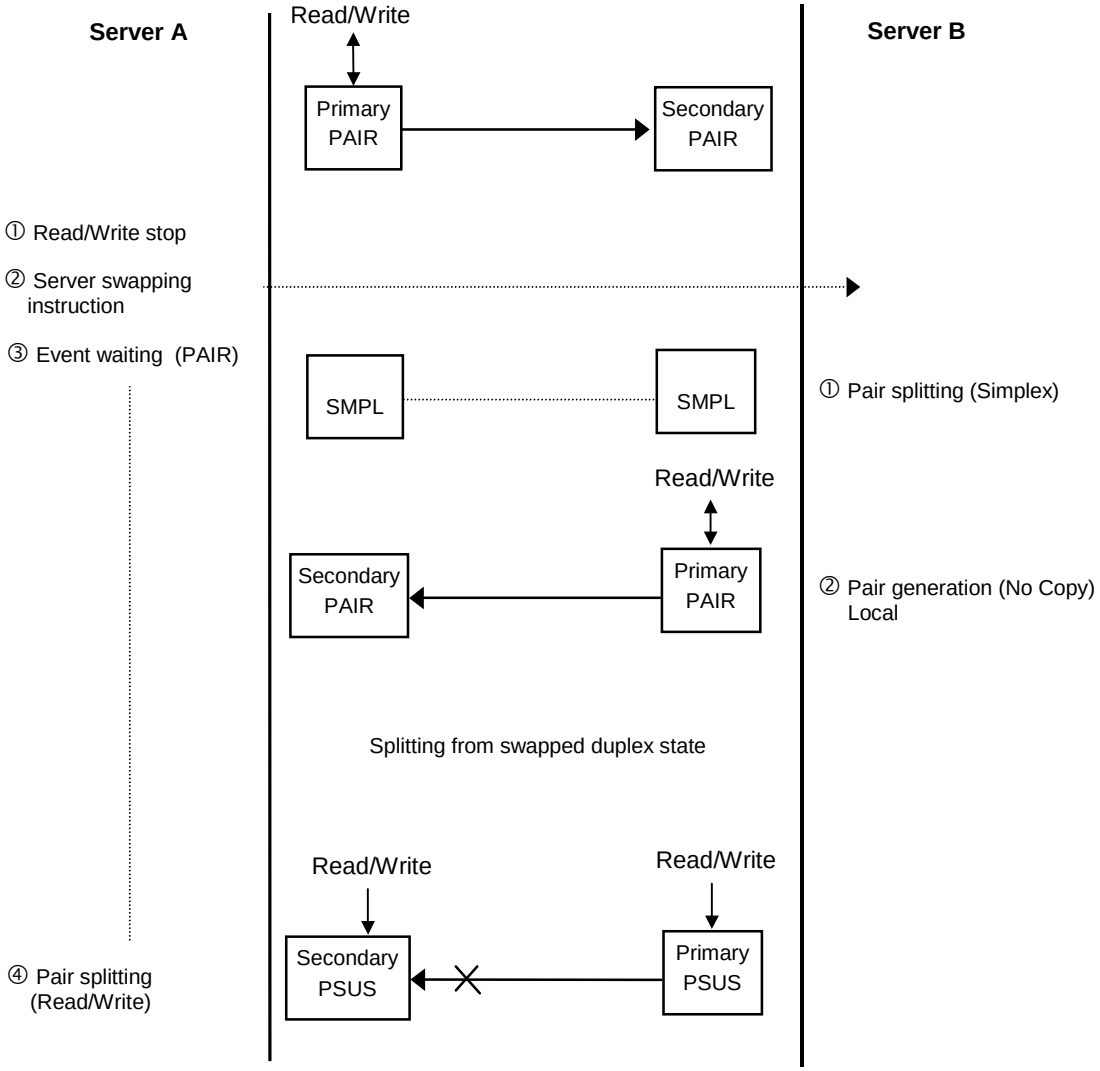


Figure 2-15: Swapping Paired Volume for Duplex Operation Using TrueCopy/TCE

Restoring S-VOL for duplex operation

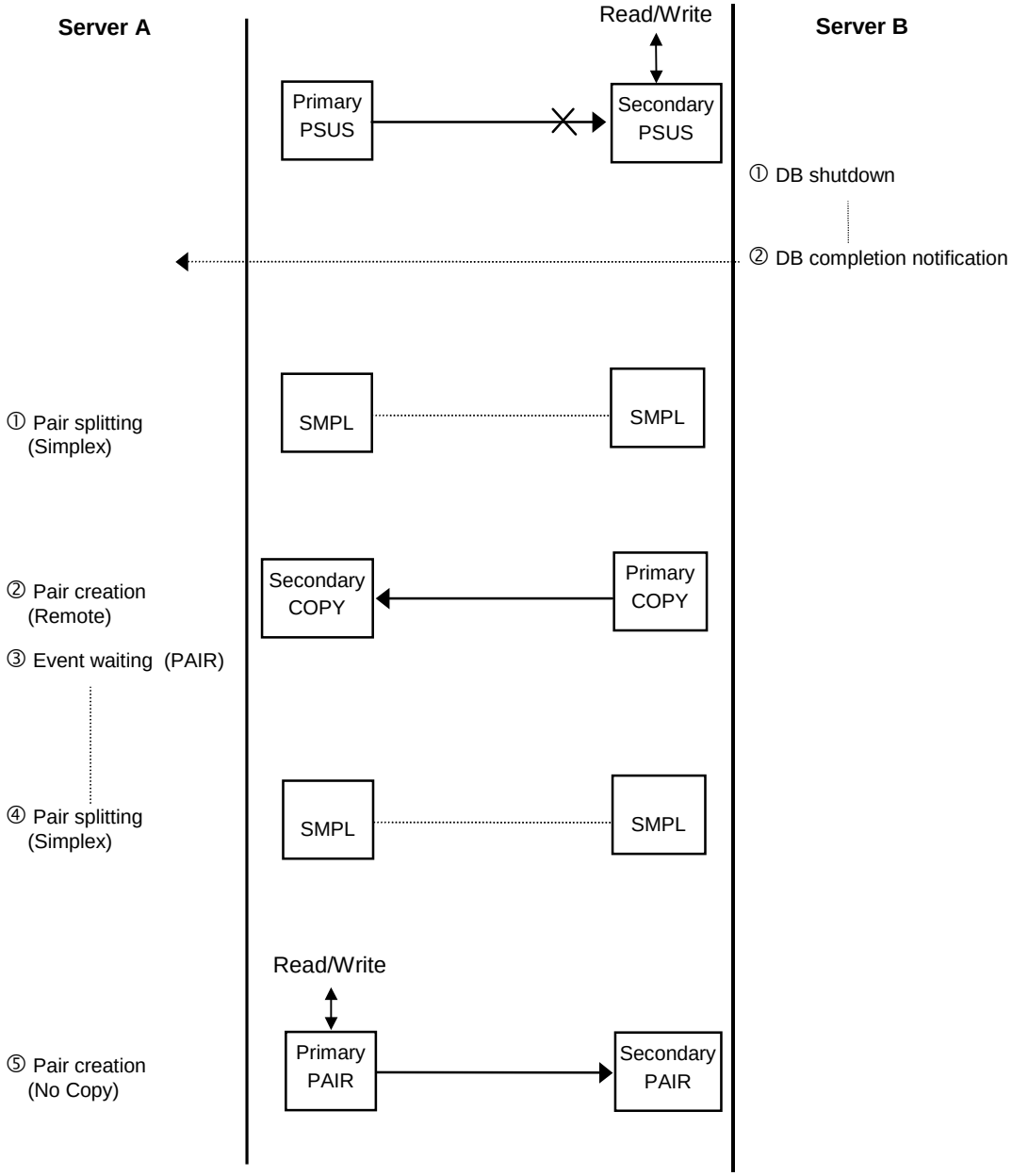


Figure 2-16: Restoring S-VOL for Duplex Operation Using TrueCopy/ TCE

CCI software structure

Figure 2-17 illustrates the CCI software structure: the CCI components on the AMS array, and the CCI instance on the UNIX®/PC host. The CCI components on the AMS array include the command device(s) and the ShadowImage/SnapShot/TrueCopy/TCE volumes. Each CCI instance on a UNIX®/PC host includes:

- Log and trace files
- A command host
- Error monitoring and event reporting files
- A configuration management feature

HORCM operational environment

The HORCM operates as a daemon process on the host and is activated automatically when the host 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 which it is referred.

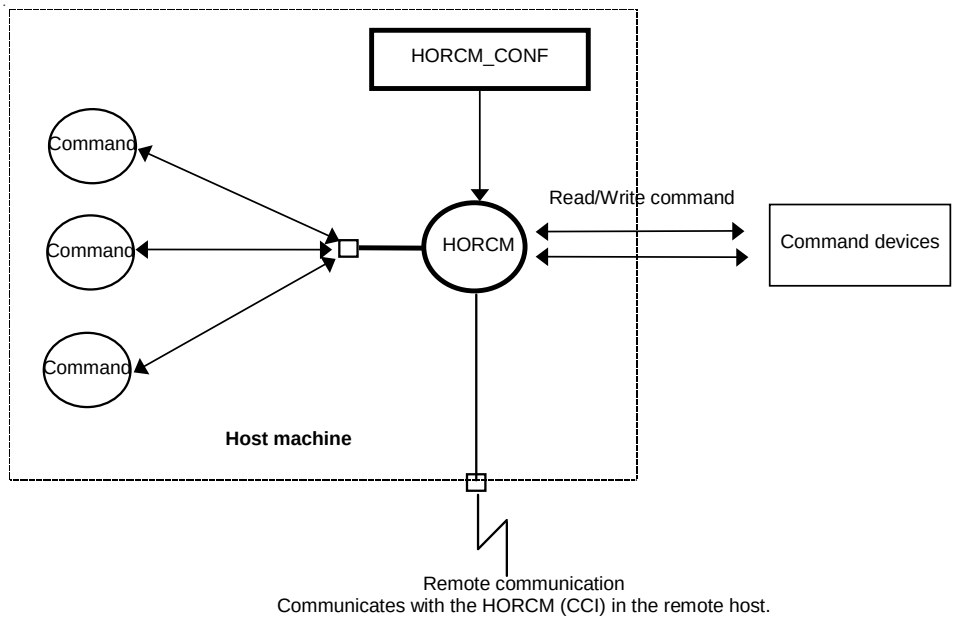


Figure 2-17: HORCM Operational Environment

CCI instance configurations

The basic unit of the CCI software structure is the CCI instance. Each copy of CCI on a host 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 host (one node). If two or more nodes are run on a single host (e.g., for test operations), it is possible to activate two or more instances using instance numbers.

NOTE: The default command execution environment for CCI is TrueCopy/TCE (without specification of HORCC_MRCF). Therefore, in order to use CCI command for ShadowImage/SnapShot, the user must specify the environment variable HORCC_MRCF in the configuration definition file (HORCM_CONF). Also, when returning the execution environment of ShadowImage/SnapShot to that of TrueCopy/TCE, the setting must be changed (without specification of HORCC_MRCF).

The CCI instance shown in Figure 2-18 has a remote execution link and a connection to the AMS array. 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 AMS array illustrates the connection between the CCI software on the host and the command device. The command device accepts ShadowImage, SnapShot, TrueCopy, and TCE CCI commands and communicates read and write I/Os between the host and the volumes on the AMS array. The host does not communicate ShadowImage, SnapShot, TrueCopy, or TCE commands directly to the volumes on the AMS array. The CCI commands are always sent through the AMS array command device.

NOTE: The AMS array command device must be defined using the Storage Navigator Modular 2. For details on setting the command device, refer to the *Hitachi AMS ShadowImage in-system replication User's Guide*, the *Hitachi AMS Copy-on-write SnapShot User's Guide*, the *Hitachi AMS TrueCopy remote replication User's Guide*, and/or the *TrueCopy Extended Distance User's Guide*.

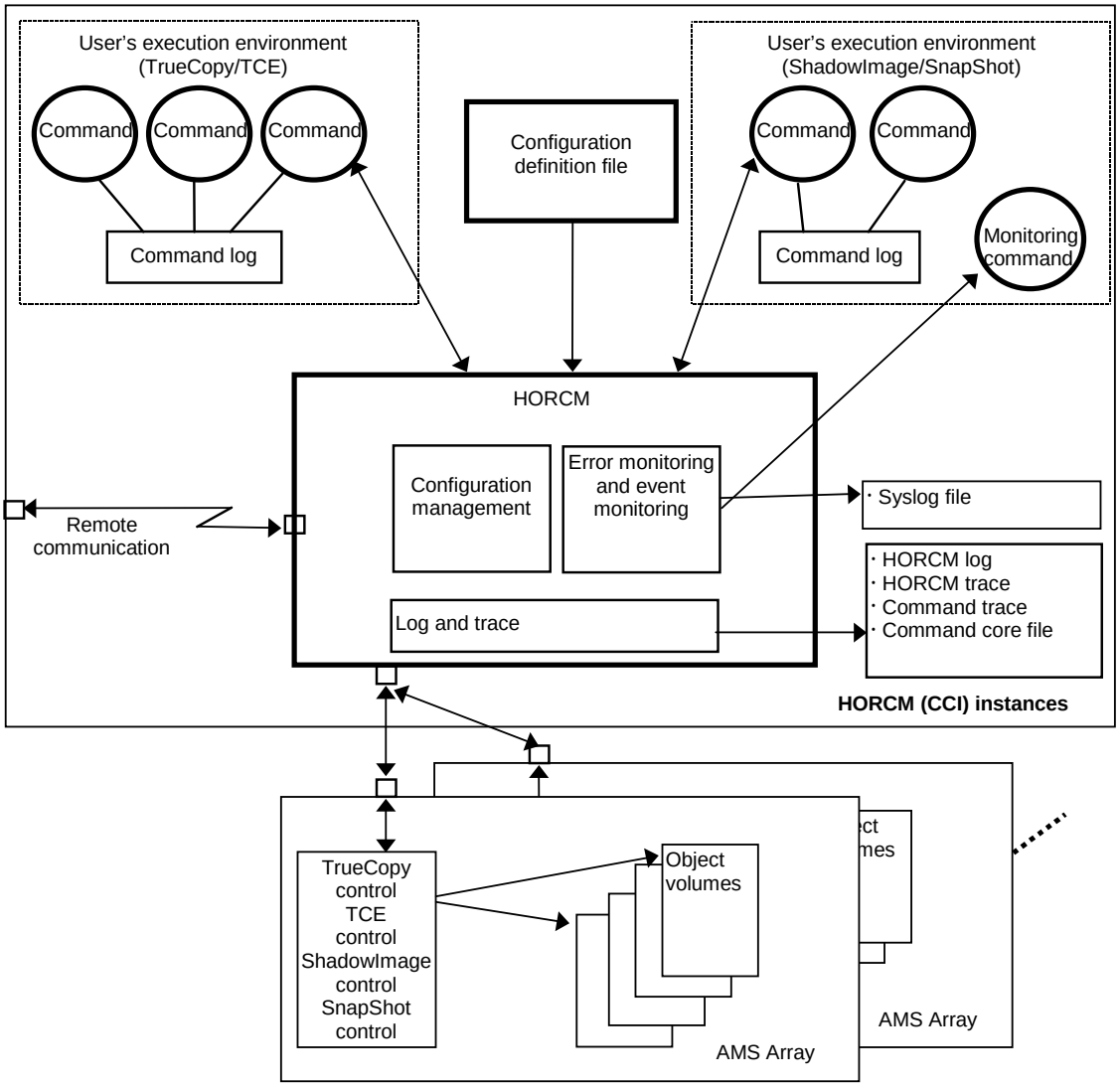


Figure 2-18: CCI Software Structure

Configuration definition file

The CCI configuration definition file (HORCM_CONF) 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 hosts 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 hosts and the paired logical volumes and the names of the remote hosts connected to the volumes. See Example of configuration definition file, on page 2-51 for sample CCI configurations and their configuration definition file(s).

Figure 2-19 shows the configuration definition of paired volumes. Figure 2-20 shows a sample configuration file for a UNIX®-based operating system. Figure 2-21 shows a sample configuration file for the Windows® 2000/ Windows Server™ 2003/Windows Server™ 2008 operating systems.

The CCI provides a sample configuration definition file (HORCM_CONF), so that the system administrator can copy this file to set necessary parameters and locate it in the specified directory.

The configuration definition file can be created automatically using the mkconf command tool (the user must customize the contents depending on the management). The value for the poll(10ms) must be specified manually.

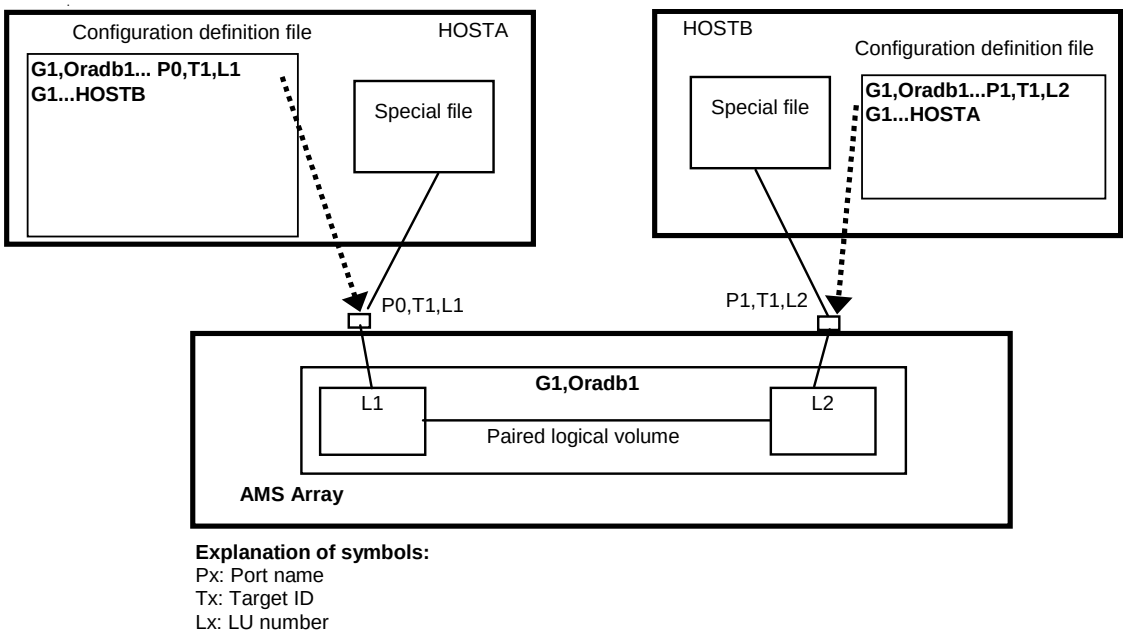


Figure 2-19: Configuration Definition of Paired Volumes

Each of the following figures displays an example of HORCM_CONF:

```
HORCM_MON
#ip_address   service        poll(10ms)  timeout(10ms)
HSTA          horcm          12000       3000

HORCM_CMD
#unitID 0... (seq#85000018)
#dev_name     dev_name       dev_name
/dev/rdsk/c0t2d0

#unitID 1... (seq#85000019)
#dev_name     dev_name       dev_name
/dev/rdsk/c1t0d1

HORCM_DEV
#dev_group    dev_name       port#       TargetID   LU#      MU#
oradb         oradb1         CL1-A       1          1
oralog        oradb3         CL1-A1      2          3
oralog        oradb4         CL1-A1      2          4

HORCM_INST
#dev_group    ip_address     service
oradb         HSTB           horcm
oradb         HSTC           horcm
```

The port number and the unitID are merged into port#. (When the specified value of the combination of the local and remote port number and target ID are duplicated). Refer to **HORCM_DEV**.

Figure 2-20: Configuration File Example using TrueCopy/TCE – UNIX®-Based Hosts

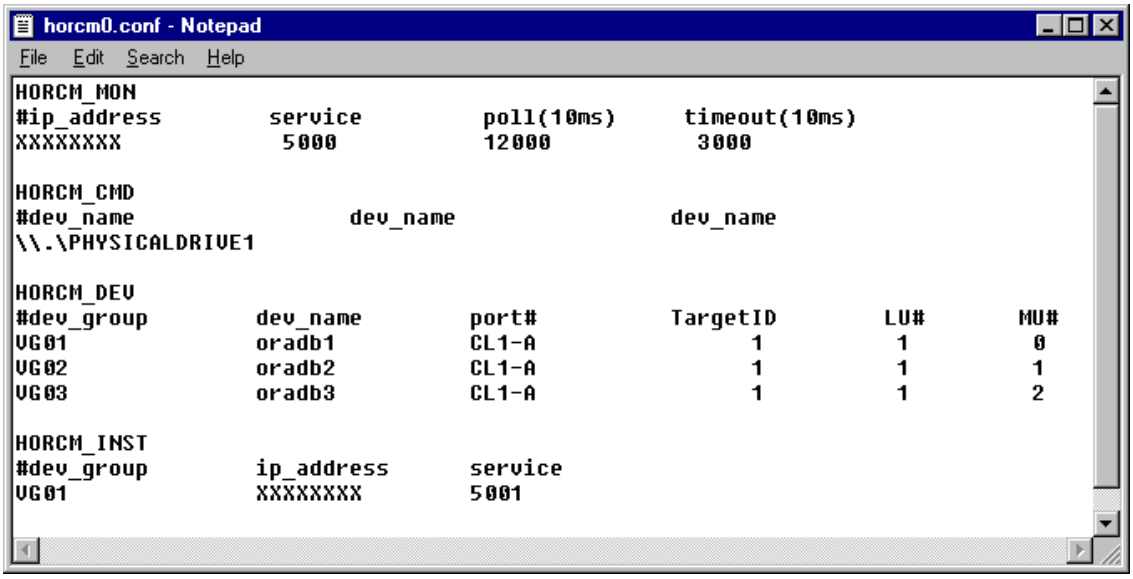


Figure 2-21: Configuration File Example using ShadowImage – Windows 2000® / Windows Server™ 2003 / Windows Server™ 2008 Hosts

To create and edit the configuration definition file manually

1. Shut down the HORCM using `horcmshutdown`.
2. Open the configuration definition file (HORCM_CONF) using the text editor. Set the parameters for **HORCM_MON** and **HORCM_CMD**. Save the file.
3. Start the HORCM (horcmstart).
4. Execute the `raidscan` command and write down the target IDs displayed in the execution result.
5. Shut down the HORCM using `horcmshutdown`.
6. Open the configuration definition file (HORCM_CONF). Using the text editor, set the target ID based on the memo you took in step 4 above for the **HORCM_DEV** parameter.
7. Set the **HORCM_INST** parameter, and then save the configuration definition file.

The following items are in the configuration definition file:

- **Ip_address**: The IP address (IPv4 or IPv6) of the local host. When HORCM has two or more network addresses on different subnets for communication, this item must be NONE (for both IPv4 or IPv6).
- **Service**: The port name assigned to the CCI service (registered in the /etc/services file). The service parameter defines the CCI instance that runs on the local host. If a port number is specified instead of a port name, the port number will be used.
- **Poll(10ms)**: The interval for monitoring paired volumes. To reduce the HORCM daemon load, make this interval longer. You must always set a value more than or equal to 6000 for ShadowImage/SnapShot/TrueCopy/TCE operations. To calculate the poll(10ms) value, see the following equation and the example. Setting the value incorrectly may

cause an internal conflict between the CCI and the AMS array; the internal processing of the AMS array suspends temporarily. Processing may not proceed. If the interval is 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.

```
Calculating the value for poll(10ms):
6000 ? the number of all CCI instances that controls the AMS
array, which its host is connected to the AMS array.
```

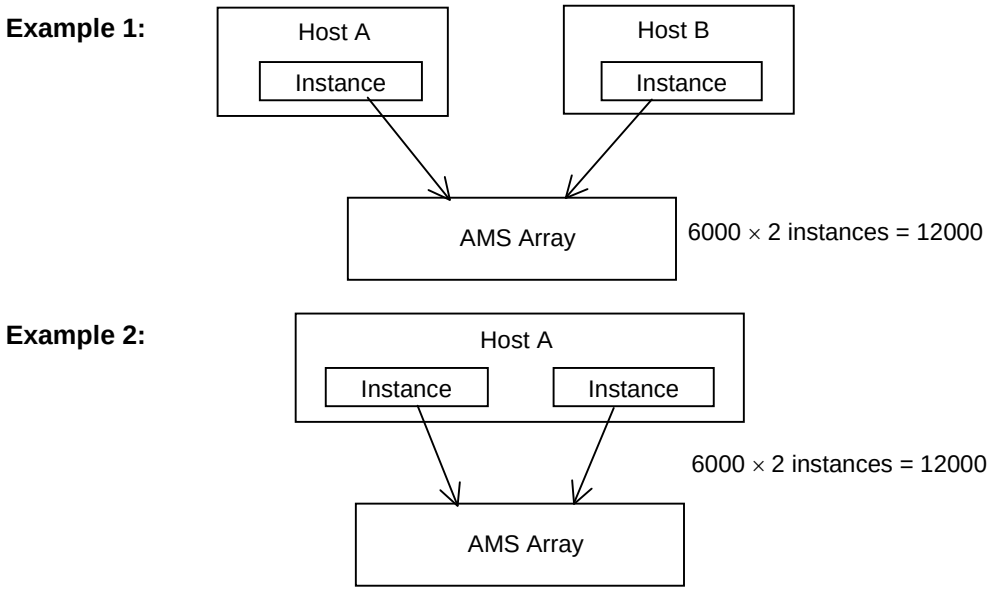


Figure 2-22: Setting Poll(10ms) Value

- **Timeout(10ms):** The time-out period of communication with the remote host.

When a host is connected to two or more AMS arrays, the HORCM identifies each AMS using the unit ID (see Figure 2-23). The unit ID is assigned sequentially in the order described in this section of the configuration definition file. If more than one command device (up to 128 command devices) is specified in an AMS array, the second or more command device has to be described side by side with the already described command device in a line. The host must be able to verify that the unit ID is the same Serial# among hosts when the AMS array is shared by two or more hosts. Verify this using the `raidqry` command.

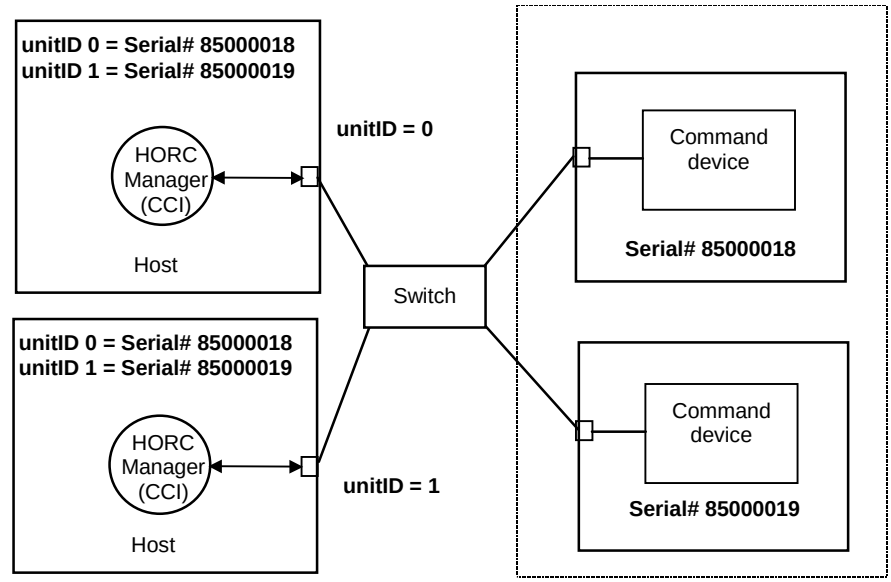


Figure 2-23: Configuration and Unit IDs for Multiple AMS Arrays

The command device on the AMS array specifies a physical drive. However, it can be done following the AMS array serial number, LU number, and port number using a method which does not depend on the change of the physical drive of Windows® 2000/Windows Server™ 2003/Windows Server™ 2008.

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

In the following example, the command device is described as the AMS array (serial#85000018), the LU number (#250), the port number (CL1-A), and the target group number (#1).

```
HORCM_CMD
#dev_name                    dev_namedev_name
\\.\CMD-85000018-250-CL1-A
```

Abbreviated specification: Specify it as shown below when it only has to be a command device of the AMS array (serial#85000018).

```
\\.\CMD-85000018
```

When a command device is used with a multi-path: Specify the AMS array (serial#85000018) and the LU number (#250) as the command device.

```
\\.\CMD-85000018-250
```

Specification of all the parts and the host groups: Specify the AMS array (serial#85000018), the LU number (#250), the port number (CL1-A), and the target group number (#1) as the command device.

```
\\.\CMD-85000018-250-CL1-A-1
```

Other specification: The AMS array (serial#85000018), the LU number (#250), and the port number (CL1-A) can be specified as the command device as shown below.

```
\\.\CMD-85000018-250-CL1-A
\\.\CMD-85000018-250-CL1
```

The values shown in Table 2-12 are defined in the HORCM_DEV parameter:

Table 2-12: Port Number of Volume Corresponding to dev_name Volume

Displayed by CCI	Port Name used in AMS Array
CL1-A	Controller# 0, Port# A
CL1-B	Controller# 0. Port# B
CL1-C	Controller# 0. Port# C
CL1-D	Controller# 0. Port# D
CL1-E	Controller# 0, Port# E
CL1-F	Controller# 0, Port# F
CL1-G	Controller# 0, Port# G
CL1-H	Controller# 0, Port# H
CL2-A	Controller# 1. Port# A
CL2-B	Controller# 1. Port# B
CL2-C	Controller# 1. Port# C
CL2-D	Controller# 1. Port# D
CL2-E	Controller# 1, Port# E
CL2-F	Controller# 1, Port# F
CL2-G	Controller# 1, Port# G
CL2-H	Controller# 1, Port# H

Note 1: The raidscan command cannot be executed while editing the configuration definition file. Therefore, in order to execute the raidscan command, edit the configuration definition file to the item HORCM_CMD, save the file, and then execute the raidscan command to obtain (write down) the target ID.

Note 2: The conversion table for Windows® 2000/Windows Server™ 2003/ Windows Server™ 2008 is based on the Emulex® driver. If a different interface adapter is used, the target ID indicated by the raidscan command may be different than the target ID indicated by the Windows® 2000/Windows Server™ 2003/Windows Server™ 2008 system. In such case, for the configuration definition file, use the target ID that is displayed (obtained) by the raidscan -find command. For conversion table details see Chapter 3, Fibre-to-SCSI address conversion.

```
HORCM_LDEV
#dev_group        dev_name         Serial#    LDEV#    MU#
VG01              oradb1           85000123   18       0
VG01              oradb2           85000123   19       0
```

When a logical unit number (LUN) is 18:

- 18 (decimal)
- 0x12 (hexadecimal)

The following values are defined in the HORCM_INST parameter:

- **dev_group:** The host name described in dev_group of HORCM_DEV.
- **ip_address:** The network address of the specified remote host.
- **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 for IPv4 or IPv6.

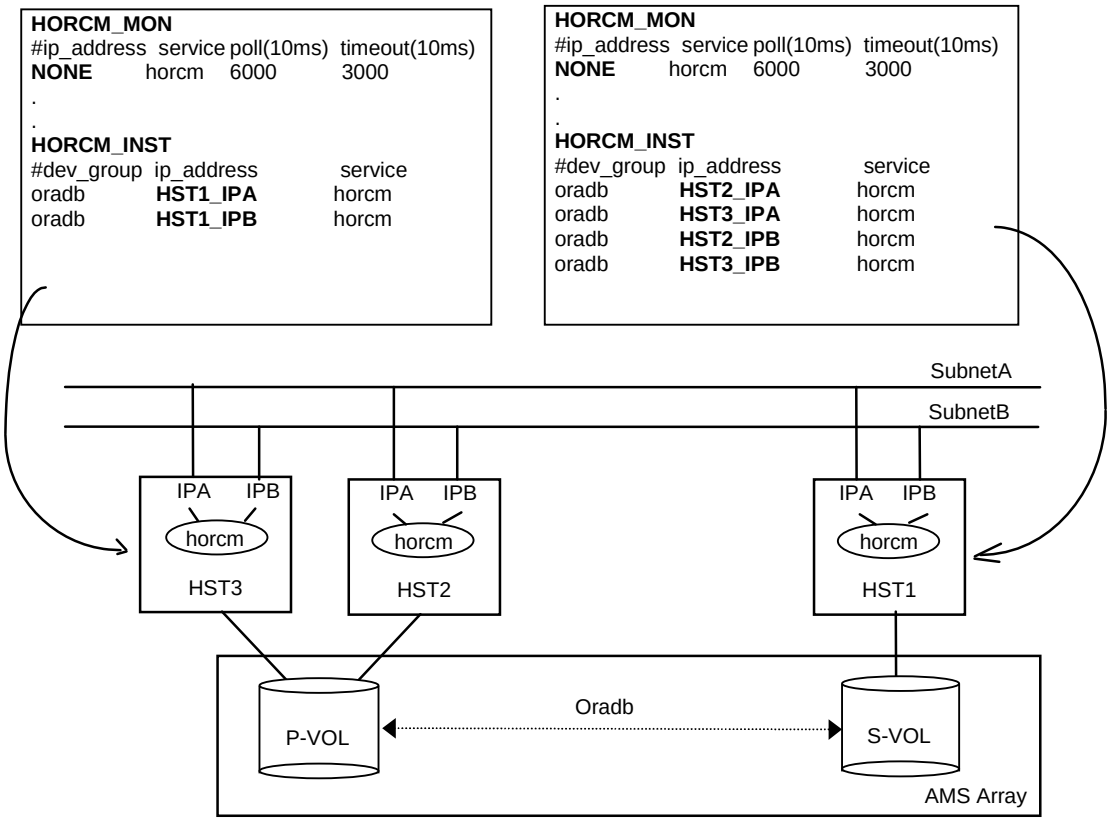


Figure 2-24: Configuration for Multiple Networks

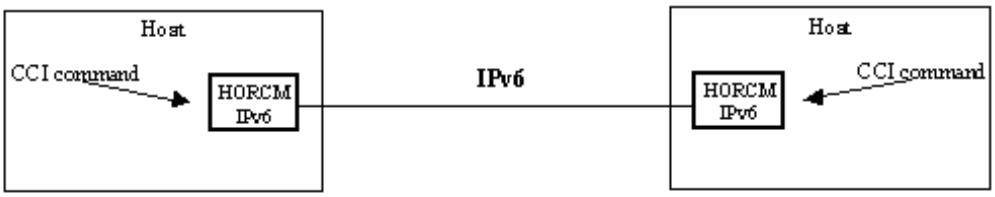
This configuration for multiple networks can be found using `raidqry –r <group>` command on each host. The current network address of HORCM can be changed using `horcctl –NC <group>` on each host.

Examples:

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

```
# horcctl –ND –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       12000    3000
#fe80::209:6bff:febe:3c17   horcm0   1000
3000

#/********** For HORCM_CMD ***************/
HORCM_CMD
#dev_name
#UnitID 0 (Serial# 85000018)
/dev/rdsk/c1t0d0s2

#/********** For HORCM_LDEV ***************/
HORCM_LDEV
#dev_group    dev_name     Serial#    LDEV#  MU#
IPV6G         devl        85000018   577

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

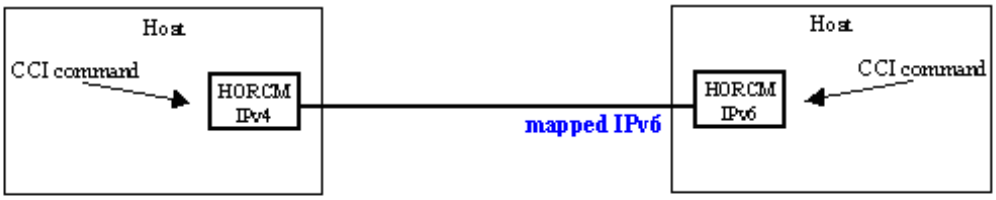
```
HORCM_MON
#ip_address service poll(10ms) timeout(10ms)
NONE6         horcm0        1000     3000
#fe80::202:a5ff:fe55:c1d2  horcm0    1000
3000

#/********** For HORCM_CMD ***************/
HORCM_CMD
#dev_name
#UnitID 0 (Serial# 85000018)
/dev/rdsk/c1t0d0s2

#/********** For HORCM_LDEV ***************/
HORCM_LDEV
#dev_group    dev_name     Serial#    LDEV#  MU#
IPV6G         devl        85000018   577

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

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




```
HORCM_MON
#ip_address service poll(10ms) timeout(10ms)
NONE         horcm4       12000     3000
#158.214.127.64    horcm4        1000     3000

#/********** For HORCM_CMD ***************/
HORCM_CMD
#dev_name
#UnitID 0 (Serial# 85000018)
/dev/rdsk/c1t0d0s2

#/********** For HORCM_LDEV ***************/
HORCM_LDEV
#dev_group    dev_name     Serial#    LDEV#   MU#
IPM4G          dev1       85000018    577

#/********** For HORCM_INST ***************/
HORCM_INST
#dev_group    ip_address                service
IPH4G         158.214.135.105           horcm6
```

```
HORCM_MON
#ip_address service poll(10ms) timeout(10ms)
NONE6        horcm6       12000     3000
#::ffff:158.214.135.105    horcm6        1000
3000

#/********** For HORCM_CMD ***************/
HORCM_CMD
#dev_name
#UnitID 0 (Serial# 85000018)
/dev/rdsk/c1t0d0s2

#/********** For HORCM_LDEV ***************/
HORCM_LDEV
#dev_group    dev_name     Serial#    LDEV#   MU#
IPM4G          dev1       85000018    577

#/********** For HORCM_INST ***************/
HORCM_INST
#dev_group    ip_address                service
IPH4G         ::ffff:158.214.127.64     horcm4
IPH4G         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.

Command device

The ShadowImage/SnapShot/TrueCopy/TCE commands are issued by the HORC Manager (HORCM) to the AMS array command device. The command device is a user-selected, dedicated logical volume on the AMS array 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 ShadowImage, SnapShot, TrueCopy, and TCE read and write commands that are executed by CCI.

The volume designated as the command device is used only by the AMS array and is blocked from the user. Set more than or equal to 65,538 blocks (1 block = 512 bytes) (33 MB) for the command device LU.

WARNING! Do not mount a volume that will be specified as a command device. Do not write any user data on the volume that is to be selected as the command device.

The CCI software on the host issues reads and writes commands to the AMS array command device. When CCI receives an error notification in reply to a read or write request to the AMS array, the CCI software will activate an alternate command device, if one is defined. If a command device is blocked, you can activate an alternate command device manually. If no alternate command device is defined or available, all ShadowImage, SnapShot, TrueCopy, and TCE commands will terminate abnormally, and the host will not be able to issue commands to the AMS array. The user must set two or more command devices and use the alternate command device facility if a path error occurs or if the command device is blocked (the maximum is 128 command devices).

When you use TrueCopy or TCE, the command devices must be set up on both the local and remote arrays.

Each command device must be set using the Storage Navigator Modular 2. 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 Configuration definition file, on page 2-29 and Example of configuration definition file, on page 2-51 for details.

Alternate command device function

The CCI software issues commands to the AMS array command device via the UNIX®/PC raw I/O interface. If the command device fails in any way, all ShadowImage, SnapShot, TrueCopy, and TCE 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 (see Figure 2-25).

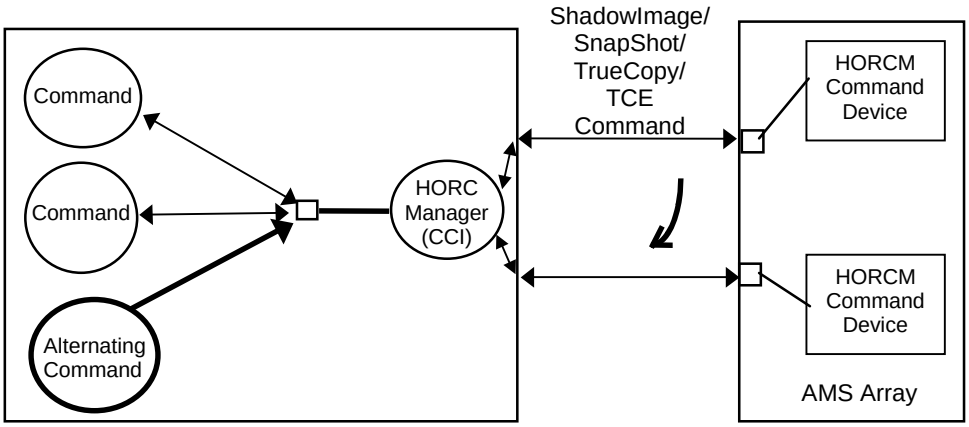


Figure 2-25: Alternate Command Device Function

For an example of setting two command devices, see Two command devices, on page 2-69.

Protection function

The CCI protection function protects a volume that cannot be recognized by the hosts from being operated (such as improper pair operation). This protecting function is turned on/off with Storage Navigator Modular 2. CCI discriminates the on/off attribute of this function when it recognizes the command device. When the current command device has the protection attribute turned on, CCI operates in Protection mode in accordance with the command device.

Figure 2-25 shows the definition of the protected volumes.

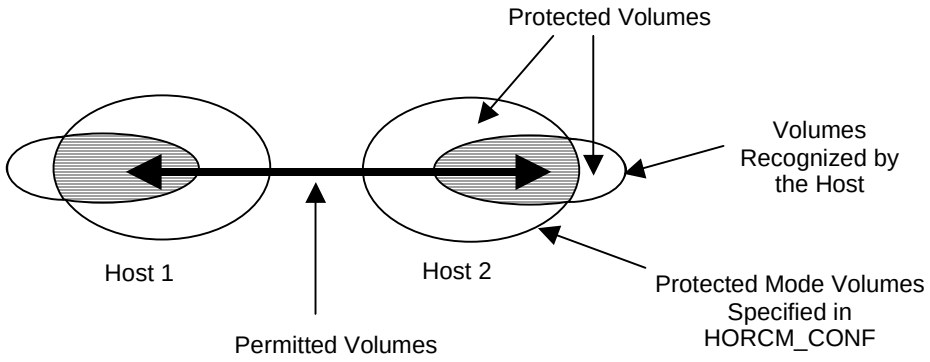


Figure 2-26: Definition of Protected Volumes

The environment variable $HORCMPROMOD forces the HORCM to be placed in Protection mode. Even a command device in the Non-Protection mode can be used in Protection mode. Relations between the settings for a command device and this variable are shown in Table 2-13.

Table 2-13: Protection Mode Variable and Command Device

Command Device	HORCMPROMOD	Mode	
Protection mode	Not related	Protection mode	
Non-Protection mode	Without the setting	Non-Protection mode	
	With the setting	Protection mode	

NOTE: When the host cannot recognize an LU due to an error caused while the protection function is ON, operation to the pair of the unrecognized LU cannot be performed. In this case, set the LU so that it can be recognized by the host, or disable the protection function (OFF) once, remove the error cause, and then set the LU again to be recognized by the host so that the pair operation can be performed.

```
# horcctl –D
Current control device = /dev/rdsl/c0t0d0*
```

Figure 2-27: Confirming Protection Mode Command Device (HP-UX®)

Volumes described in the configuration definition file (HORCM_CONF) are targets for the protection function and are managed by each mirror descriptor (MU#0). The protection mode enables CCI to check whether the volumes described in the configuration definition file match all volumes recognized from the host at the time when CCI is activated. Permitted volumes are then registered in HORCM. Permitted volumes are volumes that are recognized from the host AND the mirror descriptors that are registered in the configuration definition file.

Table 2-14: Permitted Volumes and Mirror Descriptor

Volumes on Horcm.conf	Mirror Descriptor on Horcm.conf							
	TrueCopy		ShadowImage					
			MU#0		MU#1		MU#2	
	E	none	E	none	E	none	E	none
Unknown								
/dev/rdsk/c0t0d0								
Unknown								

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.

NOTE: For the Fibre Switch environment, volumes that are recognized from the host must be set using the LUN Manager feature.

Example of one host: Group Ora1 and Ora2, in protection mode, cannot differentiate between volume Grp2 and Grp4, from Host 1. The pair operation is inhibited. If the protection mode is OFF, the pair operation is permitted.

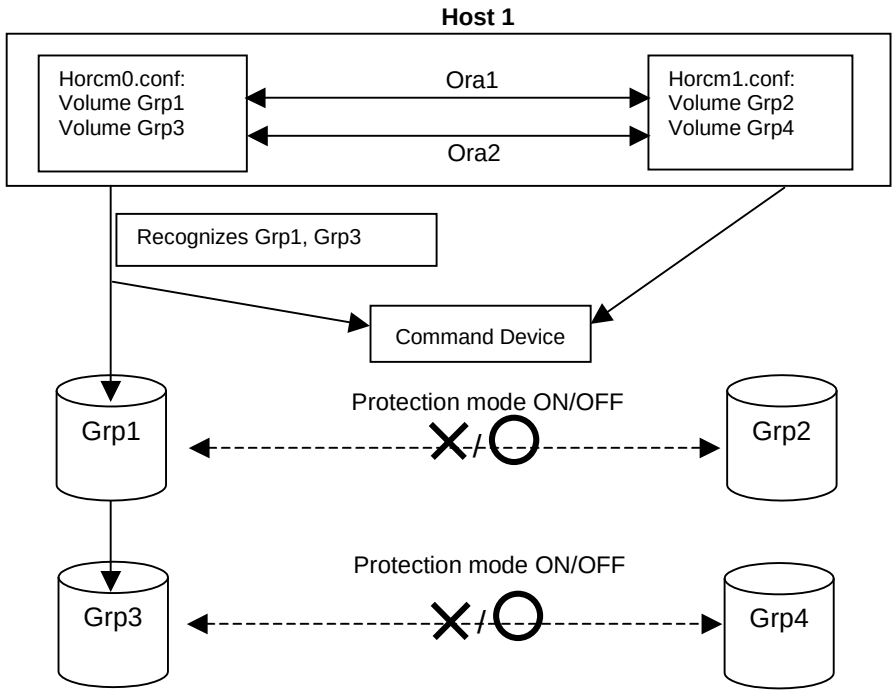


Figure 2-28: Protected Volume Configuration (one CCI host) (1)

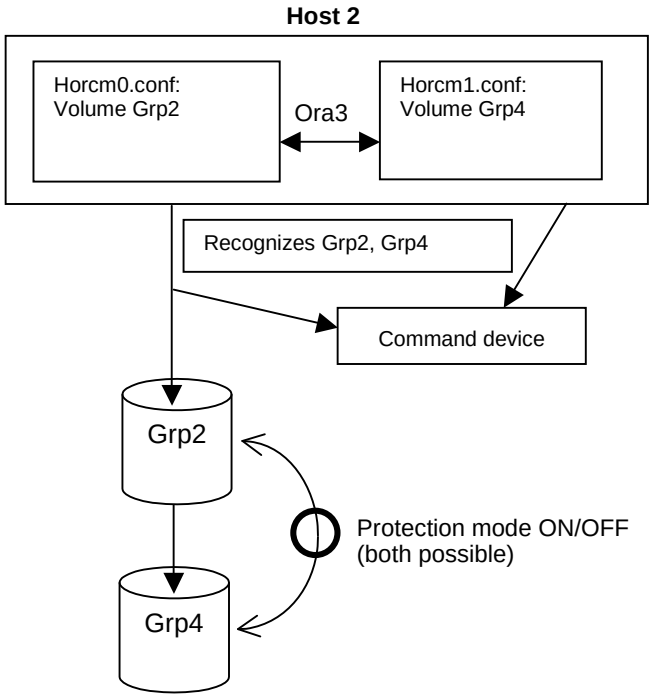


Figure 2-29: Protected Volume Configuration (one CCI host) (2)

Example of two CCI hosts: Group Ora2, in protection mode, cannot differentiate between volume Grp4 and Host 2. The pair operation is inhibited.

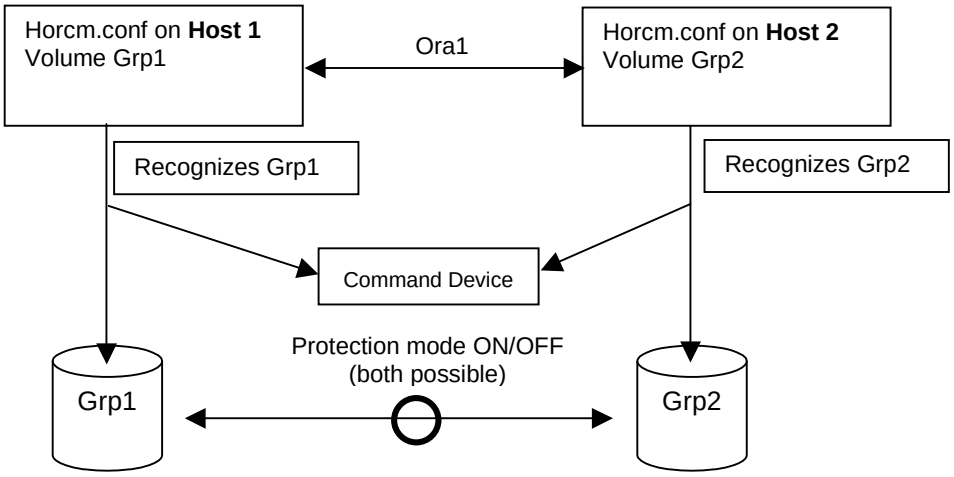


Figure 2-30: Protected Volume Configuration (two CCI hosts) (1)

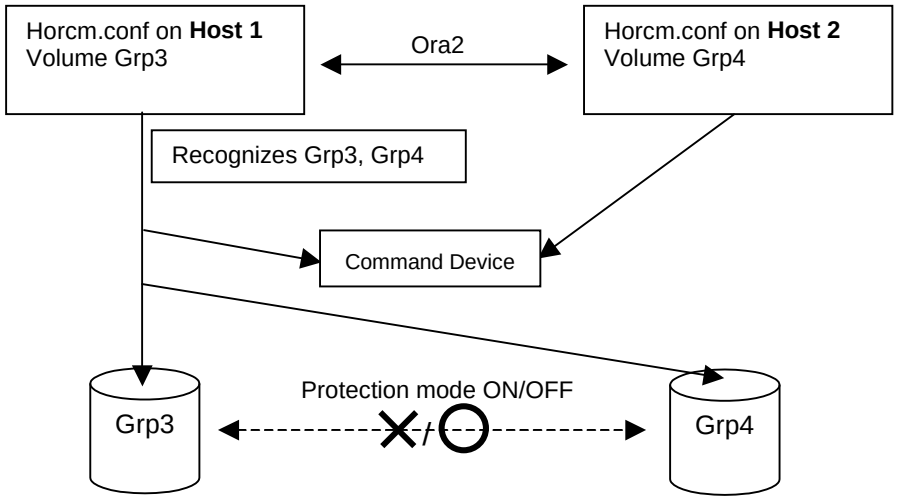


Figure 2-31: Protected Volume Configuration (two CCI hosts) (2)

Since volumes described in the configuration definition file (HORCM_CONF) are targets for the protection function, the following commands are also targets for the protection function (with the exception of pairdisplay).

- The paircreate, pairsplit, pairresync, pairvolchk, horctakeover, paircurchk, pairsyncwait, and pairevtwait commands are the target commands. Command operation during protection mode rejects volumes (EX_ENPERM) that are not permitted.
- The pairdisplay command displays volumes without LDEV-attached information, and displays LDEV# **** (for –CLI, -).

Example:

```
# 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 , 3,   0-0 )85010061  ****.----  ----,-----   ----  -
oradb   oradev1(R)  (CL1-A , 3,   1-0 )85010061  ****.----  ----,-----   ----  -
```

- The raidscan command is not affected by the HORCM_DEV and HORCM_INST section in the configuration definition file. The raidscan command is not the target of the protection function.

You can see the correspondence of the permitted volumes and the DEVICE_FILE by using the raidscan –find command. In the configuration definition file, describing UID, PORT, TARG, and LUN of the volume specified by the –find option usually does not reject volumes as EX_PERM.

Example (for HP-UX®):

```
# ioscan  -fun | grep rdsk | raidscan –find
DEVICE_FILE        UID  S/F PORT   TARG  LUN    SERIAL  LDEV  PRODUCT_ID
/dev/rdsk/c0t3d0     0    S  CL1-A     3     0 85010061    17  DF600F
/dev/rdsk/c0t3d1     0    S  CL1-A     3     1 85010061    18  DF600F
```

The protection mode enables CCI to check whether the volumes described in the configuration definition file matches all the volumes recognized from the host when CCI is activated. Permitted volumes are then registered in HORCM. The permitted volumes are registered in /etc/horcmgr in the following steps.

If the permitted file ($HORCMPERM) exists: CCI executes the following to the target volumes described in this file (e.g. If you want to permit only the LVM within your host, describe LVM volume in $HORCMPERM):

- **For HP-UX®:** The default file name is /etc/horcmperm.conf or /etc/horcmperm*.conf (* as an instance number). CCI automatically executes
  cat $HORCMPERM | /HORCM/usr/bin/raidscan –find inst

  Example:

```
# 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
```

Confirming vg01 groups: The following is an example for confirming whether the LVM volume group vg01 is correctly mapped to the group described in the configuration definition file.

Example:

```
# 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  85010061    17
/dev/rdsk/c0t3d1      oradb1   oradev2    c0t3d1          1  85010061    18
/dev/rdsk/c0t3d2      oradb    oradev3    c0t3d2          1  85010061    19
/dev/rdsk/c0t3d3       -        -          -              1  85010061    20
```

As shown in the example, the device file /dev/rdsk/c0t3d2 is mapped to the other group, and the /dev/rdsk/c0t3d3 is not described in the configuration definition file.

- **For Windows® 2000:** The default file name is \WINNT\horcmperm.conf or \WINNT\horcmperm*.conf (* as an instance number). CCI automatically executes
  type $HORCMPERM | x:\HORCM\etc\raidscan.exe –find inst
- **For Windows Server™ 2003 / Windows Server™ 2008:** The default file name is \WINDOWS\horcmperm.conf or \WINDOWS\horcmperm*.conf (* as an instance number). CCI automatically executes
  type $HORCMPERM | x:\HORCM\etc\raidscan.exe –find inst

Example:

```
# 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
```

Example : ***(Confirming DB1 groups):***

```
set HORCC_MRCF=1
echo hd20-23 | raidscan –find verify 1 –fd
DEVICE_FILE          Group    PairVol    Device_File     M   SERIAL  LDEV
Harddisk20           oradb1   oradev1    Harddisk20      1  85010061   17
Harddisk21           oradb1   oradev2    Harddisk21      1  85010061   18
Harddisk22           oradb    oradev3    Harddisk22      1  85010061   19
Harddisk23            -        -          -             1  85010061   20
```

As shown in the example, Harddisk22 is mapped to the other group, and Harddisk23 is not described in the configuration definition file.

If the permitted file ($HORCMPERM) does not exist: CCI targets the volumes of your own host, and executes the following:

For HP-UX®:

```
‘ioscan  -fun | grep –e rdisk -e rdsk | /HORCM/usr/bin/raidscan –find inst’
```

For Solaris™:

```
‘ls /dev/rdsk/* | /HORCM/usr/bin/raidscan –find inst’
```

For AIX®:

```
‘ls –C –c disk | grep hdisk | /HORCM/usr/bin/raidscan –find inst’
```

For Linux®:

```
‘ls /dev/sd* | /HORCM/usr/bin/raidscan –find inst’
```

For Tru64 UNIX®:

```
‘ls /dev/rdisk/dsk* | /HORCM/usr/bin/raidscan –find inst’
```

For IRIX®:

```
‘ls /dev/rdsk/*vol /dev/rdsk/*/*vol/* | /HORCM/usr/bin/raidscan –find inst ‘
```

For Windows® 2000/Windows Server™ 2003/Windows Server™ 2008:

```
‘echo hd0-999 | x:\HORCM\etc\raidscan.exe –find inst’
```

NOTE: The default target number for scanning is 1,000. Since CCI automatically registers device files when CCI is activated, starting up may take time. To perform startup more quickly by using the non-protection mode, create an empty HORCMPERM file (with no size) as a dummy to prohibit scanning. The file name displayed by the –fd option will be Unknown. To display the file name using the –fd option, execute raidscan –find inst manually.

CCI software files

The CCI software product consists of application and support files, internally generated log files, and user generated files. These files are stored on the local disk in the host. Table 2-15 lists the CCI files which are provided for UNIX®-based systems. Table 2-16 lists the CCI files for Windows®.

Table 2-15: 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 creation	/usr/bin/paircreate	paircreate	0544	root	sys
06	Pair splitting	/usr/bin/pairsplit	pairsplit	0544	root	sys
07	Pair resynchronizatio n	/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

Table 2-15: CCI Files for UNIX®-based Systems (Continued)

No.	Title	File name	Command name	Mode	User*	Group
18	Connection confirming ***Note:*** Provided only for HP-UX®, and Solaris™ systems.	/HORCM/usr/bin/ inqraid	inqraid	0544	root	sys
19	Configuration file creating	/HORCM/usr/bin/ mkconf.sh	mkconf	0544	root	sys
20	Synchronous waiting	/usr/bin/pairsyncwait	pairsyncwait*	0544	root	sys
21	Oracle Validation setting	/usr/bin/raidvchkset	raidvchkset	0544	root	sys
22	Oracle Validation displaying	/usr/bin/raidvchkdsp	raidvchkdsp	0544	root	sys
23	Oracle Validation scanning	/usr/bin/raidvchkscan	raidvchkscan	0544	root	sys
24	VMware SRM/ SRA	/HORCM/usr/bin/rmsra	rmsra	0544	root	sys

NOTE: ShadowImage/SnapShot does not support the horcmd, horctakeover, paircurchk, and pairsyncwait command. TrueCopy/TCE support the `horctakeover` and the `paircurchk` command. TrueCopy/TCE does not support the `horcmd` command. TCE supports the `pairsyncwait` command.

Table 2-16: CCI Files for Windows®

No.	Title	File name	Command name
01	HORCM	\HORCM\etc\horcmgr.exe	horcmd*
02	HORCM_CONF	\HORCM\etc\horcm.conf	--
03	Takeover	\HORCM\etc\horctakeover.exe	horctakeover*
04	Accessibility check	\HORCM\etc\paircurchk.exe	paircurchk*
05	Pair creation	\HORCM\etc\paircreate.exe	paircreate
06	Pair splitting	\HORCM\etc\pairsplit.exe	pairsplit
07	Pair resynchronization	\HORCM\etc\pairresync.exe	pairresync
08	Event waiting	\HORCM\etc\pairevtwait.exe	pairevtwait
09	Error notification	\HORCM\etc\pairmon.exe	pairmon
10	Volume check	\HORCM\etc\pairvolchk.exe	pairvolchk
11	Pair configuration confirmation	\HORCM\etc\pairdisplay.exe	pairdisplay
12	RAID scanning	\HORCM\etc\raidscan.exe	raidscan

Table 2-16: CCI Files for Windows® (Continued)

No.	Title	File name	Command name
13	RAID activity reporting	\HORCM\etc\raidar.exe	raidar
14	Connection confirmation	\HORCM\etc\raidqry.exe	raidqry
15	Trace control	\HORCM\etc\horcctl.exe	horcctl
16	HORCM activation script	\HORCM\etc\horcmstart.exe	horcmstart
17	HORCM shutdown script	\HORCM\etc\horcmshutdown.exe	horcmshutdown
18	Synchronous waiting	\HORCM\etc\pairsyncwait.exe	pairsyncwait*
19	Connection confirming ***Note:*** Provided only for Solaris™ systems.	\HORCM\usr\inqraid	inqraid
20	Configuration file creating	\HORC\Tool\mkconf.sh	mkconf
21	Oracle Validation setting	\HORCM\usr\raidvchkset	raidvchkset
22	Oracle Validation displaying	\HORCM\usr\raidvchkdsp	raidvchkdsp
23	Oracle Validation scanning	\HORCM\usr\raidvchkscan	raidvchkscan
24	Takeover	\HORCM\usr\bin\horctakeover.exe	horctakeover*
25	Tool	\HORCM\Tool\svcexe.exe	svcexe
26	Sample script for svcexe	HORCM\Tool\HORCM0_run.txt	--
27	VMware SRM/SRA	\HORCM\rmsra.exe	rmsra
28	Accessibility check	\HORCM\usr\bin\paircurchk.exe	paircurchk*
29	Pair creation	\HORCM\usr\bin\paircreate.exe	paircreate
30	Pair splitting	\HORCM\usr\bin\pairsplit.exe	pairsplit
31	Pair resynchronization	\HORCM\usr\bin\pairresync.exe	pairresync
32	Event waiting	\HORCM\usr\bin\pairevtwait.exe	pairevtwait
33	Volume check	\HORCM\usr\bin\pairvolchk.exe	pairvolchk
34	Pair configuration confirmation	\HORCM\usr\bin\pairdisplay.exe	pairdisplay
35	RAID scanning	\HORCM\usr\bin\raidscan.exe	raidscan
36	RAID connection confirmation	\HORCM\usr\bin\raidqry.exe	raidqry
37	Synchronous waiting	\HORCM\usr\bin\pairsyncwait.exe	pairsyncwait*
38	Oracle Validation setting	\HORCM\usr\bin\raidvchkset	raidvchkset
39	Oracle Validation displaying	\HORCM\usr\bin\raidvchkdsp	raidvchkdsp
40	Oracle Validation scanning	\HORCM\usr\bin\raidvchkscan	raidvchkscan

Note: The commands in \HORCM\etc\ are used when you execute from the console window. If these commands are executed without an argument, the interactive mode will start up. The commands in \HORCM\usr\bin have no console window, and can therefore be used when you execute from the user application

Note: ShadowImage/SnapShot does not support the `horcmd`, `horctakeover`, `paircurchk`, and `pairsyncwait` command. TrueCopy/TCE support the `horctakeover` and the `paircurchk` command. TrueCopy/TCE does not support the `horcmd` command. TCE supports the `pairsyncwait` command.

Log and trace files

The CCI software (HORCM) and ShadowImage/SnapShot/TrueCopy/TCE commands maintain start-up log files, execution log files, and trace files which can be used to identify the cause of errors and maintain status transition history records of the paired volumes.

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 ShadowImage, SnapShot, TrueCopy, and/or TCE 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 AMS array command device to execute the ShadowImage/SnapShot/TrueCopy/TCE operations automatically. The CCI scripts are:

- HORCM startup script (horcmstart.sh, horcmstart.exe):?A script that 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 host error.

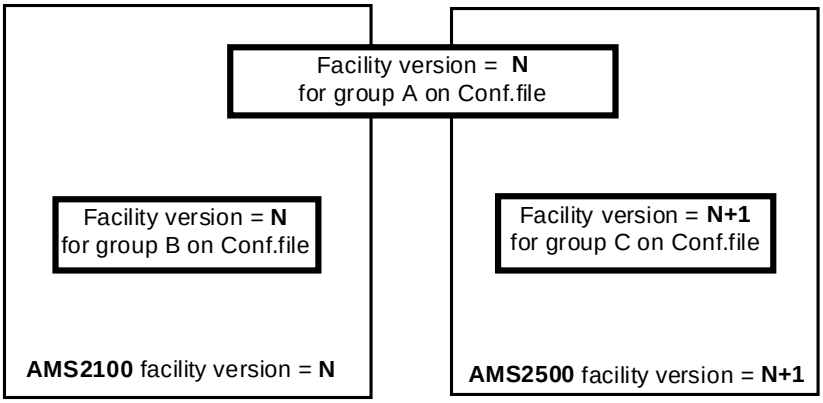
When constructing the HORCM environment, the system administrator should make a copy of the HORCM_CONF file. The copied file should be set according to the system environment and registered as the following file (* is the instance number):

- UNIX®-based systems: /etc/horcm.conf or /etc/horcm*.conf
- Windows® 2000 systems: \WINNT\horcm.conf of \WINNT\horcm*.conf
- Windows Server™ 2003/Windows Server™ 2008: \WINDOWS\horcm.conf or \WINDOWS\horcm*.conf

Group version control for mixed array configurations

Before executing each option of a command, CCI checks the facility version of the Hitachi array internally to verify that the same version is installed on a mixed array configuration. If the configuration includes older array systems (e.g., AMS2500), this method may not meet the requirements for the mixed array system environment because the older array system limits the availability enhancements in later facility versions. If the facility versions of the array systems are different, the user will not be able to use AMS2500-specific facility because CCI applies the minimum version to all array systems. To expand the capability for mixed array 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 array system configuration, if the facility version of the array systems (e.g., AMS2500) is different on a group, CCI will apply the minimum version for each group.



Mixed array configuration

Figure 2-32: Definition of the Group Version

Example of configuration definition file

Figure 2-33-to-Figure 2-43 show examples of CCI configurations, the configuration definition file(s) for each configuration, and examples of CCI command use for each configuration.

Two hosts and two instances

The command device is defined using the system raw device name (character-type device file name). For example, the command devices for Figure 2-33 to Figure 2-35 would be:

For HP-UX®:

HORCM_CMD of HOSTA = /dev/rdsk/c0t0d0
HORCM_CMD of HOSTB = /dev/rdsk/c1t0d0

For Solaris™:

HORCM_CMD of HOSTA = /dev/rdsk/c0t0d0s2
HORCM_CMD of HOSTB = /dev/rdsk/c1t0d0s2

You can use the command device without a label in the format command.

For AIX®:

HORCM_CMD of HOSTA = /dev/rhdisk*X*
HORCM_CMD of HOSTB = /dev/rhdisk*X*

Where *X* = device number created automatically by AIX®.

For Tru64 UNIX®:

HORCM_CMD of HOSTA = /dev/rdisk/dsk*X*c
HORCM_CMD of HOSTB = /dev/rdisk/dsk*X*c

Where *X* = device number assigned by Tru64 UNIX®.

For Linux®:

HORCM_CMD of HOSTA = /dev/sd*X*
HORCM_CMD of HOSTB = /dev/sd*X*

Where *X* = device number assigned by Linux®.

For IRIX®:

HORCM_CMD of HOSTA = /dev/rdsk/dks*X*d*X*l*X*vol
OR
HORCM_CMD of HOSTA = /dev/rdsk/node_wwn/lun*X*vol/c*X*p*X*

HORCM_CMD of HOSTB = /dev/rdsk/dks*X*d*X*l*X*vol
OR
HORCM_CMD of HOSTB = /dev/rdsk/node_wwn/lun*X*vol/c*X*p*X*

Where *X* = device number assigned by IRIX®.

For Windows® 2000/Windows Server™ 2003/Windows Server™ 2008:

HORCM_CMD of HOSTA = \\.\PhysicalDrive*X*
OR
HORCM_CMD of HOSTA = \\.\Volume{guid}
OR
HORCM_CMD of HOSTA = \\.\CMD-Ser#-ldev#-Port#

HORCM_CMD of HOSTB = \\.\PhysicalDrive*X*
OR
HORCM_CMD of HOSTB = \\.\Volume{guid}
OR
HORCM_CMD of HOSTB = \\.\CMD-Ser#-ldev#-Port#

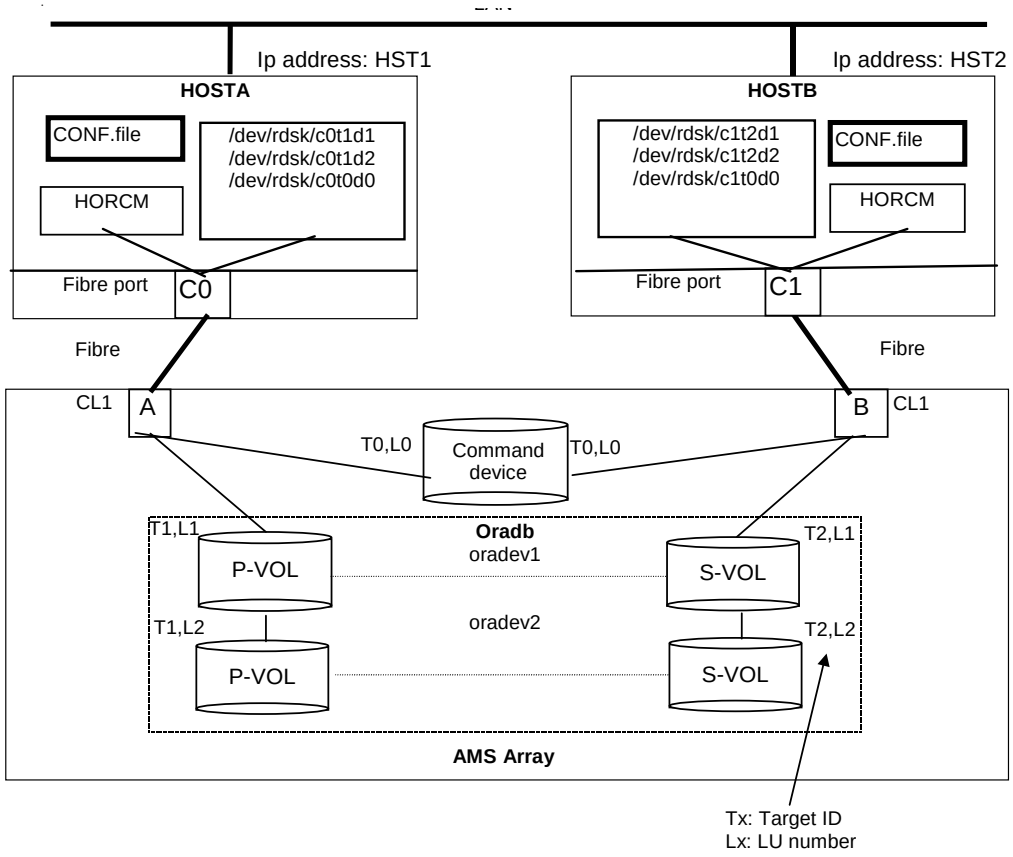
Where *X* = device number assigned by Windows® 2000/Windows Server™ 2003/Windows Server™ 2008.

The Physical Drive number may change at every reboot. If the number changes, use \\.\CMD-Ser#-ldev#-Port# or Volume{guid} for which the same name is kept.

NOTE: f \\.\CMD-Ser#-ldev#-Port# or \\.\Volume{guid} is specified, CCI changes it to \\.\PhysicalDrive? to be corresponded. For MSCS, it is recommended to use \\.\CMD-Ser#-ldev#-Port# instead of \\.\Volume{GUID} because \\.\Volume{GUID} may not be maintained. Using \\.\CMD-Ser#-ldev#-Port# does not require creating any partition on a volume. Volume{guid} is created when you make a partition by using the Windows' Disk Management. You can find Volume{guid} by using the `inqraid $Volume -CLI -fv` or `raidscan -x findcmddev0.?` commands.

NOTE: Regarding a command device for CCI, do not set two or more paths for a single host. (Windows® 2000/Windows Server™ 2003/Windows Server™ 2008 may change the **guid** when a volume with an identical **guid** is found.

NOTE: For Windows Server™ 2003/Windows Server™ 2008, when a path detachment, which is caused by a controller detachment or interface failure, continues for longer than one minute, the command device may be unable to be recognized at the time when recovery from the path detachment is made. To make the recovery, execute the re-scanning of the disks of Windows®. When Windows® cannot access the command device, though CCI becomes able to recognize the command device, restart CCI.



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

```
HORCM_MON
#ip_address  service   poll(10ms)   timeout(10ms)
HST1         horcm     12000 [Note 1]     3000

HORCM_CMD
#dev_name
/dev/xxx  [Note 2]

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

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     12000 [Note 1]     3000

HORCM_CMD
#dev_name
 /dev/yyy  [Note 2]

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

HORCM_INST
#dev_group      ip_address      service
 Oradb          HST1            horcm
```

Note 1: To calculate the value for poll(10ms), see section 2.5.3.
Note 2: The command device is dedicated to CCI communications and cannot be used by any other applications (neither the user). Command devices must be set using Hitachi Storage Navigator Modular 2. If setting two command devices, add second command device in the HORCM_CMD section.

Figure 2-33: ShadowImage Example with Two Hosts and Two Instances

Example of CCI commands with HOSTA (group Oradb): ShadowImage

For C shell:

```
#  setenv HORCC_MRCF  1
#  paircreate  -g Oradb –vl
```

For Windows®:

```
set  HORCC_MRCF=1
#  paircreate  -g Oradb –vl
```

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

```
# paircreate   -g Oradb  -d oradev1 –vl
```

This command creates pairs for all LUs designated as **oradev1** in the configuration definition file.

```
#  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 )85010061    18.P-VOL COPY,85010061    20 -
Oradb   oradev1(R)  (CL1-B , 2,   1-0 )85010061    20.S-VOL COPY,-----       18 -
Oradb   oradev2(L)  (CL1-A , 1,   2-0 )85010061    19.P-VOL COPY,85010061    21 -
Oradb   oradev2(R)  (CL1-B , 2,   2-0 )85010061    21.S-VOL COPY,-----       19 –
```

Example of CCI commands with HOSTB (group Oradb): ShadowImage

For C shell:

```
#  setenv HORCC_MRCF  1
#  paircreate  -g Oradb  -vr
```

For Windows®:

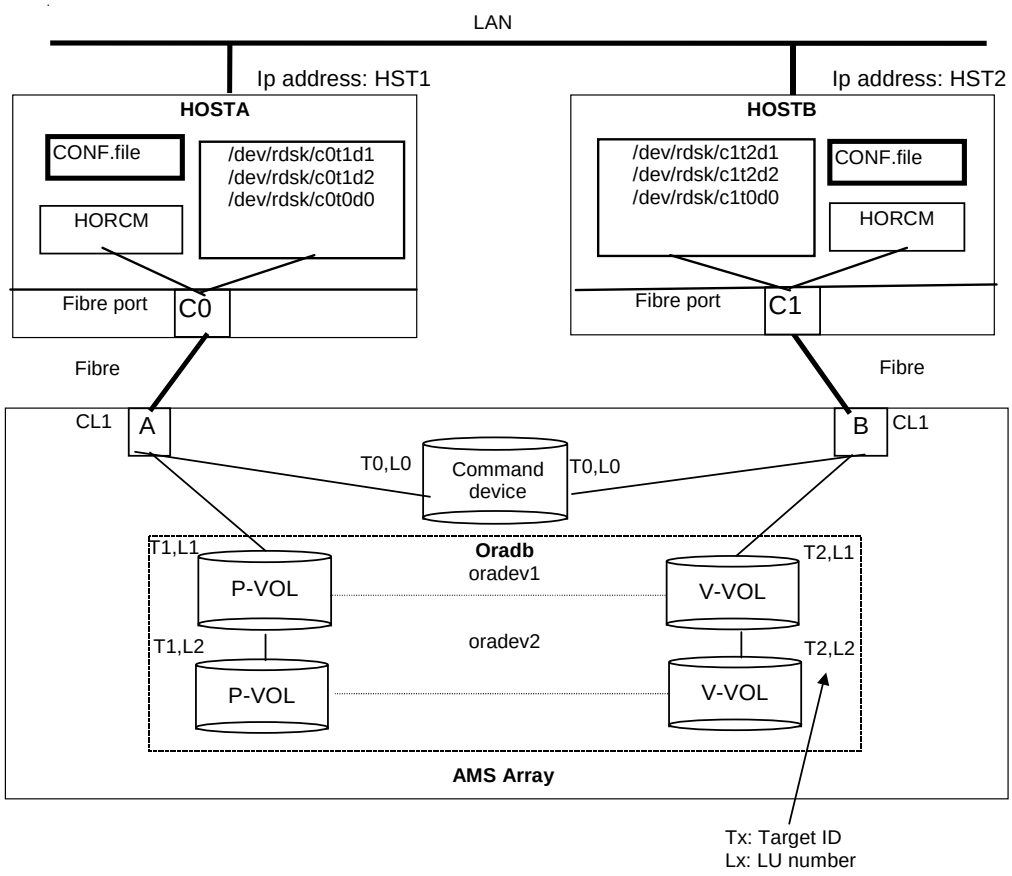
```
set  HORCC_MRCF=1
#  paircreate  -g Oradb  -vr
```

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

```
#  paircreate  -g Oradb  -d  oradev1  -vr
```

This command creates pairs for all LUs designated as **oradev1** in the configuration definition file.

```
#  pairdisplay  -g  Oradb
Group   PairVol(L/R) (Port#,TID, LU-M) ,Seq#,LDEV#.P/S,Status, Seq#,P-LDEV# M
Oradb   oradev1(L)  (CL1-B , 2,   1-0 )85010061    20.S-VOL COPY,-----       18 -
Oradb   oradev1(R)  (CL1-A , 1,   1-0 )85010061    18.P-VOL COPY,85010061    20 -
Oradb   oradev2(L)  (CL1-B , 2,   2-0 )85010061    21.S-VOL COPY,-----       19 -
Oradb   oradev2(R)  (CL1-A , 1,   2-0 )85010061    19.P-VOL COPY,85010061    21 –
```



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

```
HORCM_MON
#ip_address  service   poll(10ms)   timeout(10ms)
HST1         horcm     12000 [Note 1]     3000

HORCM_CMD
#dev_name
/dev/xxx  [Note 2]

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

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     12000 [Note 1]     3000

HORCM_CMD
#dev_name
 /dev/yyy  [Note 2]

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

HORCM_INST
#dev_group  ip_address  service
 Oradb      HST1        horcm
```

Note 1: To calculate the value for poll(10ms), see section 2.5.3.
Note 2: The command device is dedicated to CCI communications and cannot be used by any other applications (neither the user). Command devices must be set using Hitachi Storage Navigator Modular 2. If setting two command devices, add second command device in the HORCM_CMD section.

Figure 2-34: SnapShot Example with Two Hosts and Two Instances

Example of CCI commands with HOSTA (group Oradb): SnapShot

For C shell:

```
#  setenv HORCC_MRCF  1
#  paircreate  -g Oradb –vl –split
```

For Windows®:

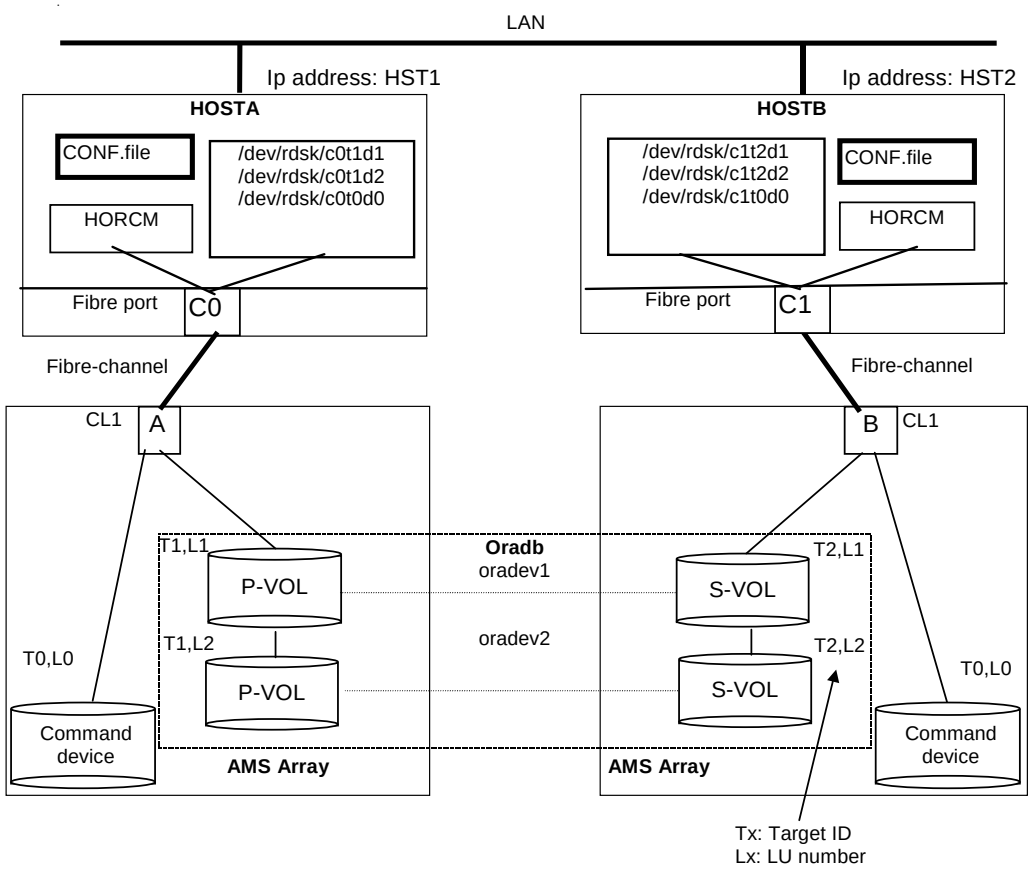
```
set  HORCC_MRCF=1
#  paircreate  -g Oradb –vl –split
```

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

```
# paircreate   -g Oradb  -d oradev1 –vl –split
```

This command creates pairs for all LUs designated as **oradev1** in the configuration definition file.

```
#  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 )85010061    18.P-VOL PSUS,85010061    20 -
oradb   oradev1(R)  (CL1-B , 2,   1-0 )85010061    20.S-VOL SSUS,-----       18 -
oradb   oradev2(L)  (CL1-A , 1,   2-0 )85010061    19.P-VOL PSUS,85010061    21 -
oradb   oradev2(R)  (CL1-B , 2,   2-0 )85010061    21.S-VOL SSUS,-----       19 –
```



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

```
HORCM_MON
#ip_address  service   poll(10ms)   timeout(10ms)
HST1         horcm     12000 [Note 1]     3000

HORCM_CMD
#dev_name
/dev/xxx  [Note 2]

HORCM_DEV
#dev_group  dev_name  port#  TargetID  LU#  MU#
 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     12000 [Note 1]     3000

HORCM_CMD
#dev_name
 /dev/yyy  [Note 2]

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

HORCM_INST
#dev_group      ip_address      service
 Oradb          HST1            horcm
```

Note 1: To calculate the value for poll(10ms), see section 2.5.3.
Note 2: The command device is dedicated to CCI communications and cannot be used by any other applications (neither the user). Command devices must be set using Hitachi Storage Navigator Modular 2. If setting two command devices, add second command device in the HORCM_CMD section.

Figure 2-35: TrueCopy/TCE Example with Two Hosts and Two Instances

Example of CCI commands with HOSTA (group Oradb): TrueCopy

For TCE, a fence level of “async” must be specified.

```
# 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 2-35).

```
# 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-B, T2, L1 for the configuration in Figure 2-35).

```
#  pairdisplay  -g Oradb
Group   PairVol(L/R) (Port#,TID, LU) ,Seq#,LDEV#.P/S,Status,Fence, Seq#,P-LDEV# M
Oradb  oradev1(L)  (CL1-A  ,  1,  1 )85010061   18.P-VOL COPY NEVER ,85010062    20 -
Oradb  oradev1(R)  (CL1-B  ,  2,  1 )85010062    20.S-VOL COPY NEVER , -----    18 -
Oradb  oradev2(L)  (CL1-A  ,  1,  2 )85010061   19.P-VOL COPY NEVER ,85010062    21 -
Oradb  oradev2(R)  (CL1-B  ,  2,  2 )85010062    21.S-VOL COPY NEVER , -----    19 –
```

Example of CCI commands with HOSTB (group Oradb): TrueCopy

For TCE, a fence level of “async” must be specified.

```
#  paircreate  -g Oradb  -f never  -vr
```

This command creates pairs for all LUs assigned to group **Oradb** in the configuration definition file (two pairs for the configuration in Figure 2-35).

```
#  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-B, T2, L1 for the configuration in Figure 2-35).

```
#  pairdisplay  -g  Oradb
Group   PairVol(L/R) (Port#,TID, LU) ,Seq#,LDEV#.P/S,Status,Fence, Seq#,P-LDEV# M
Oradb  oradev1(L)  (CL1-B  ,  2,  1 )85010062    20.S-VOL COPY NEVER , -----    18 -
Oradb  oradev1(R)  (CL1-A  ,  1,  1 )85010061   18.P-VOL COPY NEVER ,85010062    20 -
Oradb  oradev2(L)  (CL1-B  ,  2,  2 )85010062    21.S-VOL COPY NEVER , -----    19 -
Oradb  oradev2(R)  (CL1-A  ,  1,  2 )85010061   19.P-VOL COPY NEVER ,85010062    21 –
```

One host and two instances

The command device is defined using the system raw device name (character-type device file name). The command device must be defined in the configuration definition file for every instance. Sixteen (16) instances can be used per command device. If this restriction is to be exceeded, then a different path for each instance should be used. For example, the command devices shown in Figure 2-36, Figure 2-37, and Figure 2-38 would be:

For HP-UX®:

HORCM_CMD of HOSTA = /dev/rdsk/c0t0d0
HORCM_CMD of HOSTB = /dev/rdsk/c1t0d0

For Solaris™:

HORCM_CMD of HOSTA = /dev/rdsk/c0t0d0s2
HORCM_CMD of HOSTB = /dev/rdsk/c1t0d0s2

You can use the command device without a label in the format command.

For AIX®:

HORCM_CMD of HOSTA = /dev/rhdisk*X*
HORCM_CMD of HOSTB = /dev/rhdisk*X*

Where *X* = device number created automatically by AIX®.

For Tru64 UNIX®:

HORCM_CMD of HOSTA = /dev/rdisk/dsk*X*c
HORCM_CMD of HOSTB = /dev/rdisk/dsk*X*c

Where *X* = device number assigned by Tru64 UNIX®.

For Linux®:

HORCM_CMD of HOSTA = /dev/sd*X*
HORCM_CMD of HOSTB = /dev/sd*X*

Where *X* = device number assigned by Linux®.

For IRIX®:

HORCM_CMD of HOSTA = /dev/rdsk/dks*X*d*X*l*X*vol
OR
HORCM_CMD of HOSTA = /dev/rdsk/node_wwn/lun*X*vol/c*X*p*X*

HORCM_CMD of HOSTB = /dev/rdsk/dks*X*d*X*l*X*vol
OR
HORCM_CMD of HOSTB = /dev/rdsk/node_wwn/lun*X*vol/c*X*p*X*

Where *X* = device number assigned by IRIX®.

For Windows® 2000/Windows Server™ 2003/Windows Server™ 2008:

HORCM_CMD of HOSTA = \\.\PhysicalDrive*X*
OR
HORCM_CMD of HOSTA = \\.\Volume{guid}
OR
HORCM_CMD of HOSTA = \\.\CMD-Ser#-ldev#-Port#

HORCM_CMD of HOSTB = \\.\PhysicalDrive*X*
OR
HORCM_CMD of HOSTB = \\.\Volume{guid}
OR
HORCM_CMD of HOSTB = \\.\CMD-Ser#-ldev#-Port#

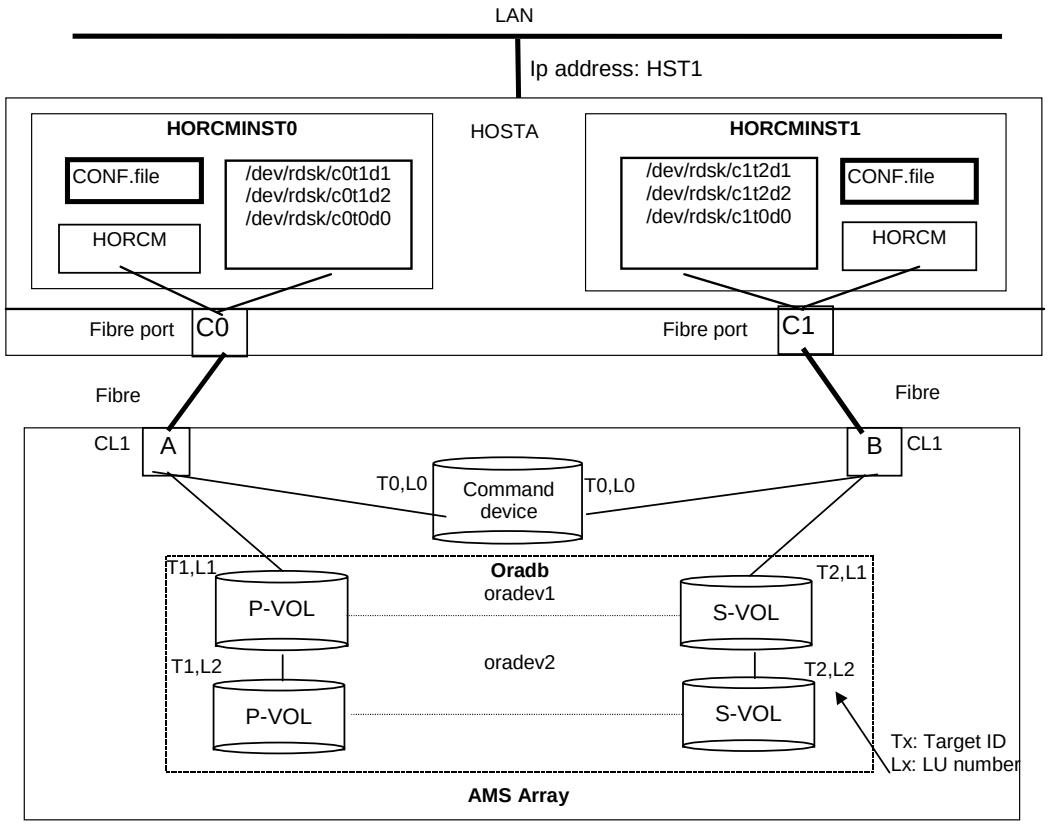
Where *X* = device number assigned by Windows® 2000/Windows Server™ 2003/Windows Server™ 2008.

The Physical Drive number may change at every reboot. If the number changes, use \\.\CMD-Ser#-ldev#-Port# or Volume{guid} for which the same name is kept.

If \\.\CMD-Ser#-ldev#-Port# or \\.\Volume{guid} is specified, CCI changes it to \\.\PhysicalDrive? to be corresponded. For MSCS, it is recommended to use \\.\CMD-Ser#-ldev#-Port# instead of \\.\Volume{GUID} because \\.\Volume{GUID} may not be maintained. Using \\.\CMD-Ser#-ldev#-Port# does not require creating any partition on a volume. Volume{guid} is created when you make a partition by using the Windows' Disk Management. You can find Volume{guid} by using the `inqraid $Volume -CLI -fv` or `raidscan -x findcmddev0.?` commands.

NOTE: Regarding a command device for CCI, do not set two or more paths for a single host. (Windows® 2000/Windows Server™ 2003/Windows Server™ 2008 may change the guid when a volume with an identical guid is found.

NOTE: For Windows Server™ 2003/Windows Server™ 2008, when a path detachment, which is caused by a controller detachment or interface failure, continues for longer than one minute, the command device may be unable to be recognized at the time when recovery from the path detachment is made. To make the recovery, execute the re-scanning of the disks of Windows®. When Windows® cannot access the command device although CCI becomes able to recognize the command device, restart CCI.



Configuration file for HORCMINST0 (horcm0.conf)

```
HORCM_MON
#ip_address  service   poll(10ms)   timeout(10ms)
HST1         horcm0    12000 [Note 1]     3000

HORCM_CMD
#dev_name
 /dev/xxx  [Note 2]

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

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    12000 [Note 1]     3000

HORCM_CMD
#dev_name
 /dev/xxx  [Note 2]

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

HORCM_INST
#dev_group     ip_address      service
 Oradb         HST1            horcm0
```

Note 1: To calculate the value for poll(10ms), see section 2.5.3.
Note 2: The command device is dedicated to CCI communications and cannot be used by any other application (neither the user). Command devices must be set using Hitachi Storage Navigator Modular 2. When setting two command devices, add second command device in the HORCM_CMD section.
In the same line, you can also add a command device specified by a different path so that the host can use the same command device when one of the paths cannot be used.

Figure 2-36: ShadowImage Example with One Host and Two Instances

Example of CCI commands with Instance-0 on HOSTA: ShadowImage

For C shell:

```
#  setenv  HORCMINST  0
```

For Windows®:

```
set  HORCMINST=0
```

For C shell:

```
#  setenv  HORCC_MRCF  1
# paircreate –g Oradb –vl
```

For Windows®:

```
set  HORCC_MRCF=1
# paircreate –g Oradb –vl
```

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

```
# paircreate –g Oradb –d oradev1 –vl
```

This command creates pairs for all LUs designated as **oradev1** in the configuration definition file.

```
# 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 )85010061    18.P-VOL COPY,85010061    19 -
Oradb   oradev1(R)  (CL1-B , 2,   1-0 )85010061    19.S-VOL COPY,-----       18 -
Oradb   oradev2(L)  (CL1-A , 1,   2-0 )85010061    20.P-VOL COPY,85010061    21 -
Oradb   oradev2(R)  (CL1-B , 2,   2-0 )85010061    21.S-VOL COPY,-----       20 –
```

Example of CCI commands with Instance-1 on HOSTA: ShadowImage

For C shell:

```
# setenv HORCMINST 1
```

For Windows®:

```
set HORCMINST=1
```

For C shell:

```
# setenv HORCC_MRCF 1
# paircreate –g Oradb –vr
```

For Windows®:

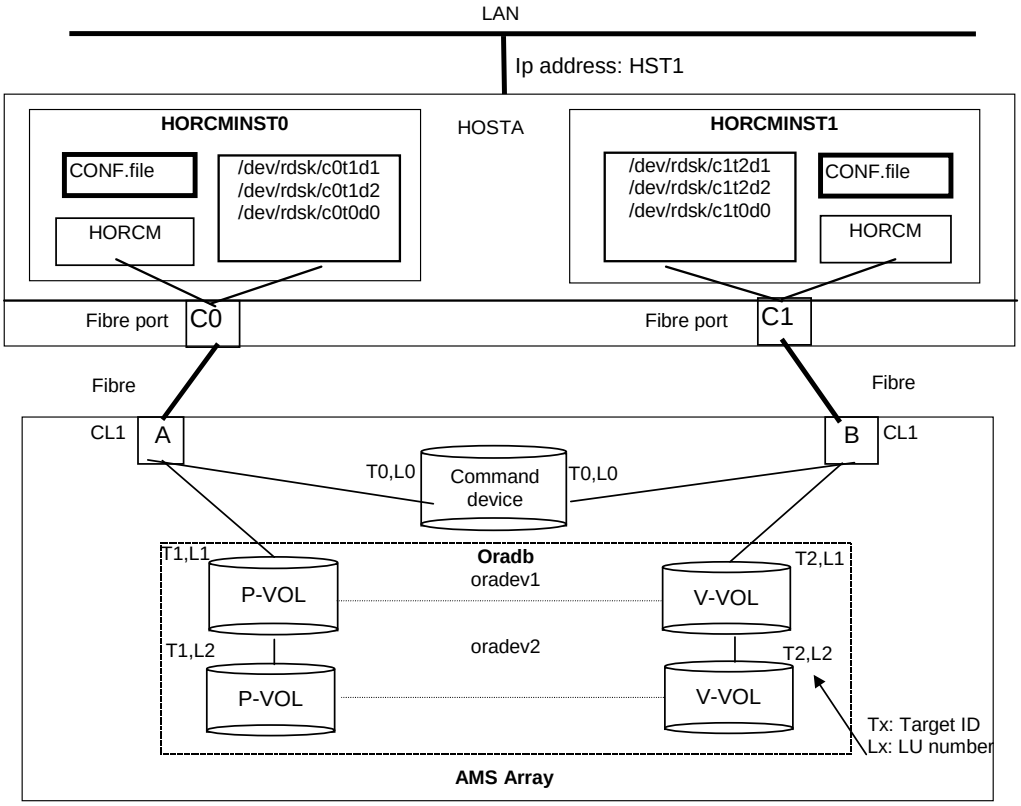
```
set HORCC_MRCF=1
# paircreate –g Oradb –vr
```

This command creates pairs for all LUs designated as **Oradb** in the configuration definition file.

```
# paircreate –g Oradb –d oradev1 –vr
```

This command creates pairs for all LUs designated as **oradev1** in the configuration definition file.

```
# pairdisplay –g Oradb
Group   PairVol(L/R) (Port#,TID, LU-M) ,Seq#,LDEV#.P/S,Status, Seq#,P-LDEV# M
Oradb   oradev1(L)   (CL1-B , 2,   1-0 )85010061    19.S-VOL COPY,-----      18 -
Oradb   oradev1(R)   (CL1-A , 1,   1-0 )85010061    18.P-VOL COPY,85010061   19 -
Oradb   oradev2(L)   (CL1-B , 2,   2-0 )85010061    21.S-VOL COPY,-----      20 -
Oradb   oradev2(R)   (CL1-A , 1,   2-0 )85010061    20.P-VOL COPY,85010061   21 –
```



Configuration file for HORCMINST0 (horcm0.conf)

```
HORCM_MON
#ip_address  service   poll(10ms)   timeout(10ms)
HST1         horcm0    12000 [Note 1]     3000

HORCM_CMD
#dev_name
 /dev/xxx  [Note 2]

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

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    12000 [Note 1]     3000

HORCM_CMD
#dev_name
 /dev/xxx  [Note 2]

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

HORCM_INST
#dev_group      ip_address      service
 Oradb          HST1            horcm0
```

Note 1: To calculate the value for poll(10ms), see section 2.5.3.
Note 2: The command device is dedicated to CCI communications and cannot be used by any other application (neither the user). Command devices must be set using Hitachi Storage Navigator Modular 2. When setting two command devices, add second command device in the HORCM_CMD section.
In the same line, you can also add a command device specified by a different path so that the host can use the same command device when one of the paths cannot be used.

Figure 2-37: SnapShot Example with One Host and Two Instances

Example of CCI commands with Instance-0 on HOSTA: SnapShot

For C shell:

```
#  setenv  HORCMINST  0
```

For Windows®:

```
set  HORCMINST=0
```

For C shell:

```
#  setenv  HORCC_MRCF  1
# paircreate –g Oradb –vl -split
```

For Windows®:

```
set  HORCC_MRCF=1
# paircreate –g Oradb –vl -split
```

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

```
# paircreate –g Oradb –d oradev1 –vl -split
```

This command creates pairs for all LUs designated as **oradev1** in the configuration definition file.

```
# 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 )85010061    18.P-VOL PSUS,85010061    19 -
Oradb   oradev1(R)  (CL1-B , 2,   1-0 )85010061    19.S-VOL SSUS,-----       18 -
Oradb   oradev2(L)  (CL1-A , 1,   2-0 )85010061    20.P-VOL PSUS,85010061    21 -
Oradb   oradev2(R)  (CL1-B , 2,   2-0 )85010061    21.S-VOL SSUS,-----       20 –
```

Example of CCI commands with Instance-1 on HOSTA: SnapShot

For C shell:

```
#  setenv  HORCMINST  1
```

For Windows®:

```
set  HORCMINST=1
```

For C shell:

```
#  setenv  HORCC_MRCF  1
# paircreate –g Oradb –vr -split
```

For Windows®:

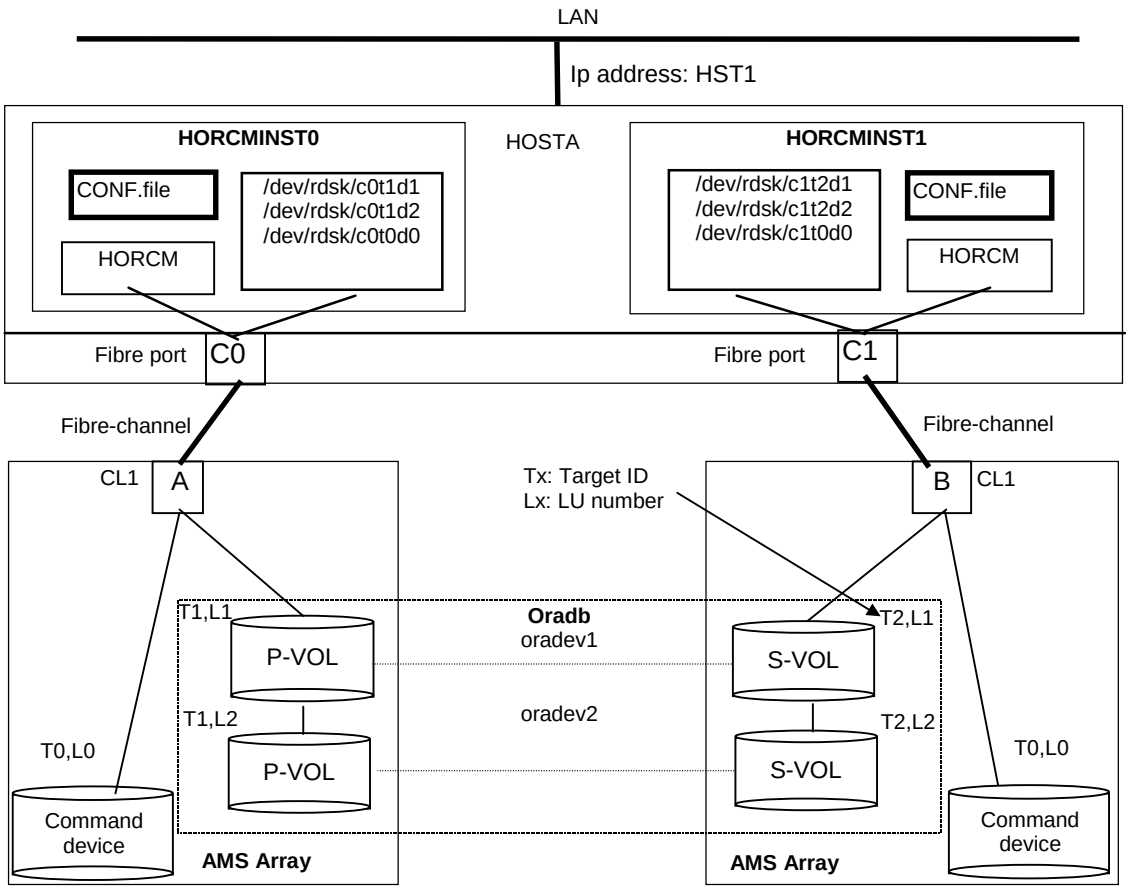
```
set  HORCC_MRCF=1
# paircreate –g Oradb –vr -split
```

This command creates pairs for all LUs designated as **Oradb** in the configuration definition file.

```
# paircreate –g Oradb –d oradev1 –vr -split
```

This command creates pairs for all LUs designated as **oradev1** in the configuration definition file.

```
# pairdisplay –g Oradb
Group   PairVol(L/R) (Port#,TID, LU-M) ,Seq#,LDEV#.P/S,Status, Seq#,P-LDEV# M
Oradb   oradev1(L)   (CL1-B , 2,   1-0 )85010061   19.S-VOL SSUS,-----      18 -
Oradb   oradev1(R)   (CL1-A , 1,   1-0 )85010061   18.P-VOL PSUS,85010061   19 -
Oradb   oradev2(L)   (CL1-B , 2,   2-0 )85010061   21.S-VOL SSUS,-----      20 -
Oradb   oradev2(R)   (CL1-A , 1,   2-0 )85010061   20.P-VOL PSUS,85010061   21 –
```



Configuration file for HORCMINST0 (horcm0.conf)

```
HORCM_MON
#ip_address  service   poll(10ms)   timeout(10ms)
HST1         horcm0    12000 [Note 1]      3000

HORCM_CMD
#dev_name
 /dev/xxx  [Note 2]

HORCM_DEV
#dev_group  dev_name  port#  TargetID  LU#  MU#
 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    12000 [Note 1]      3000

HORCM_CMD
#dev_name
 /dev/yyy  [Note 2]

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

HORCM_INST
#dev_group      ip_address      service
 Oradb          HST1            horcm0
```

Note 1: To calculate the value for poll(10ms), see section 2.5.3.
Note 2: The command device is dedicated to CCI communications and cannot be used by any other applications (neither the user). Command devices must be set using Hitachi Storage Navigator Modular 2. If setting two command devices, add second command device in the HORCM_CMD section.
In the same line, you can also add a command device specified by different path, so that the host can use the same command device incase when one of the path cannot be used.

Figure 2-38: TrueCopy/TCE Example with One Host and Two Instances

Example of CCI commands with Instance-0 on HOSTA: TrueCopy

For TCE, a fence level of “async” must be specified.

For C shell:

```
#  setenv  HORCMINST  0
```

For Windows®:

```
set  HORCMINST=0
#  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 2-38).

```
# 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-B, T2, L1 for the configuration in Figure 2-38).

```
#  pairdisplay  -g Oradb
Group   PairVol(L/R) (Port#,TID, LU) ,Seq#,LDEV#.P/S,Status,Fence, Seq#,P-LDEV# M
Oradb  oradev1(L)  (CL1-A  ,  1,  1 )85010061    18.P-VOL COPY NEVER ,85010062    19 -
Oradb  oradev1(R)  (CL1-B  ,  2,  1 )85010062    19.S-VOL COPY NEVER , -----      18 -
Oradb  oradev2(L)  (CL1-A  ,  1,  2 )85010061    20.P-VOL COPY NEVER ,85010062    21 -
Oradb  oradev2(R)  (CL1-B  ,  2,  2 )85010062    21.S-VOL COPY NEVER , -----      20 –
```

Example of CCI commands with Instance-1 on HOSTA: TrueCopy

For TCE, a fence level of “async” must be specified.

For C shell:

```
#  setenv  HORCMINST  1
```

For Windows®:

```
set  HORCMINST=1
```

This command creates pairs for all LUs designated as **Oradb** in the configuration definition file (two pairs for the configuration in Figure 2-38).

```
#  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-B, T2, L1 for the configuration in Figure 2-38).

```
#  pairdisplay  -g  Oradb
Group   PairVol(L/R) (Port#,TID, LU) ,Seq#,LDEV#.P/S,Status,Fence, Seq#,P-LDEV# M
Oradb  oradev1(L)  (CL1-B  ,  2,  1 )85010062    19.S-VOL COPY NEVER , -----      18 -
Oradb  oradev1(R)  (CL1-A  ,  1,  1 )85010061    18.P-VOL COPY NEVER ,85010062    19 -
Oradb  oradev2(L)  (CL1-B  ,  2,  2 )85010062    21.S-VOL COPY NEVER , -----      20 -
Oradb  oradev2(R)  (CL1-A  ,  1,  2 )85010061    20.P-VOL COPY NEVER ,85010062    21 –
```

Two command devices

Setting two command devices enables you to use the alternate command device function.

The command device is defined by using the system raw device name (character-type device file name). The command device defined in the configuration definition file must be established to follow either every instance. If one command device is used between different instances on the same port, then the number of instances is up to 16 per command device. If this restriction is exceeded, use a different path for each instance. For example, the command devices Figure 2-39-to-Figure 2-41 would be:

For HP-UX®:

```
HORCM_CMD for HORCMINST0 = /dev/rdsk/c0t0d0
HORCM_CMD for HORCMINST0 = /dev/rdsk/c1t0d1
HORCM_CMD for HORCMINST1 = /dev/rdsk/c1t0d0
HORCM_CMD for HORCMINST1 = /dev/rdsk/c1t0d1
```

You can use the command device without a label in the format command.

For Solaris™:

```
HORCM_CMD for HORCMINST0 = /dev/rdsk/c0t0d0s2
HORCM_CMD for HORCMINST0 = /dev/rdsk/c1t0d1s2
HORCM_CMD for HORCMINST1 = /dev/rdsk/c1t0d0s2
HORCM_CMD for HORCMINST1 = /dev/rdsk/c1t0d1s2
```

For AIX®:

```
HORCM_CMD for HORCMINST0 = /dev/rhdiskX
HORCM_CMD for HORCMINST0 = /dev/rhdiskY
HORCM_CMD for HORCMINST1 = /dev/rhdiskX
HORCM_CMD for HORCMINST1 = /dev/rhdiskY
```

Where *X* and *Y* = device number created automatically by AIX®.

For Tru64 UNIX®:

```
HORCM_CMD for HORCMINST0 = /dev/rdisk/dskXc
HORCM_CMD for HORCMINST0 = /dev/rdisk/dskYc
HORCM_CMD for HORCMINST1 = /dev/rhdisk/dskXc
HORCM_CMD for HORCMINST1 = /dev/rhdisk/dskYc
```

Where *X* and *Y* = device number created automatically by Tru64 UNIX®.

For Linux®:

```
HORCM_CMD for HORCMINST0 = /dev/sdX
HORCM_CMD for HORCMINST0 = /dev/sdY
HORCM_CMD for HORCMINST1 = /dev/sdX
HORCM_CMD for HORCMINST1 = /dev/sdY
```

Where *X* and *Y* = device number assigned by Linux®.

For IRIX®:

HORCM_CMD for HORCMINST0 = /dev/rdsk/dks*X*d*X*l*X*vol
OR
HORCM_CMD for HORCMINST0 = /dev/rdsk/node_wwn/lun*X*vol/c*X*p*X*

HORCM_CMD for HORCMINST0 = /dev/rdsk/dks*Y*d*Y*l*Y**X*vol
OR
HORCM_CMD for HORCMINST0 = /dev/rdsk/node_wwn/lun*Y*vol/c*Y*p*Y*

HORCM_CMD for HORCMINST1 = /dev/rdsk/dks*X*d*X*l*X*vol
OR
HORCM_CMD for HORCMINST1 = /dev/rdsk/node_wwn/lun*X*vol/c*X*p*X*

HORCM_CMD for HORCMINST1 = /dev/rdsk/dks*Y*d*Y*l*Y*vol
OR
HORCM_CMD for HORCMINST1 = /dev/rdsk/node_wwn/lun*Y*vol/c*Y*p*Y*

Where *X* and *Y* = device number assigned by IRIX®.

For Windows® 2000/Windows Server™ 2003/Windows Server™ 2008:

HORCM_CMD of HORCMINST0 = \\.\PhysicalDrive*X*
OR
HORCM_CMD of HORCMINST0 = \\.\Volume{guid}
OR
HORCM_CMD of HORCMINST0 = \\.\CMD-Ser#-ldev#-Port#

HORCM_CMD of HORCMINST0 = \\.\PhysicalDrive*Y*
OR
HORCM_CMD of HORCMINST0 = \\.\Volume{guid}
OR
HORCM_CMD of HORCMINST0 = \\.\CMD-Ser#-ldev#-Port#

HORCM_CMD of HORCMINST1 = \\.\PhysicalDrive*X*
OR
HORCM_CMD of HORCMINST1 = \\.\Volume{guid}
OR
HORCM_CMD of HORCMINST1 = \\.\CMD-Ser#-ldev#-Port#

HORCM_CMD of HORCMINST1 = \\.\PhysicalDrive*Y*
OR
HORCM_CMD of HORCMINST1 = \\.\Volume{guid}
OR
HORCM_CMD of HORCMINST1 = \\.\CMD-Ser#-ldev#-Port#

Where *X* and *Y* = device number assigned by Windows® 2000/Windows Server™ 2003/Windows Server™ 2008.

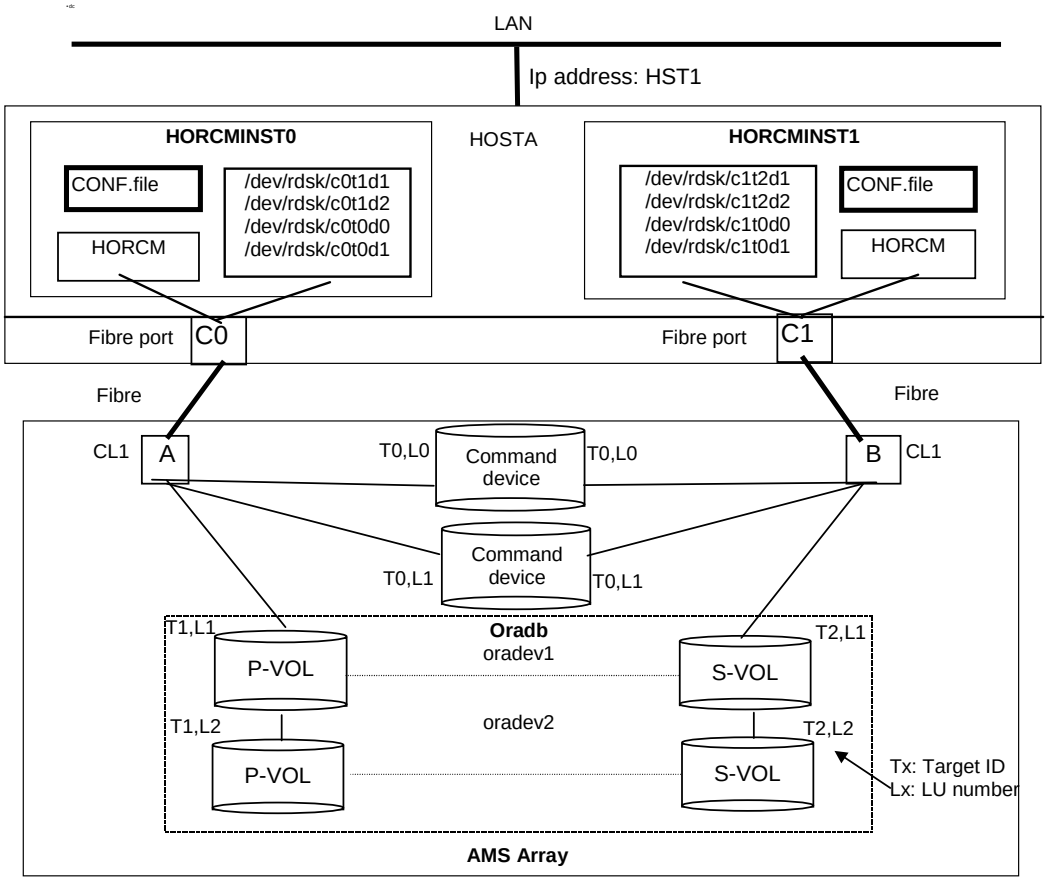
The PhysicalDrive number may change at every reboot. If the number changes, use \\.\CMD-Ser#-ldev#-Port# or Volume{guid} for which the same name is kept.

If \\.\CMD-Ser#-ldev#-Port# or \\.\Volume{guid} is specified, CCI changes it to \\.\PhysicalDrive? to be corresponded. For MSCS, it is recommended to use \\.\CMD-Ser#-ldev#-Port# instead of \\.\Volume{GUID} because \\.\Volume{GUID} may not be maintained. Using \\.\CMD-Ser#-ldev#-Port# does not require creating any partition on a volume. Volume{guid} is

created when you make a partition by using the Windows' Disk Management. You can find Volume{guid} by using the `inqraid $Volume -CLI -fv` or `raidscan -x findcmddev0.?` commands.

Note 1: Regarding a command device for CCI, do not set two or more paths for a single host. (Windows® 2000/Windows Server™ 2003/Windows Server™ 2008 may change the **guid** when a volume with an identical **guid** is found.

Note 2: For Windows Server™ 2003/Windows Server™ 2008, when a path detachment, which is caused by a controller detachment or interface failure, continues for longer than one minute, the command device may be unable to be recognized at the time when recovery from the path detachment is made. To make the recovery, execute the re-scanning of the disks of Windows®. When Windows® cannot access the command device although CCI becomes able to recognize the command device, restart CCI



Configuration file for HORCMINST0 (horcm0.conf)

```
HORCM_MON
#ip_address  service   poll(10ms)   timeout(10ms)
HST1         horcm0    12000 [Note 1]      3000

HORCM_CMD
#dev_name
 /dev/xxx  /dev/yyy  [Note 2]

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

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    12000 [Note 1]      3000

HORCM_CMD
#dev_name
 /dev/xxx  /dev/yyy  [Note 2]

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

HORCM_INST
#dev_group      ip_address      service
 Oradb          HST1            horcm0
```

Note 1: To calculate the value for poll(10ms), see section 2.5.3.
Note 2: The command device is dedicated to CCI communications and cannot be used by any other application (neither the user). Command devices must be set using Hitachi Storage Navigator Modular 2. When setting two command devices, add second command device in the HORCM_CMD section.
In the same line, you can also add a command device specified by a different path so that the host can use the same command device when one of the paths cannot be used.

Figure 2-39: ShadowImage Example with Two Command Devices

Example of CCI commands with Instance-0 on HOSTA: ShadowImage

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

For C shell:

```
# setenv HORCMINST 0
```

For Windows®:

```
set HORCMINST=0
```

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

```
# paircreate –g Oradb –vl
```

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

Designate a volume name (oradev1) and a local instance 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.

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 )85010061    18.P-VOL COPY,85010061    19 -
Oradb   oradev1(R)  (CL1-B , 2,   1-0 )85010061    19.S-VOL COPY,-----       18 -
Oradb   oradev2(L)  (CL1-A , 1,   2-0 )85010061    20.P-VOL COPY,85010061    21 -
Oradb   oradev2(R)  (CL1-B , 2,   2-0 )85010061    21.S-VOL COPY,-----       20 –
```

Example of CCI commands with Instance-1 on HOSTA: ShadowImage

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

For C shell:

```
# setenv HORCMINST 1
```

For Windows®:

```
set HORCMINST=1
```

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 instance P-VOL a case.

```
# paircreate –g Oradb –vr
```

This command creates pairs for all LUs designated as **Oradb** in the configuration definition file.

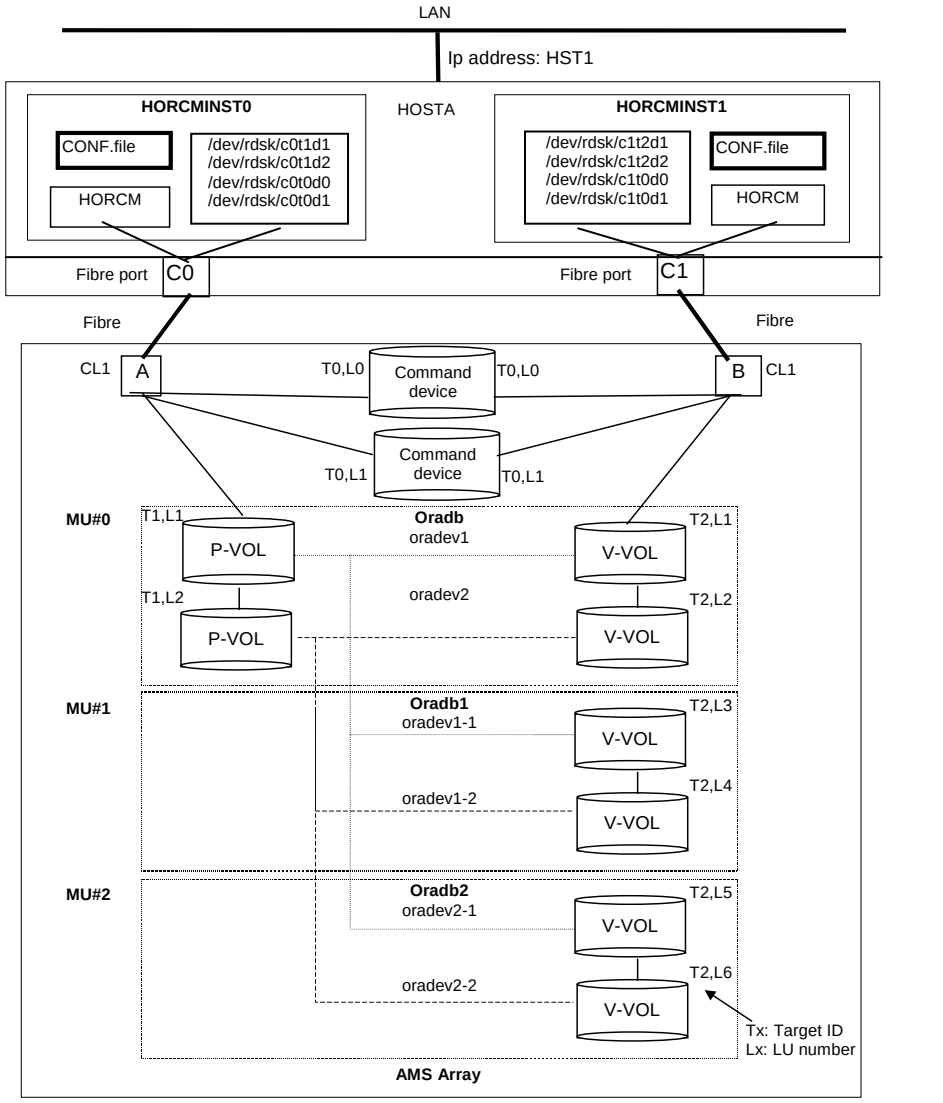
Designate a volume name (oradev1) and a remote instance P-VOL a case.

```
# paircreate –g Oradb –d oradev1 –vr
```

This command creates pairs for all LUs designated as **oradev1** in the configuration definition file.

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-B , 2,   1-0 )85010061    19.S-VOL COPY,-----      18 -
Oradb   oradev1(R)   (CL1-A , 1,   1-0 )85010061    18.P-VOL COPY,85010061   19 -
Oradb   oradev2(L)   (CL1-B , 2,   2-0 )85010061    21.S-VOL COPY,-----      20 -
Oradb   oradev2(R)   (CL1-A , 1,   2-0 )85010061    20.P-VOL COPY,85010061   21 –
```



Configuration file for HORCMINST0 (horcm0.conf)

```
HORCM_MON
#ip_address  service   poll(10ms)   timeout(10ms)
HST1         horcm0    12000 [Note 1]     3000

HORCM_CMD
#dev_name
 /dev/xxx  /dev/yyy  [Note 2]

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         HST1            horcm1
```

Configuration file for HORCMINST1 (horcm1.conf)

```
HORCM_MON
#ip_address  service   poll(10ms)   timeout(10ms)
HST1         horcm1    12000 [Note 1]     3000

HORCM_CMD
#dev_name
 /dev/xxx  /dev/yyy  [Note 2]

HORCM_DEV
#dev_group  dev_name  port#   TargetID  LU#  MU#
 Oradb      oradev1   CL1-B       2     1    0
 Oradb      oradev2   CL1-B       2     2    0
 Oradb1     oradev1-1 CL1-B       2     3    0
 Oradb1     oradev1-2 CL1-B       2     4    0
 Oradb2     oradev2-1 CL1-B       2     5    0
 Oradb2     oradev2-2 CL1-B       2     6    0

HORCM_INST
#dev_group     ip_address      service
 Oradb         HST1            horcm0
```

Note 1: To calculate the value for poll(10ms), see section 2.5.3.
Note 2: The command device is dedicated to CCI communications and cannot be used by any other application (neither the user). Command devices must be set using Hitachi Storage Navigator Modular 2. When setting two command devices, add second command device in the HORCM_CMD section.
In the same line, you can also add a command device specified by a different path so that the host can use the same command device when one of the paths cannot be used.

Figure 2-40: SnapShot Example with Two Command Devices

Example of CCI commands with Instance-0 on HOSTA: SnapShot

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

For C shell:

```
# setenv HORCMINST 0
```

For Windows®:

```
set HORCMINST=0
```

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

```
# paircreate –g Oradb –vl -split
```

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

Designate a volume name (oradev1) and a local instance P-VOL a case.

```
# paircreate –g Oradb –d oradev1 –vl -split
```

This command creates pairs for all LUs designated as **oradev1** in the configuration definition file.

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 )85010061    18.P-VOL PSUS,85010061    19 -
Oradb   oradev1(R)  (CL1-B , 2,   1-0 )85010061    19.S-VOL SSUS,-----       18 -
Oradb   oradev2(L)  (CL1-A , 1,   2-0 )85010061    20.P-VOL PSUS,85010061    21 -
Oradb   oradev2(R)  (CL1-B , 2,   2-0 )85010061    21.S-VOL SSUS,-----       20 –
```

Example of CCI commands with Instance-1 on HOSTA: SnapShot

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

For C shell:

```
# setenv HORCMINST 1
```

For Windows®:

```
set HORCMINST=1
```

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 instance P-VOL a case.

```
# paircreate –g Oradb –vr -split
```

This command creates pairs for all LUs designated as **Oradb** in the configuration definition file.

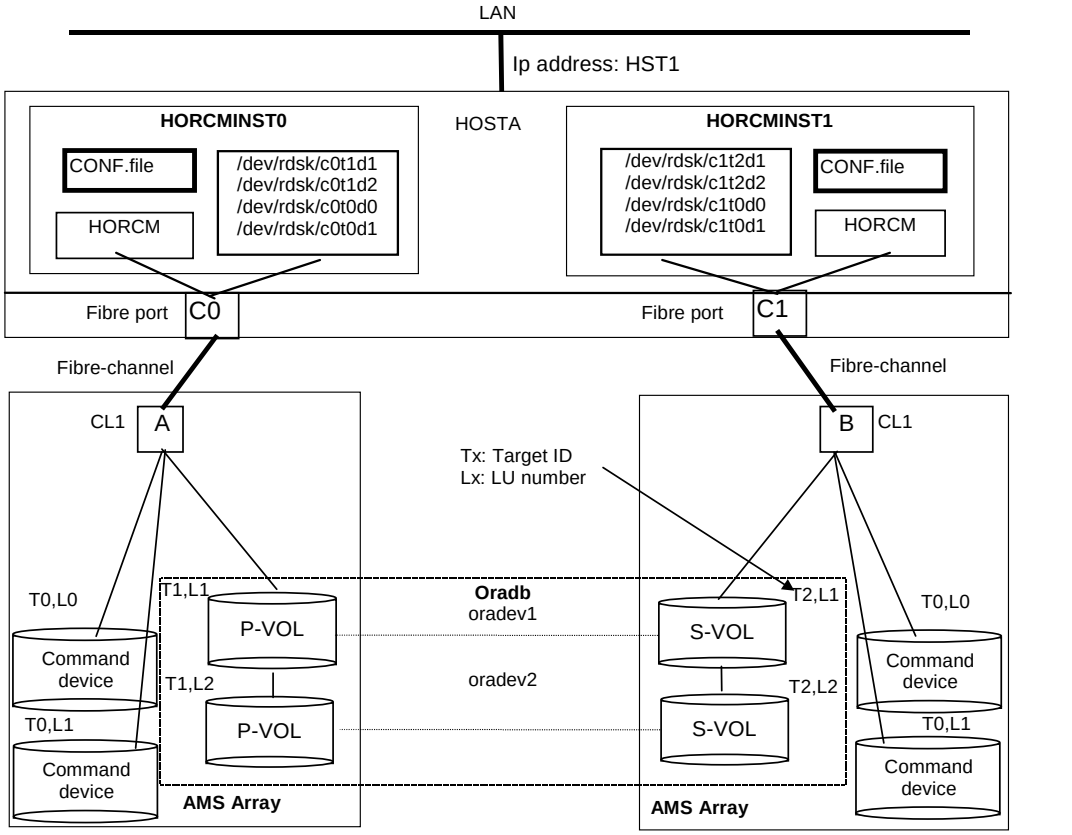
Designate a volume name (oradev1) and a remote instance P-VOL a case.

```
# paircreate –g Oradb –d oradev1 –vr -split
```

This command creates pairs for all LUs designated as **oradev1** in the configuration definition file.

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-B , 2,   1-0 )85010061    19.S-VOL SSUS,-----      18 -
Oradb   oradev1(R)   (CL1-A , 1,   1-0 )85010061    18.P-VOL PSUS,85010061   19 -
Oradb   oradev2(L)   (CL1-B , 2,   2-0 )85010061    21.S-VOL SSUS,-----      20 -
Oradb   oradev2(R)   (CL1-A , 1,   2-0 )85010061    20.P-VOL PSUS,85010061   21 –
```



Configuration file for HORCMINST0 (horcm0.conf)

```
HORCM_MON
#ip_address  service   poll(10ms)   timeout(10ms)
HST1         horcm0    12000 [Note 1]     3000

HORCM_CMD
#dev_name
 /dev/xxx  /dev/yyy  [Note 2]

HORCM_DEV
#dev_group  dev_name  port#  TargetID  LU#  MU#
 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    12000 [Note 1]     3000

HORCM_CMD
#dev_name
 /dev/zzz  /dev/uuu  [Note 2]

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

HORCM_INST
#dev_group      ip_address      service
 Oradb          HST1            horcm0
```

Note 1: To calculate the value for poll(10ms), see section 2.5.3.
Note 2: The command device is dedicated to CCI communications and cannot be used by any other applications (neither the user). Command devices must be set using Hitachi Storage Navigator Modular 2. If setting two command devices, add second command device in the HORCM_CMD section.
In the same line, you can also add a command device specified by different path, so that the host can use the same command device incase when one of the path cannot be used.

Figure 2-41: TrueCopy/TCE Example with Two Command Devices

Example of CCI commands with Instance-0 on HOSTA: TrueCopy

For TCE, a fence level of “async” must be specified.

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 2-41).

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-B, T2, L1 for the configuration in Figure 2-41).

Designate a group name and display pair status.

```
# pairdisplay -g Oradb
Group   PairVol(L/R) (Port#,TID, LU) ,Seq#,LDEV#.P/S,Status,Fence, Seq#,P-LDEV# M
Oradb  oradev1(L)  (CL1-A  ,  1,  1 )85010061    18.P-VOL COPY NEVER ,85010062    19 -
Oradb  oradev1(R)  (CL1-B  ,  2,  1 )85010062    19.S-VOL COPY NEVER , -----      18 -
Oradb  oradev2(L)  (CL1-A  ,  1,  2 )85010061    20.P-VOL COPY NEVER ,85010062    21 -
Oradb  oradev2(R)  (CL1-B  ,  2,  2 )85010062    21.S-VOL COPY NEVER , -----      20 –
```

Example of CCI commands with Instance-1 on HOSTA: TrueCopy

For TCE, a fence level of “async” must be specified.

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 LUs 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 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-B, T2, L1 for the configuration in Figure 2-41).

Designate a group name and display pair status.

```
# pairdisplay -g Oradb
Group   PairVol(L/R) (Port#,TID, LU) ,Seq#,LDEV#.P/S,Status,Fence, Seq#,P-LDEV# M
Oradb  oradev1(L)  (CL1-B  ,  2,  1 )85010062    19.S-VOL COPY NEVER , -----     18 -
Oradb  oradev1(R)  (CL1-A  ,  1,  1 )85010061    18.P-VOL COPY NEVER ,85010062    19 -
Oradb  oradev2(L)  (CL1-B  ,  2,  2 )85010062    21.S-VOL COPY NEVER , -----     20 -
Oradb  oradev2(R)  (CL1-A  ,  1,  2 )85010061    20.P-VOL COPY NEVER ,85010062    21 –
```

TrueCopy/ShadowImage configuration with cascade pairs

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 port, then the number of instances is up to 16 per command device. If this restriction is exceeded, use a different path for each instance. For example, the command devices for would be as follows:

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

The command device can be used without a label in the format command.

AIX®:

HORCM_CMD of HOSTA (/etc/horcm.conf) = /dev/rhdisk*X*
HORCM_CMD of HOSTB (/etc/horcm.conf) = /dev/rhdisk*X*
HORCM_CMD of HOSTB (/etc/horcm0.conf) = /dev/rhdisk*X*

where *X* = device number assigned by AIX®

Tru64 UNIX®:

HORCM_CMD of HOSTA (/etc/horcm.conf) = /dev/rhdisk/dsk*X*c
HORCM_CMD of HOSTB (/etc/horcm.conf) = /dev/rhdisk/dsk*X*c
HORCM_CMD of HOSTB (/etc/horcm0.conf) = /dev/rhdisk/dsk*X*c

where *X* = device number assigned by Tru64 UNIX®

Linux®:

HORCM_CMD of HOSTA (/etc/horcm.conf) = /dev/sd*X*
HORCM_CMD of HOSTB (/etc/horcm.conf) = /dev/sd*X*
HORCM_CMD of HOSTB (/etc/horcm0.conf) = /dev/sd*X*

where *X* = device number assigned by Linux®

IRIX®:

HORCM_CMD of HOSTA (/etc/horcm.conf) = /dev/rdsk/dks*X*d*X*l*X*vol
OR
HORCM_CMD of HOSTA (/etc/horcm.conf) = /dev/rdsk/node_wwn/lun*X*vol/c*X*p*X*
HORCM_CMD of HOSTB (/etc/horcm.conf) = /dev/rdsk/dks*X*d*X*l*X*vol
OR
HORCM_CMD of HOSTB (/etc/horcm.conf) = /dev/rdsk/node_wwn/lun*X*vol/c*X*p*X*
HORCM_CMD of HOSTB (/etc/horcm0.conf) = /dev/rdsk/dks*X*d*Y*l*X*vol

OR
HORCM_CMD of HOSTB (/etc/horcm0.conf) = /dev/rdsk/node_wwn/lun*X*vol/c*Y*p*X*

where *X* = device number assigned by IRIX®

Windows® 2000/Windows Server™ 2003/Windows Server™ 2008:

HORCM_CMD of HOSTA (/etc/horcm.conf) = \\.\PhysicalDrive*X*
OR
HORCM_CMD of HOSTA (/etc/horcm.conf) = \\.\Volume{guid}
OR
HORCM_CMD of HOSTA (/etc/horcm.conf) = \\.\CMD-Ser#-ldev#-Port#

HORCM_CMD of HOSTB (/etc/horcm.conf) = \\.\PhysicalDrive*X*
OR
HORCM_CMD of HOSTB (/etc/horcm.conf) = \\.\Volume{guid}
OR
HORCM_CMD of HOSTB (/etc/horcm.conf) = \\.\CMD-Ser#-ldev#-Port#

HORCM_CMD of HOSTB (/etc/horcm0.conf) = \\.\PhysicalDrive*X*
OR
HORCM_CMD of HOSTB (/etc/horcm0.conf) = \\.\Volume{guid}
OR
HORCM_CMD of HOSTB (/etc/horcm0.conf) = \\.\CMD-Ser#-ldev#-Port#

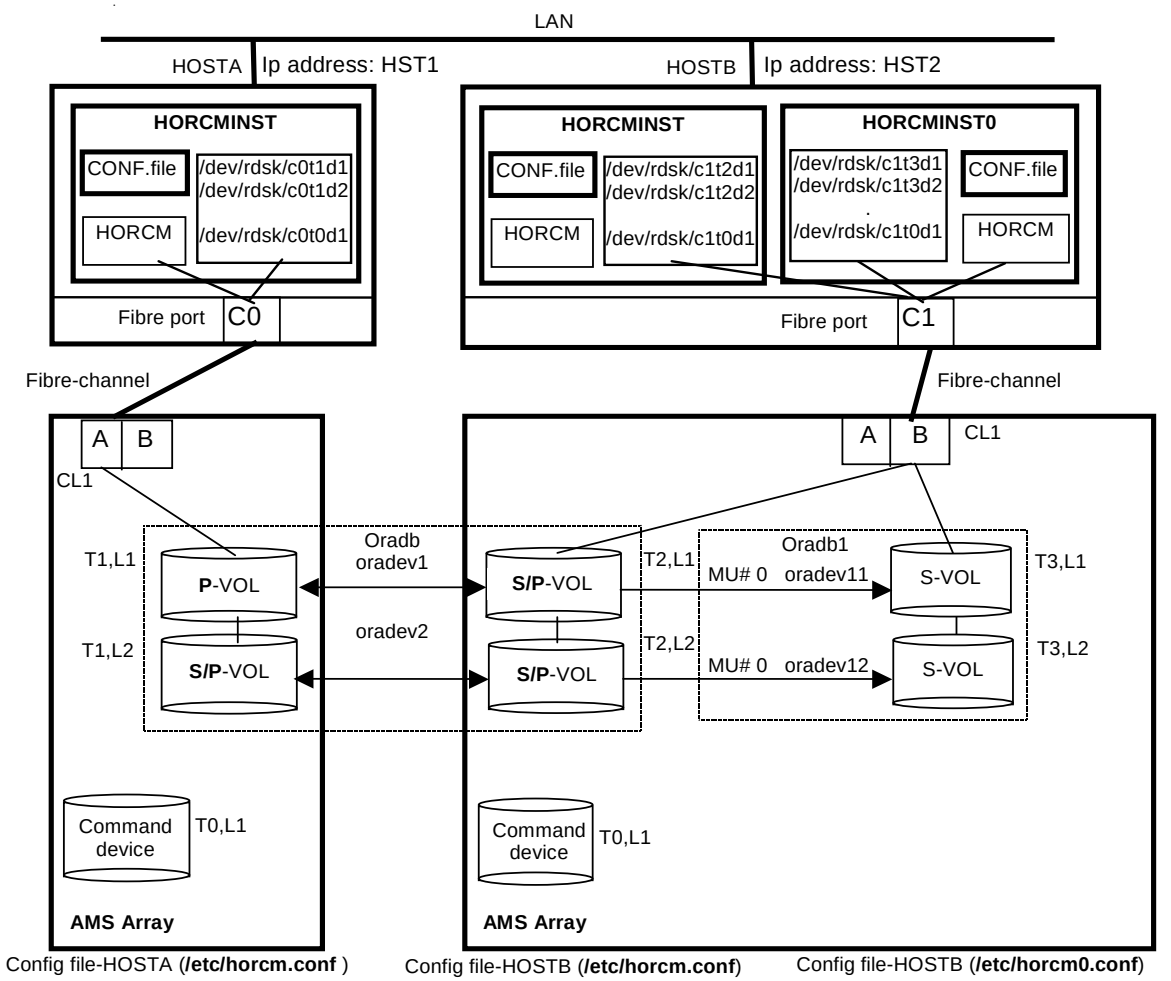
where *X* = device number assigned by Windows® 2000/Windows Server™ 2003/Windows Server™ 2008.

The PhysicalDrive number may change at every reboot. If the number changes, use \\.\CMD-Ser#-ldev#-Port# or Volume{guid} for which the same name is kept.

If "\\.\CMD-Ser#-ldev#-Port# or \\.\Volume{guid}" is specified, CCI changes it to "\\.\PhysicalDrive?" to be corresponded. For MSCS, it is recommended to use \\.\CMD-Ser#-ldev#-Port# instead of \\.\Volume{GUID} because \\.\Volume{GUID} may not be maintained. Using \\.\CMD-Ser#-ldev#-Port# does not require to create any partition on a volume. Volume{guid} is created when you make a partition by using the Windows' Disk Management. You can find Volume{guid} by using the `inqraid $Volume -CLI -fv` or `raidscan -x findcmddev0.?` commands.

Note 1: Regarding a command device for CCI, do not set two or more paths for a single host. (Windows® 2000/Windows Server™ 2003/Windows Server™ 2008 may change the **guid** when a volume with an identical **guid** is found.

Note 2: For Windows Server™ 2003/Windows Server™ 2008, when a path detachment, which is caused by a controller detachment or interface failure, continues for longer than one minute, the command device may be unable to be recognized at the time when recovery from the path detachment is made. To make the recovery, execute the re-scanning of the disks of Windows®. When Windows® cannot access the command device although CCI becomes able to recognize the command device, restart CCI.



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

```
HORCM_MON
#ip_address service poll(10ms) timeout(10ms)
HST1        horcm   12000 [Note 1]    3000
HORCM_CMD
#dev_name
 /dev/xxx  [Note 2]
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(10ms)
HST2        horcm   12000 [Note 1]    3000
HORCM_CMD
#dev_name
 /dev/xxx  [Note 2]
HORCM_DEV
#dev_groupdev_name port#  TID LU# MU#
Oradb       oradev1   CL1-B  2     1
Oradb       oradev2   CL1-B  2     2
Oradb1      oradev11  CL1-B  2     1     0
Oradb1      oradev12  CL1-B  2     2     0

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

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

```
HORCM_MON
#ip_address service poll(10ms) timeout(10ms)
HST2        horcm0  12000 [Note 1]    3000
HORCM_CMD
#dev_name
 /dev/xxx  [Note 2]
HORCM_DEV
#dev_groupdev_name port#  TID LU# MU#
Oradb       oradev1   CL1-B  2     1
Oradb       oradev2   CL1-B  2     2
Oradb1      oradev11  CL1-B  3     1     0
Oradb1      oradev12  CL1-B  3     2     0

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

Shaded portions: If HORCMINST0 needs to operate TrueCopy's paired volume, then describe **oradb**.
Note 1: To calculate the value for poll(10ms), see section 2.5.3.
Note 2: The command device is dedicated to CCI communications and cannot be used by any other applications (neither the user). Command devices must be set using Hitachi Storage Navigator Modular 2. If you are setting two command devices, add second command device in the HORCM_CMD section. In the same line, you can also add a command device specified by different path, so that the host can use the same command device when one of the paths cannot be used.

Figure 2-42: TrueCopy/ShadowImage Configuration Example with Cascade Pairs

Example of CCI commands with HOSTA and HOSTB:

Designate a group name (Oradb) on TrueCopy environment of HOSTA.

```
# paircreate -g Oradb -f never -vl
```

When the command execution environment is not set, set HORCC_MRCF. For C shell:

```
# setenv HORCC_MRCF 1
```

For Windows®:

```
set HORCC_MRCF=1
```

Designate a group name (Oradb1) on ShadowImage environment of HOSTB.

```
# 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 2-42).

Designate a group name and display pair status on HOSTA.

```
# 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-A , 1,  1-0 )85010061    26.SMPL ----,-----  ---- -
Oradb   oradev1(L)   (CL1-A , 1,  1 )85010061    26.P-VOL COPY,85010062    28 -
Oradb1  oradev11(R)  (CL1-B , 2,  1-0 )85010062    28.P-VOL COPY,85010062    30 -
Oradb   oradev1(R)   (CL1-B , 2,  1 )85010062    28.S-VOL COPY,-----      26 -
Oradb   oradev2(L)   (CL1-A , 1,  2-0 )85010061    27.SMPL ----,-----     ---- -
Oradb   oradev2(L)   (CL1-A , 1,  2 )85010061    27.P-VOL COPY,85010062    29 -
Oradb1  oradev12(R)  (CL1-B , 2,  2-0 )85010062    29.P-VOL COPY,85010062    31 -
Oradb   oradev2(R)   (CL1-B , 2,  2 )85010062    29.S-VOL COPY,-----     27 –
```

Example of CCI commands with HOSTB:

Designate a group name (oradb) on TrueCopy environment of HOSTB

```
# paircreate -g Oradb -f never -vr
```

When the command execution environment is not set, set HORCC_MRCF. For C shell:

```
# setenv HORCC_MRCF 1
```

For Windows®:

```
set HORCC_MRCF=1
```

Designate a group name (Oradb1) on ShadowImage environment of HOSTB.

```
# 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 2-42).

Designate a group name and display pair status on TrueCopy environment of HOSTB.

```
# pairdisplay –g oradb –m all
Group   PairVol(L/R) (Port#,TID, LU-M) ,Seq#,LDEV#.P/S,Status, Seq#,P-LDEV# M
Oradb1  oradev11(L) (CL1-B , 2,  1-0 )85010062    28.P-VOL PAIR,85010062    30 -
Oradb   oradev1(L)  (CL1-B , 2,  1 )85010062    28.S-VOL PAIR,-----       26 -
Oradb   oradev1(R)  (CL1-A , 1,  1-0 )85010061    26.SMPL ----,-----       ---- -
Oradb   oradev1(R)  (CL1-A , 1,  1 )85010061     26.P-VOL PAIR,85010062    28 -
Oradb1  oradev12(L) (CL1-B , 2,  2-0 )85010062    29.P-VOL PAIR,85010062    31 -
Oradb   oradev2(L)  (CL1-B , 2,  2 )85010062    29.S-VOL PAIR,-----       27 -
Oradb   oradev2(R)  (CL1-A , 1,  2-0 )85010061    27.SMPL ----,-----       ---- -
Oradb   oradev2(R)  (CL1-A , 1,  2 )85010061    27.P-VOL PAIR,85010062    29 –
```

Designate a group name and display pair status on ShadowImage environment of HOSTB.

```
# pairdisplay –g oradb1 –m all
Group   PairVol(L/R) (Port#,TID, LU-M) ,Seq#,LDEV#.P/S,Status, Seq#,P-LDEV# M
Oradb1  oradev11(L) (CL1-B , 2,  1-0 )85010062    28.P-VOL PAIR,85010062    30 -
Oradb   oradev1(L)  (CL1-B , 2,  1 )85010062    28.S-VOL PAIR,-----       26 -
Oradb1  oradev11(R) (CL1-B , 3,  1-0 )85010062    30.S-VOL PAIR,-----       28 -
Oradb1  oradev12(L) (CL1-B , 2,  2-0 )85010062    29.P-VOL PAIR,85010062    31 -
Oradb   oradev2(L)  (CL1-B , 2,  2 )85010062    29.S-VOL PAIR,-----       27 -
Oradb1  oradev12(R) (CL1-B , 3,  2-0 )85010062    31.S-VOL PAIR,-----       29 –
```

Designate a group name and display pair status on ShadowImage environment of HOSTB (HORCMINST0).

```
# pairdisplay –g oradb1 –m all
Group   PairVol(L/R) (Port#,TID, LU-M) ,Seq#,LDEV#.P/S,Status, Seq#,P-LDEV# M
Oradb1  oradev11(L) (CL1-B , 3,  1-0 )85010062    30.S-VOL PAIR,-----       28 -
Oradb1  oradev11(R) (CL1-B , 2,  1-0 )85010062    28.P-VOL PAIR,85010062    30 -
Oradb   oradev1(R)  (CL1-B , 2,   1 )85010062    28.S-VOL PAIR,-----       26 -
Oradb1  oradev12(L) (CL1-B , 3,  2-0 )85010062    31.S-VOL PAIR,-----       29 -
Oradb1  oradev12(R) (CL1-B , 2,  2-0 )85010062    29.P-VOL PAIR,85010062    31 -
Oradb   oradev2(R)  (CL1-B , 2,   2 )85010062    29.S-VOL PAIR,-----       27 –
```

TCE/SnapShot Configuration with cascade pairs

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 port, then the number of instances is up to 16 per command device. If this restriction is exceeded, use a different path for each instance. For example, the command devices for would be as follows:

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

The command device can be used without a label in the format command.

AIX®:

HORCM_CMD of HOSTA (/etc/horcm.conf) = /dev/rhdisk*X*
HORCM_CMD of HOSTB (/etc/horcm.conf) = /dev/rhdisk*X*
HORCM_CMD of HOSTB (/etc/horcm0.conf) = /dev/rhdisk*X*

where *X* = device number assigned by AIX®

Tru64 UNIX®:

HORCM_CMD of HOSTA (/etc/horcm.conf) = /dev/rhdisk/dsk*X*c
HORCM_CMD of HOSTB (/etc/horcm.conf) = /dev/rhdisk/dsk*X*c
HORCM_CMD of HOSTB (/etc/horcm0.conf) = /dev/rhdisk/dsk*X*c

where *X* = device number assigned by Tru64 UNIX®

Linux®:

HORCM_CMD of HOSTA (/etc/horcm.conf) = /dev/sd*X*
HORCM_CMD of HOSTB (/etc/horcm.conf) = /dev/sd*X*
HORCM_CMD of HOSTB (/etc/horcm0.conf) = /dev/sd*X*

where *X* = device number assigned by Linux®

IRIX®:

HORCM_CMD of HOSTA (/etc/horcm.conf) = /dev/rdsk/dks*X*d*X*l*X*vol
OR
HORCM_CMD of HOSTA (/etc/horcm.conf) = /dev/rdsk/node_wwn/lun*X*vol/c*X*p*X*
HORCM_CMD of HOSTB (/etc/horcm.conf) = /dev/rdsk/dks*X*d*X*l*X*vol
OR
HORCM_CMD of HOSTB (/etc/horcm.conf) = /dev/rdsk/node_wwn/lun*X*vol/c*X*p*X*
HORCM_CMD of HOSTB (/etc/horcm0.conf) = /dev/rdsk/dks*X*d*Y*l*X*vol
OR
HORCM_CMD of HOSTB (/etc/horcm0.conf) = /dev/rdsk/node_wwn/lun*X*vol/c*Y*p*X*

where *X* = device number assigned by IRIX®

Windows® 2000/Windows Server™ 2003/Windows Server™ 2008:

HORCM_CMD of HOSTA (/etc/horcm.conf) = \\.\PhysicalDrive*X*
OR
HORCM_CMD of HOSTA (/etc/horcm.conf) = \\.\Volume{guid}
OR
HORCM_CMD of HOSTA (/etc/horcm.conf) = \\.\CMD-Ser#-ldev#-Port#

HORCM_CMD of HOSTB (/etc/horcm.conf) = \\.\PhysicalDrive*X*
OR
HORCM_CMD of HOSTB (/etc/horcm.conf) = \\.\Volume{guid}
OR
HORCM_CMD of HOSTB (/etc/horcm.conf) = \\.\CMD-Ser#-ldev#-Port#

HORCM_CMD of HOSTB (/etc/horcm0.conf) = \\.\PhysicalDrive*X*
OR
HORCM_CMD of HOSTB (/etc/horcm0.conf) = \\.\Volume{guid}
OR
HORCM_CMD of HOSTB (/etc/horcm0.conf) = \\.\CMD-Ser#-ldev#-Port#

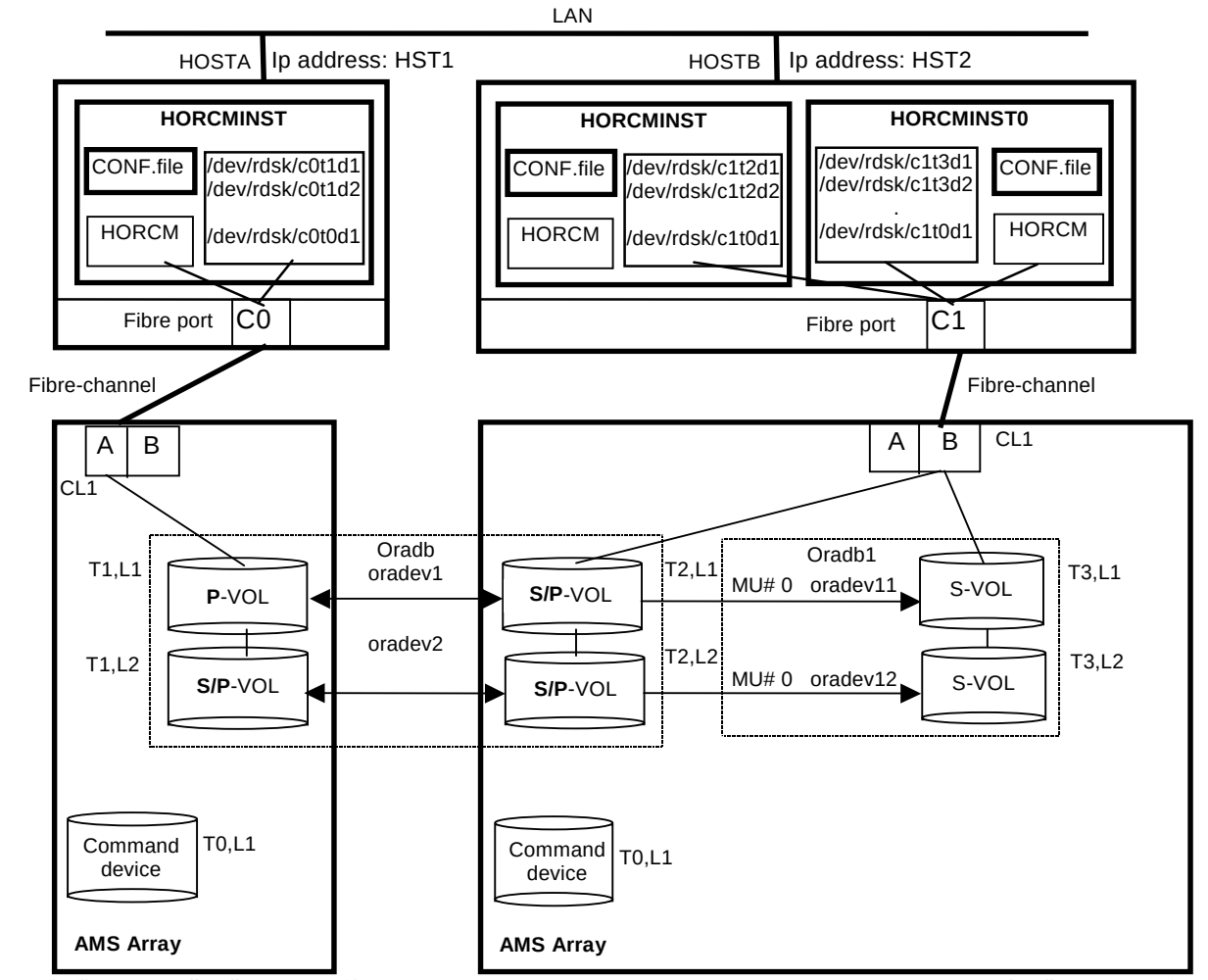
where *X* = device number assigned by Windows® 2000/Windows Server™ 2003/Windows Server™ 2008.

The PhysicalDrive number may change at every reboot. If the number changes, use \\.\CMD-Ser#-ldev#-Port# or Volume{guid} for which the same name is kept.

If "\\.\CMD-Ser#-ldev#-Port# or \\.\Volume{guid}" is specified, CCI changes it to "\\.\PhysicalDrive?" to be corresponded. For MSCS, it is recommended to use \\.\CMD-Ser#-ldev#-Port# instead of \\.\Volume{GUID} because \\.\Volume{GUID} may not be maintained. Using \\.\CMD-Ser#-ldev#-Port# does not require to create any partition on a volume. Volume{guid} is created when you make a partition by using the Windows' Disk Management. You can find Volume{guid} by using the `inqraid $Volume -CLI -fv` or `raidscan -x findcmddev0.?` commands.

Note 1: Regarding a command device for CCI, do not set two or more paths for a single host. (Windows® 2000/Windows Server™ 2003/Windows Server™ 2008 may change the **guid** when a volume with an identical **guid** is found.

Note 2: For Windows Server™ 2003/Windows Server™ 2008, when a path detachment, which is caused by a controller detachment or interface failure, continues for longer than one minute, the command device may be unable to be recognized at the time when recovery from the path detachment is made. To make the recovery, execute the re-scanning of the disks of Windows®. When Windows® cannot access the command device although CCI becomes able to recognize the command device, restart CCI.



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

```
HORCM_MON
#ip_address service poll(10ms) timeout(10ms)
HST1        horcm   12000 [Note 1]     3000
HORCM_CMD
#dev_name
 /dev/xxx  [Note 2]
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(10ms)
HST2        horcm   12000 [Note 1]     3000
HORCM_CMD
#dev_name
 /dev/xxx  [Note 2]
HORCM_DEV
#dev_groupdev_name port#  TID LU# MU#
Oradb       oradev1   CL1-B  2     1
Oradb       oradev2   CL1-B  2     2
Oradb1      oradev11  CL1-B  2     1     0
Oradb1      oradev12  CL1-B  2     2     0

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

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

```
HORCM_MON
#ip_address service poll(10ms) timeout(10ms)
HST2        horcm0  12000 [Note 1]     3000
HORCM_CMD
#dev_name
 /dev/xxx  [Note 2]
HORCM_DEV
#dev_groupdev_name port#  TID LU# MU#
Oradb       oradev1   CL1-B  2     1
Oradb       oradev2   CL1-B  2     2
Oradb1      oradev11  CL1-B  3     1     0
Oradb1      oradev12  CL1-B  3     2     0

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

Shaded portions: If HORCMINST0 needs to operate TCE's paired volume, then describe **oradb**.
Note 1: To calculate the value for poll(10ms), see section 2.5.3.
Note 2: The command device is dedicated to CCI communications and cannot be used by any other applications (neither the user). Command devices must be set using Hitachi Storage Navigator Modular 2. If you are setting two command devices, add second command device in the HORCM_CMD section. In the same line, you can also add a command device specified by different path, so that the host can use the same command device when one of the paths cannot be used.

Figure 2-43: TCE/SnapShot Configuration Example with Cascade Pairs

Example of CCI commands with HOSTA and HOSTB:

Designate a group name (Oradb) on TCE environment of HOSTA.

```
#  paircreate  -g Oradb  -f async  -vl
```

When the command execution environment is not set, set HORCC_MRCF of HOSTB.

For C shell:

```
#  setenv  HORCC_MRCF 1
```

For Windows®:

```
set  HORCC_MRCF=1
```

Cascade the P-VOL of SnapShot with the S-VOL of TCE specifying a group in the SnapShot environment of HOSTB.

```
#  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 2-43).

Designate a group name and display pair status on HOSTA.

```
# 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-A , 1,  1-0 )85003052    26.SMPL ----,-----  ---- -
Oradb   oradev1(L)   (CL1-A , 1,  1 )85003052    26.P-VOL COPY,85003053    28 -
Oradb1  oradev11(R)  (CL1-B , 2,  1-0 )85003053    28.P-VOL COPY,85003053    30 -
Oradb   oradev1(R)   (CL1-B , 2,  1 )85003053    28.S-VOL COPY,-----      26 -
Oradb   oradev2(L)   (CL1-A , 1,  2-0 )85003052    27.SMPL ----,-----     ---- -
Oradb   oradev2(L)   (CL1-A , 1,  2 )85003052    27.P-VOL COPY,85003053    29 -
Oradb1  oradev12(R)  (CL1-B , 2,  2-0 )85003053    29.P-VOL COPY,85003053    31 -
Oradb   oradev2(R)   (CL1-B , 2,  2 )85003053    29.S-VOL COPY,-----     27 –
```

Make the Host A specify the cascaded SnapShot pair and split the pair. The command is issued to the group of TCE, however, what is actually split is the cascaded SnapShot pair.

```
#  pairsplit  -g Oradb  -mscas 123456 0
```

The V-VOL (Mu#:0) of the SnapShot pair, Oradev11, which was specified as Oradb in the configuration definition file and cascaded with a pair in the group of TCE, is split.

When the status of the volume, which was produced by the splitting of a cascaded SnapShot pair, is displayed specifying a group in the SnapShot environment of the Host B, the following is displayed.

```
#  pairdisplay  -g Oradb1  -d Oradev11 –v smk
Group   PairVol(L/R) Serial#  LDEV# P/S Status  UTC-TIME -----Split-Marker------
Oradb1   oradev11(L) 85003053    30.S-VOL SSUS,-          -
Oradb1   oradev11(R) 85003053    28.P-VOL PSUS,123456ef  123456
```

Error monitoring and configuration confirmation

HORCM supports error monitoring and configuration confirmation commands for linkage with the system operation management of the UNIX®/PC host.

Paired volume error monitoring

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

Objects and scope of monitoring: The HORCM operates as a daemon process on the host 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 P-VOL error or S-VOL's SUS), does the HORC Manager regard the change as an error.

Monitoring time and interval: This command always issues I/O instructions to the AMS array in order to obtain information for monitoring. It is possible to specify the monitoring interval in the configuration definition file to adjust the daemon load.

Error notification by HORCM: Since the operation management of the UNIX® host checks Syslog to find system errors in many cases, ShadowImage/SnapShot/TrueCopy/TCE error messages are output to Syslog for linkage with the system operation management.

Error notification command: The CCI supports the error notification function using commands in order to allow the UNIX® host/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. Operations can be specified using certain options. If the command finds the status transition data in the status transition queue, it displays the data of all volumes. Specifying the option of this command can erase data in the HORCM's status transition queue.

Pair status display and configuration confirmation

The configuration definition file combines physical volumes in the AMS array used independently by the hosts. Therefore, be certain that the host volumes are combined as intended by the host system administrator.

The pairdisplay command displays the pairing status to enable you to verify the completion of pair creation or pair resynchronization (see Figure 2-44). This command is also used to confirm the configuration of the paired volume connection path (physical link of paired volumes among the hosts).

```
  --Link information of ?--  ----Link information of ?---
Group   PairVol(L/R) (Port#,TID, LU-M) ,Seq#,LDEV#.P/S,Status, Seq#,P-LDEV# M
G1      Oradb1(L)   (P1  , T1,   L1 ),Seq#,   1.P-VOL Pair , Seq#,    2  -
G1     Oradb1(R)   (P2  , T2,   L2 ),Seq#,   2.S-VOL Pair , Seq#,    1  -
```

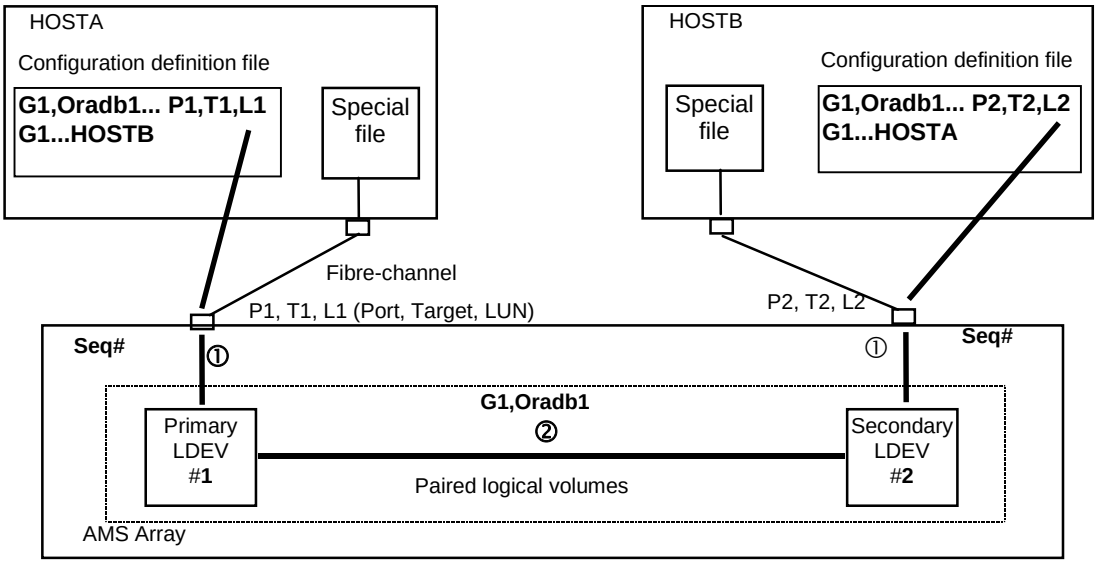


Figure 2-44: Pair Configuration Confirmation (Pairdisplay)

The raidscan command displays the fibre or iSCSI port, target ID, LDEVs mapped to LUNs, and status of those LDEVs, regardless of the configuration definition file. When a port number is specified, this command displays information about all target IDs and LUNs of that port.

About VMware

Operation procedures and restrictions when using CCI installed in a Guest OS of VMware are explained below.

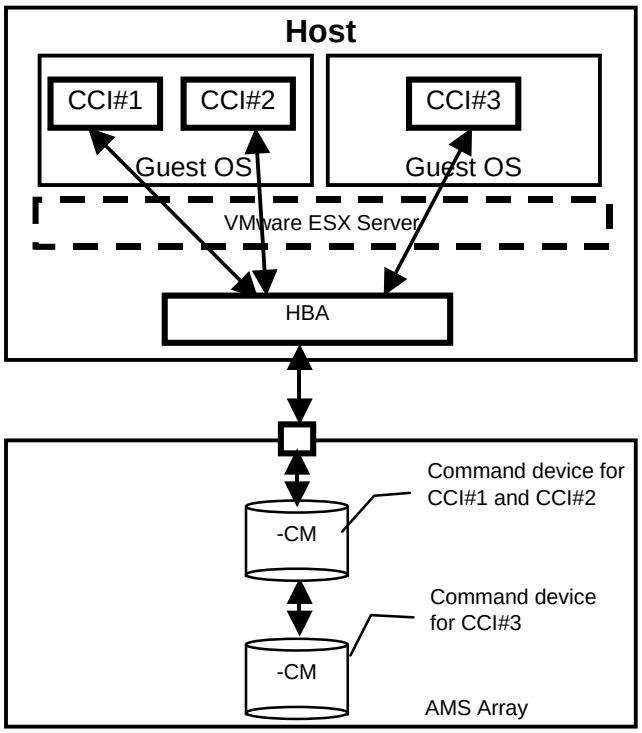


Figure 2-45: CCI Configuration on VMware

Restrictions on VMware

- About the Guest OS:
  - To make CCI operate on the Guest OS, it is required that both CCI and VMware support the OS to be used as a Guest OS. For the details, refer to “Applicable Platforms” described at the beginning of this manual.
  - It is required that the LU assigned to the Guest OS has become recognizable when VMware (a host OS) is started. The LU in which the Guest OS has been installed cannot create a pair.
- About the command device:
  - CCI uses the SCSI through interface in order to access a command device. Therefore, map the command device using the method of Raw Device Mapping.
  - When starting the CCI instance on two or more Guest OS’s, you can assign the same command device to each Guest OS. However, when you use the common command device, you cannot use the same instance number even if between the different Guest OS.
- Restrictions on the LU assigned to the pair
  - The LU of the guest OS assigned to the pair must be mapped as Raw Device Mapping using Physical Compatibility Mode.

CAUTION! It is required that the LUs assigned to the guest OS must be visible at the time of starting VMware (host OS). If the S-VOLs used by VSS are in invisible status when starting the VMware (host OS), the VMware (host OS) may not be able to start.

- Restrictions for sharing LU between guest OS and VMware (host OS)
  - Sharing of LUs, such as a command device, is not permitted between guest OS and VMware (host OS).

Operation procedures for creation and resynchronization of a pair

Procedures are explained below for the cases of the pair creation and the pair resynchronization referring to an operation example in which a pair is usually placed in the PSUS status and the P-VOL is resynchronized with the S-VOL when the backup is necessary.

The procedure to create a pair

1. Execute a `paircreate` command.
2. Wait for the volumes to be paired.
3. Un-mount the P-VOL.
4. Execute a `pairsplit` command.
5. Mount the P-VOL.
6. Rescan the HBA by clicking the **Rescan** button on the **Configure** tab in the VMware operation window.
7. Reboot the Guest OS.

NOTE: After the `paircreate` command or rescanning of the disks on the Host OS is executed, it is required to reboot the Guest OS in order to enable it to recognize the S-VOL.

8. Mount the S-VOL.

The procedure to resynchronize a pair

1. Un-mount the S-VOL.
2. Execute a `pairresync` command.
3. Wait for the volumes to be paired.
4. Un-mount the P-VOL.
5. Execute a `pairsplit` command.
6. Mount the P-VOL.
7. Rescan the HBA by clicking the **Rescan** button on the **Configure** tab in the VMware operation window.
8. Check if the Guest OS has recognized the S-VOL. If it has not recognized the S-VOL, reboot the Guest OS.

Hyper-V

This section explains operation restrictions when using CCI installed in a Hyper-V guest OS.

Restrictions on Hyper-V

To make CCI operate on the guest OS, it is required that both CCI and Hyper-V support the OS to be used as a guest OS. See Applicable platforms in the Preface for details.

Map the command device using the method of path through disk. CCI uses the SCSI through interface in order to access a command device.

When starting CCI Instance on two or more guest OS, assign the command device for each guest OS.

One hundred and twenty-eight command devices can be created per array. Therefore, the maximum number of acceptable guest OS is 128 for each array.

Restrictions on the LU assigned to the pair

The LU assigned to the pair must be mapped as path through disk. The disk that mapped VHD does not become a pair target.

CAUTION! It is required that the LUs assigned to guest OS must be visible when starting Hyper-V (management OS).

Share Restrictions between Guest OS and Hyper-V

Sharing of LUs, such as a command device, is not permitted between guest OS and Hyper-V (management OS).

Restrictions about the cluster shared volume

The cluster shared volume (CSV) is not supported in CCI.

Recovery procedures for HA configurations

After configuring and starting CCI 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 HITRACK and SNMP Agent or Web. However, a motive for the action above should be given by the CCI operation command.

Figure 2-46 shows the system failover and recovery procedure Figure 2-47 shows the regression and TrueCopy recovery procedure.

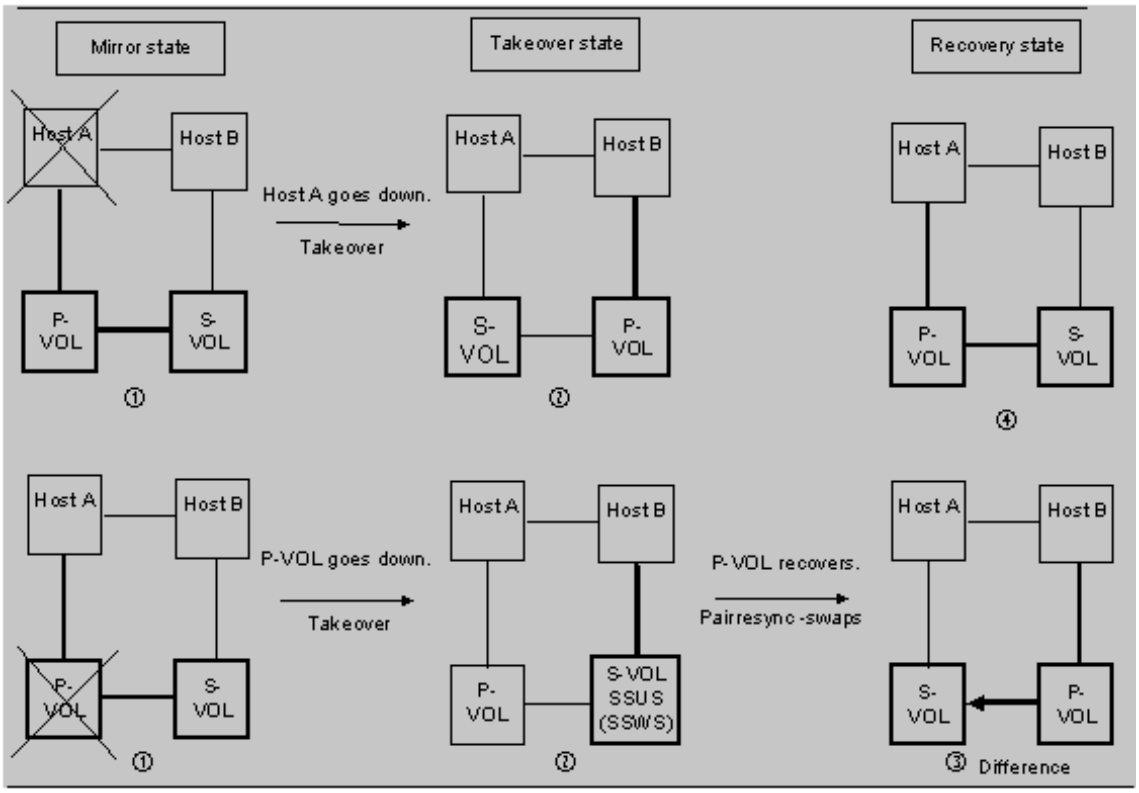


Figure 2-46: System Failover and Recovery

1. A failure occurs in the host A server (1-top) or in the P-VOL (1-bottom).
2. Host B detects the failure of host A or the P-VOL and issues a takeover command to make the S-VOL 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 P-VOL failure (1-bottom), the **SVOL-SSUS-takeover** command will be executed.
3. While host B continues processing, P-VOL and S-VOL 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 P-VOL has recovered, host A can take over processing from host B by executing the **Swap-takeover** (**horctakeover**) command.

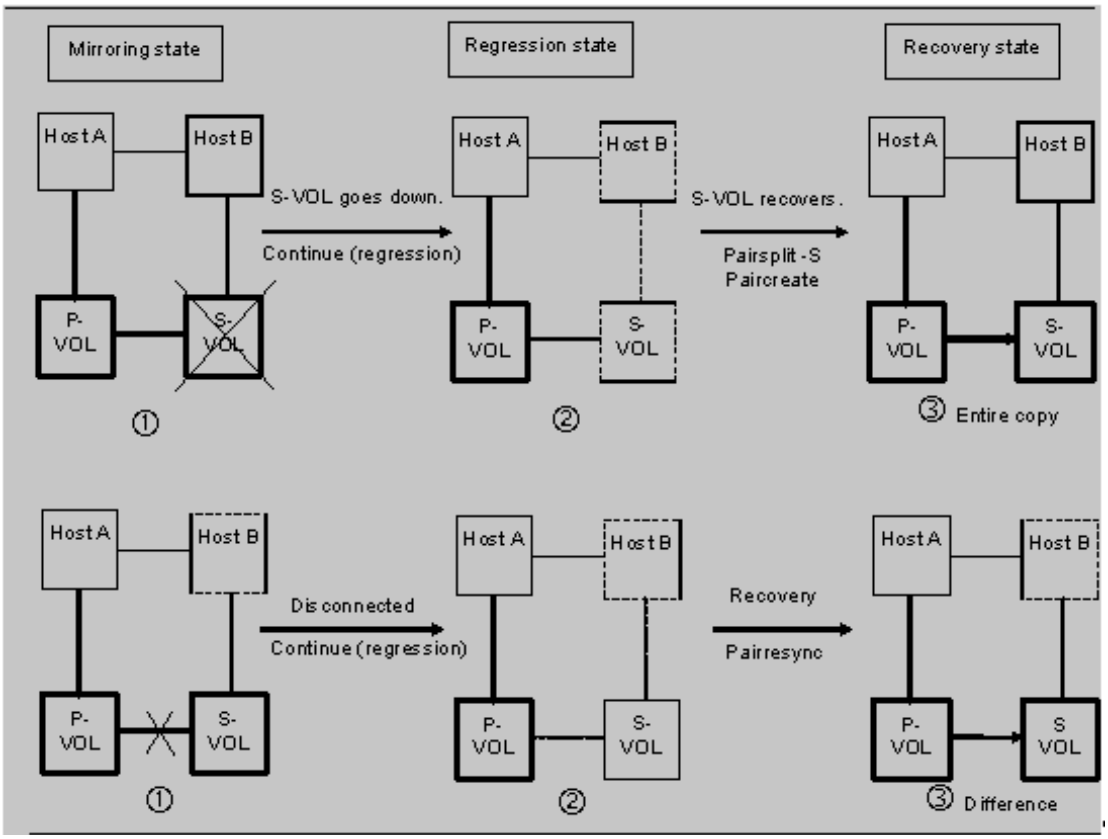


Figure 2-47: Degeneracy and Recovery in Case of System Error

1. The P-VOL detects a failure in the S-VOL 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 P-VOL 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 S-VOL recovers from the failure. The host A issues the **pairsplit -S**, **paircreate -vl**, or **pairresync** command to update the P-VOL data by copying entire data or copying differential data only. The updated data is fed back to the S-VOL.

About Platform Support for Internet Protocol Version 6 (IPv6)

IPv6 is the next generation internet protocol designed by the IETF to replace the current version IPv4. IPv6 is expected to gradually replace IPv4, with the two coexisting for a number of years during a transition period.

CCI support for IPv6 depends on the platform and OS version (see Applicable platforms, on page 1-ix). For some operating systems, CCI may not be able to perform IPv6 communication completely. In such cases, CCI logs whether the OS supports IPv6 or not, as shown below.

If the platform does not support IPv6, then CCI uses an internal function corresponding to “inet_pton(), inet_ntop()”. In this case, the IPv6 address will not be allowed to describe hostname.

```
/HORCM/log*/curlog/horcm_hostname.log
********************************************************************************
- HORCM STARTUP LOG - Thu Jun 05 15:47:19 2008
********************************************************************************
15:47:19-0f230-01720- horcmgr started on Thu Jun 05 15:47:19 2008
::
15:47:19-1e848-01172- ******** starts Loading library for IPv6 *******
[ AF_INET6 = 26, AI_PASSIVE = 1 ]
15:47:19ca1-02188- 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
15:47:19-5ab3e-02188- ******** finished Loading library **************
:
HORCM set to IPv6 ( INET6 value = 26)
:
```

3

Fibre-to-SCSI address conversion

This chapter provides Information for converting fibre channel to SCSI.

- Fibre Channel-to-SCSI address conversion

Fibre Channel-to-SCSI address conversion

Fibre channel physical addresses are converted to SCSI target Ids (TIDs) using a conversion table. Table 3-1 displays the current limits for SCSI TIDs on various operating systems.

Table 3-1: Limits for Target IDs

	HP-UX® and other Systems		Solaris™ Systems		Windows® Systems	
Port	TID	LUN	TID	LUN	TID	LUN
Fibre	0 to 15	0 to 511	0 to 125	0 to 511	0 to 31	0 to 511

An example of using the raidscan command to display the TID and LUN of Harddisk6 (HP® system) is displayed in Figure 3-1.

NOTE: You must start HORCM without descriptions of HORCM_DEV or HORCM_INST in the configuration definition file because of the unknown target IDs and LUNs.

```
C:\>raidscan -pd hd6 -x drivescan hd6
Harddisk 6... Port[ 2] PhId[ 4] TId[ 3] Lun[  5] [HITACHI     ] [DF600F       ]
Port[CL1-A] Ser#[85003005] LDEV#[  14(0x00E)]
HORC = SMPL  HOMRCF[MU#0 = SMPL MU#1 = NONE MU#2 = NONE]
RAID5[Group  1- 0] SSID = 0x0000
PORT# /ALPA/C,TID#,LU#.Num(LDEV#....)...P/S, Status,Fence,LDEV#,P-Seq#,P-LDEV#
CL1-A / e2/ 4,  29,  0.1(9).............SMPL  ----  ------ ----, -----  ----
CL1-A / e2/ 4,  29,  1.1(10)............SMPL  ----  ------ ----, -----  ----
CL1-A / e2/ 4,  29,  2.1(11)............SMPL  ----  ------ ----, -----  ----
CL1-A / e2/ 4,  29,  3.1(12)............SMPL  ----  ------ ----, -----  ----
CL1-A / e2/ 4,  29,  4.1(13)............SMPL  ----  ------ ----, -----  ----
CL1-A / e2/ 4,  29,  5.1(14)............SMPL  ----  ------ ----, -----  ----
CL1-A / e2/ 4,  29,  6.1(15)............SMPL  ----  ------ ----, -----  ----
Specified device is LDEV# 0014
```

Figure 3-1: 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 done using either of the following two methods:

```
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     ] [DF600F       ]
Port[CL1-A] Ser#[85003005] LDEV#[  14(0x00E)]
HORC = SMPL  HOMRCF[MU#0 = SMPL MU#1 = NONE MU#2 = NONE]
RAID5[Group  1- 0] SSID = 0x0000
PORT# /ALPA/C,TID#,LU#.Num(LDEV#....)...P/S,Status,Fence,LDEV#,P-Seq#,P-LDEV#
CL1-A / e2/ 0,   3,  0.1(9).............SMPL  ----  ------ ----, -----  ----
CL1-A / e2/ 0,   3,  1.1(10)............SMPL  ----  ------ ----, -----  ----
CL1-A / e2/ 0,   3,  2.1(11)............SMPL  ----  ------ ----, -----  ----
CL1-A / e2/ 0,   3,  3.1(12)............SMPL  ----  ------ ----, -----  ----
CL1-A / e2/ 0,   3,  4.1(13)............SMPL  ----  ------ ----, -----  ----
CL1-A / e2/ 0,   3,  5.1(14)............SMPL  ----  ------ ----, -----  ----
CL1-A / e2/ 0,   3,  6.1(15)............SMPL  ----  ------ ----, -----  ----
Specified device is LDEV# 0014
```

Figure 3-2: Using HORCMFCTBL to Change Default Fibre Conversion

Table 3-2, Table 3-3, and Table 3-4 show the fibre address conversion tables.

NOTE: AL-PA is an abbreviation for Arbitrated Loop Physical Address, and indicates the physical address for Fibre. TID is the target ID.

Table 3-2: 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 3-3: 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 3-4: Fibre Address Conversion Table for Windows® 2000/Windows Server™ 2003/Windows Server™ 2008 Systems (Table 2)

C5(PhId5)				C4(PhId4)				C3(PhId3)				C2(PhId2)				C1(PhId1)			
AL-PA	TID	AL-PAA	TID	AL-PA	TIDv	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	0

Notes:

- 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).
- The conversion table for Windows® 2000/Windows Server™ 2003/ Windows Server™ 2008 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® 2000/Windows Server™ 2003/Windows Server™ 2008 system. In such case, for the configuration definition file, use the target ID that is displayed (obtained) by the raidscan -find command.
- The conversion table for Native Fibre is used when the FC_AL conversion for the host is unknown, or when the FC_AL conversion is the device file displayed in LUN as Fabric mode. Only LUN is displayed and the target ID (displayed as zero) will not be used. Therefore, there is no table for Native Fibre since there is no conversion to target ID.

4

CCI operations on Windows Server 2000/2003/2008

This chapter includes the following:

- LDM volume search and flush
- Dynamic disk and copy function

LDM volume search and flush

Windows® 2000/Windows Server™ 2003/Windows Server™ 2008 supports a logical device manager called LDM. A logical drive is usually linked to LDM volumes (e.g. \Device\HarddiskVolumeX). Therefore, it is not easy to link the physical volume in the array with LDM volume. Linking physical volumes in the array with LDM volume is necessary when creating the configuration definition file, as shown in Figure 4-1.

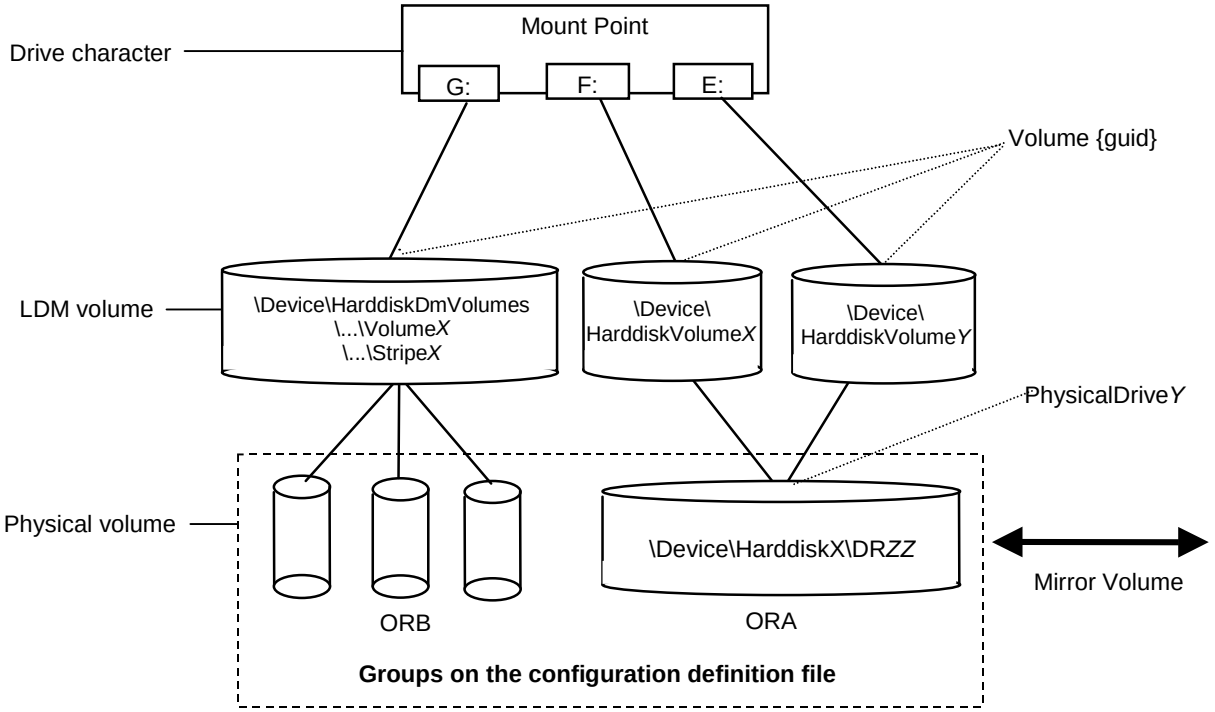


Figure 4-1: LDM Volume Configuration

LDM volume search

CCI provides you with a search function that shows the relationship between the physical volumes in the array and the LDM volumes. There are three types of volume searches:

- Physical: When using $Physical, CCI displays the relation between the physical drive and the LDEV configuration of the array.
- LDM Volume: When using $Volume, CCI displays the relation between the LDM volume/physical drive and the LDEV configuration of the array.
- Logical Device (drive character): When using $LETALL, CCI displays the relation between the logical device and directory-mounted volume/LDM volume/physical drive and the LDEV configuration of the array.

NOTE: The search condition ($Physical, #Volume, #LETALL) can be used for `raidscan -find` command, `inqraid` command, and `mkconf` command.

Also, the search condition ($LETALL) for searching the directory-mounted volumes can be used for `raidscan -find` command and `mkconf` command.

In the Windows® 2000/Windows Server™ 2003/Windows Server™ 2008 systems, the DOS devices (e.g. C: Volume{guid}) are related to the device object name (\Device\...). CCI changes the long name of these device objects to a shorter name, as shown below.

- LDM device object name for Windows® 2000/Windows Server™ 2003/ Windows Server™ 2008:
  \Device\HarddiskVolume*X* (partition volume) ↴ **\Vol*X*\Dsk*Y***
  Dsk*Y* indicates that Vol*X* is configured by Harddisk*Y*.
  \Device\HarddiskDmVolumes\...\Volume (span volume) ↴ **\Dms*X*\Dsk*Y*s**
  \Device\HarddiskDmVolumes\...\Stripe*X* (stripe volume) ↴ **\Dmt*X*\Dsk*Y*s**
  \Device\HarddiskDmVolumes\...\Raid*X* (RAID 5 volume) ↴ **\Dmt*X*\Dsk*Y*s**
  Dsk*Y*s indicates that Dms*X* (Dmt*X*, Dmr*X*) is configured by several Harddisk*Y1*, *Y2*....
- Device object name for Windows® 2000/Windows Server™ 2003/ Windows Server™ 2008 physical drive:
  \Device\Harddisk*X*\DRZZ -> **Harddisk*X***

Use the search condition (&Physical, $Volume, $LETALL) for the inqraid command, as shown below. You can see the relation between the logical device and directory-mounted volume/LDM volume/physical drive and the LDEV configuration of the array.

```
inqraid $Phy -CLI
DEVICE_FILE    PORT   SERIAL  LDEV CTG  H/M/12  SSID R:Group PRODUCT_ID
Harddisk0      CL2-A   85006145    7    -  s/s/ss  0000 1:01-00 DF600F
Harddisk1      CL2-A   85006145    8    -  s/s/ss  0000 1:01-00 DF600F
Harddisk2      CL2-A   85006145    9    -  s/s/ss  0000 1:01-00 DF600F
Harddisk3      CL2-A   85006145   10    -  s/s/ss  0000 1:01-00 DF600F
```

Figure 4-2: Inqraid Command using $Physical for Search Condition (Windows® 2000/Windows Server™ 2003/Windows Server™ 2008)

```
inqraid $Volume -CLI
DEVICE_FILE    PORT   SERIAL  LDEV CTG  H/M/12  SSID R:Group PRODUCT_ID
\Vol44\Dsk0    CL2-A   85006145    7    -  s/s/ss  0000 1:01-00 DF600F
\Vol45\Dsk0    CL2-A   85006145    7    -  s/s/ss  0000 1:01-00 DF600F
\Dmt1\Dsk1     CL2-A   85006145    8    -  s/s/ss  0000 1:01-00 DF600F
\Dmt1\Dsk2     CL2-A   85006145    9    -  s/s/ss  0000 1:01-00 DF600F
\Dmt1\Dsk3     CL2-A   85006145   10    -  s/s/ss  0000 1:01-00 DF600F
```

Figure 4-3: Inqraid Command using $Volume for Search Condition (Windows® 2000/Windows Server™ 2003/Windows Server™ 2008)

```
inqraid $LETALL –CLI
DEVICE_FILE    PORT    SERIAL  LDEV CTG  H/M/12  SSID R:Group PRODUCT_ID
E:\Vol44\Dsk0   CL2-A    85006145    7   -  s/s/ss  0000 1:01-00 DF600F
F:\Vol45\Dsk0   CL2-A    85006145    7   -  s/s/ss  0000 1:01-00 DF600F
G:\Dmt1\Dsk1    CL2-A    85006145    8   -  s/s/ss  0000 1:01-00 DF600F
G:\Dmt1\Dsk2    CL2-A    85006145    9   -  s/s/ss  0000 1:01-00 DF600F
G:\Dmt1\Dsk3    CL2-A    85006145   10   -  s/s/ss  0000 1:01-00 DF600F
```

Figure 4-4: Inqraid Command using $LETALL for Search Condition (Windows® 2000/Windows Server™ 2003/Windows Server™ 2008)

If you want to know the relationship between the LDM volumes and the groups in the configuration definition file, use the search conditions ($Physical, $Volume $LETALL) in the `raidscan –find verify` command. You can see the relation between the logical drive/LDM volume/physical drive and the groups.

```
raidscan -pi $LETALL -find verify
DEVICE_FILE        Group    PairVol     PORT   TARG  LUN M   SERIAL  LDEV
E:\Vol44\Dsk0       ORA     ORA_000     CL2-A     7    2 -    85006145   7
F:\Vol45\Dsk0       ORA     ORA_000     CL2-A     7    2 -    85006145   7
G:\Dmt1\Dsk1        ORB     ORB_000     CL2-A     7    4 -    85006145   8
G:\Dmt1\Dsk2        ORB     ORB_001     CL2-A     7    5 -    85006145   9
G:\Dmt1\Dsk3        ORB     ORB_002     CL2-A     7    6 -    85006145  10
```

Figure 4-5: Raidscan -find verify Command using $LETALL for Search Condition

```
raidscan -pi $LETALL –find
DEVICE_FILE       UID  S/F PORT   TARG  LUN    SERIAL  LDEV  PRODUCT_ID
E:\Vol44\Dsk0       0   F  CL2-A    7    2     85006145    7    DF600F
F:\Vol45\Dsk0       0   F  CL2-A    7    2     85006145    7    DF600F
G:\Dmt1\Dsk1        0   F  CL2-A    7    4     85006145    8    DF600F
G:\Dmt1\Dsk2        0   F  CL2-A    7    5     85006145    9    DF600F
G:\Dmt1\Dsk3        0   F  CL2-A    7    5     85006145   10    DF600F
```

Figure 4-6: Raidscan -find Command using $LETALL for Search Condition

The following is an example of LDM volume that is mounted by using a directory (hd1, hd2) that exists in D drive.

```
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-B   85006145   48   -  s/s/ss  0000 1:01-00 DF600F
D:\hd2\Vol9\Dsk1 CL2-B   85006145   49   -  s/s/ss  0000 1:01-00 DF600F
G:\Dms1\Dsk2    CL2-A    85006145   56   -  s/s/ss  0000 1:01-00 DF600F
G:\Dms1\Dsk3    CL2-A    85006145   57   -  s/s/ss  0000 1:01-00 DF600F
G:\Dms1\Dsk4    CL2-A    85006145   58   -  s/s/ss  0000 1:01-00 DF600F
```

Figure 4-7: Inqraid Command using $LETALL for Search Condition (Windows® 2000/Windows Server™ 2003/Windows Server™ 2008)

The directory-mounted volume can be operated using `–x sync` subcommand, `-x mount` subcommand, and `–x umount` subcommand that are embedded in CCI commands.

```
pairsplit -x mount D:\hd1 \Vol6
D:\hd1 <+> HarddiskVolume6
pairsplit -x mount F:\ \Vol7
F:\ <+> HarddiskVolume7
pairsplit -x umount D:\hd1
D:\hd1 <-> HarddiskVolume6
pairsplit -x umount F:\
F:\ <-> HarddiskVolume7
```

Figure 4-8: Directory Mount Command Example (Windows® 2000/ Windows Server™ 2003/Windows Server™ 2008)

Mountvol command on Windows 2000/Windows Server 2003 and 2008

NOTE: The **mountvol /D** command attached on Windows® 2000/ Windows Server™ 2003/Windows Server™ 2008 does not flush the NT file system buffer to the corresponding specified drive. Therefore, you cannot flush unwritten data to P-VOL nor browse S-VOL by using this command. Do not mount the volume by the mountvol command if the volume was unmounted by the –x umount command.

The **mountvol** command displays the mounted volume in \\?\Volume{*XXXX*}\ format.

```
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:\
```

Figure 4-9: Mountvol Command Displaying Mounted Volumes

You can use the inqraid command or the raidscan command to see the relationship between the device object name and the physical drive of the \\?\Volume{*XXXX*}\.

```
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-A    85006145   6     -   S/s/ss  0000 1:01-00 DF600F
```

Figure 4-10: Inqraid Command Displaying Mounted Volumes

```
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-A   7     1     85006145       6  DF600F
```

Figure 4-11: Raidscan Command Displaying Mounted Volumes

Flushing system buffer

There are two methods for sending (flushing) unwritten data remaining on the NT file system buffer files to logical drive (physical disk).

First method: Use the `-x sync` option to directly specify the logical drive. You must know the logical drive that corresponds to the groups on the configuration definition file before executing the `-x sync` option. If the logical drive is mounted on each directory, you need to know the mounted volume names also.

Second method: Search the logical drive that corresponds to the groups on the configuration definition file, then send (flush) the data on the system buffer file to the logical drive (physical disk). This method simplifies the first method, and is provided by the `raidscan -find sync` command. The volumes can be flushed to the directory since it does not rely on the mount point.

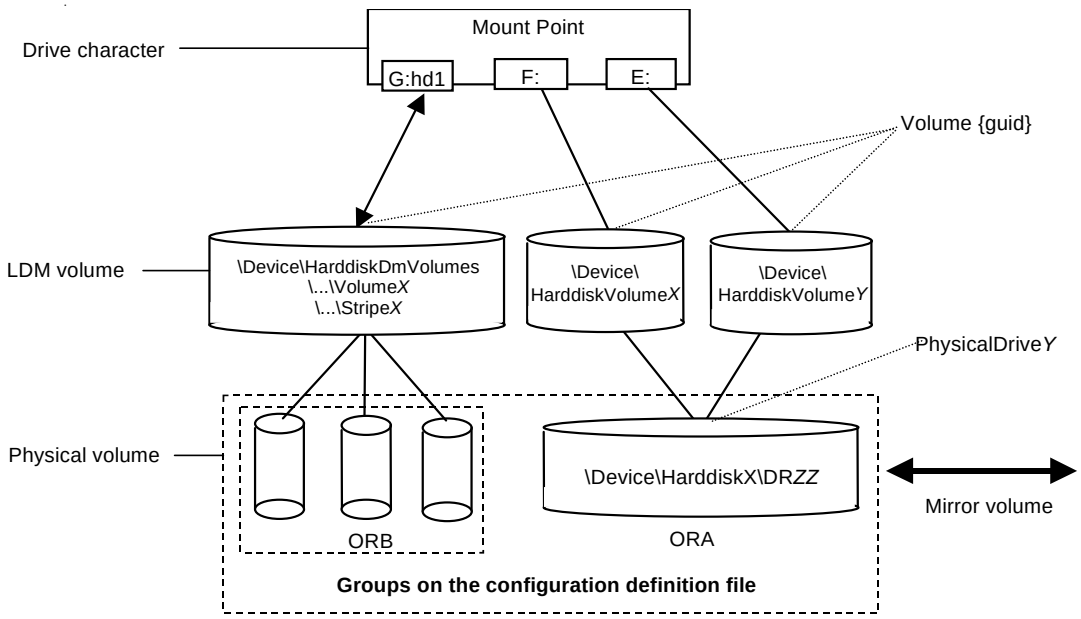


Figure 4-12: LDM Volume Flush

The following is an example of flushing the system buffer that corresponds to group ORB in the configuration definition file.

```
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}
```

Figure 4-13: Flushing System Buffer Example (1)

The following is an example of flushing the system buffer that corresponds to all groups in the CCI 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}
```

Figure 4-14: Flushing System Buffer Example (2)

Instantaneous Offline Backup on Windows® 2000/Windows Server™ 2003

Table 4-1 shows an example of flushing the system buffer that corresponds to Volume{guid} of group ORB in the configuration definition file using `raidscan –find sync` command (rather than `–x mount` or `–x umount`).

Table 4-1: Instantaneous Offline Backup on Windows® 2000/ Windows Server™ 2003

Step	P-VOL Side	S-VOL Side
1	The application closes all logical devices on P-VOL.	—
2	Flushes the system buffer that corresponds to the ORB (P-VOL). raidscan -pi $Volume -find sync -g ORB	—
3	Splits the pair with Read/Write enabled. pairsplit -g ORB	—
4	The application opens all logical devices on P-VOL, and restarts.	—
5	—	Flushes the system buffer that corresponds to ORB (updated S-VOL) when splitting the paired volume completes and when the backup starts. raidscan -pi $Volume -find sync -g ORB
6	—	Executes the S-VOL backup.
7	—	Flushes the system buffer that corresponds to ORB (updated S-VOL) after the backup is completed, or just before the paired volume is resynchronized. raidscan -pi $Volume -find sync -g ORB
8	Resynchronizes the paired volume. pairresync -g ORB	—

Note 1: The logical device of group ORB in S-VOL must be closed.

Note 2: Online Backup on Windows® 2000/Windows Server™ 2003

Table 4-2 shows an example of flushing the system buffer that corresponds to Volume{guid} of group ORB in the configuration definition file using `raidscan –find sync` command (rather than `–x mount` or `–x umount`).

Table 4-2: Online Backup on Windows® 2000/Windows Server™ 2003

Step	P-VOL Side	S-VOL Side
1	The application stops all Write accesses on P-VOL and freezes the database.	—
2	Flushes the system buffer that corresponds to the ORB (P-VOL). raidscan -pi $Volume -find sync -g ORB	—
3	Splits the pair with Read/Write enabled. pairsplit –g ORB	—
4	The application opens all logical devices on P-VOL, and restarts.	—
5	—	Flushes the system buffer that corresponds to ORB (updated S-VOL) when splitting the paired volume completes and when the backup starts. raidscan -pi $Volume -find sync -g ORB
6	—	Executes the S-VOL backup.
7	—	Flushes the system buffer that corresponds to ORB (updated S-VOL) after the backup is completed, or just before the paired volume is resynchronized. raidscan -pi $Volume -find sync -g ORB
8	Resynchronizes the paired volume. pairresync -g ORB	—

NOTE: For the logical device of group ORB in P-VOL, all the write access on P-VOL must be stopped before issuing the `raidscan –find sync` command. The logical device of group ORB in S-VOL must be closed before issuing the `raidscan –find sync` command. The logical drives (both P-VOL and S-VOL) of group ORB must be mounted always when flashing the system buffer.

Dynamic disk and copy function

Environments

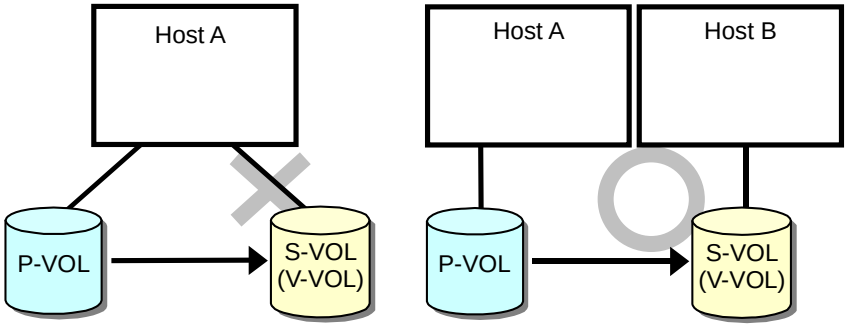
A dynamic disk is a function of Windows® 2000/Windows Server™ 2003/ Windows Server™ 2008.

NOTE: In a Windows Server 2000/Windows Server 2003/Windows Server 2008 environment, you cannot use pair volumes as a dynamic disk because if you restart Windows or use the rescan Disks command after creating or resynchronizing a pair, the S-VOL(V-VOL) appears as “Foreign” in Disk Management and becomes inaccessible.

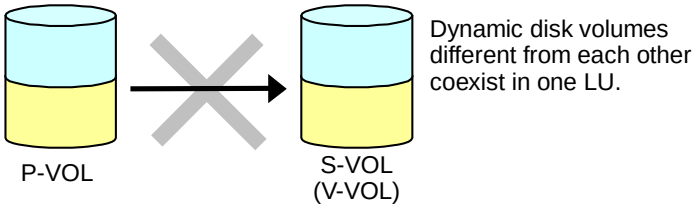
Restrictions

Observe the following restrictions when using a dynamic disk with Windows Server™ 2003. Also, the restrictions for the copying functions should be reviewed. See these in the user’s guides for ShadowImage, SnapShot, TrueCopy, and TCE.

- When a secondary host uses an S-VOL (V-VOL), verify that the host recognizes it after making sure that the pair status is PSUS after the pair is created.
- The host cannot recognize both a P-VOL and an S-VOL (V-VOL).



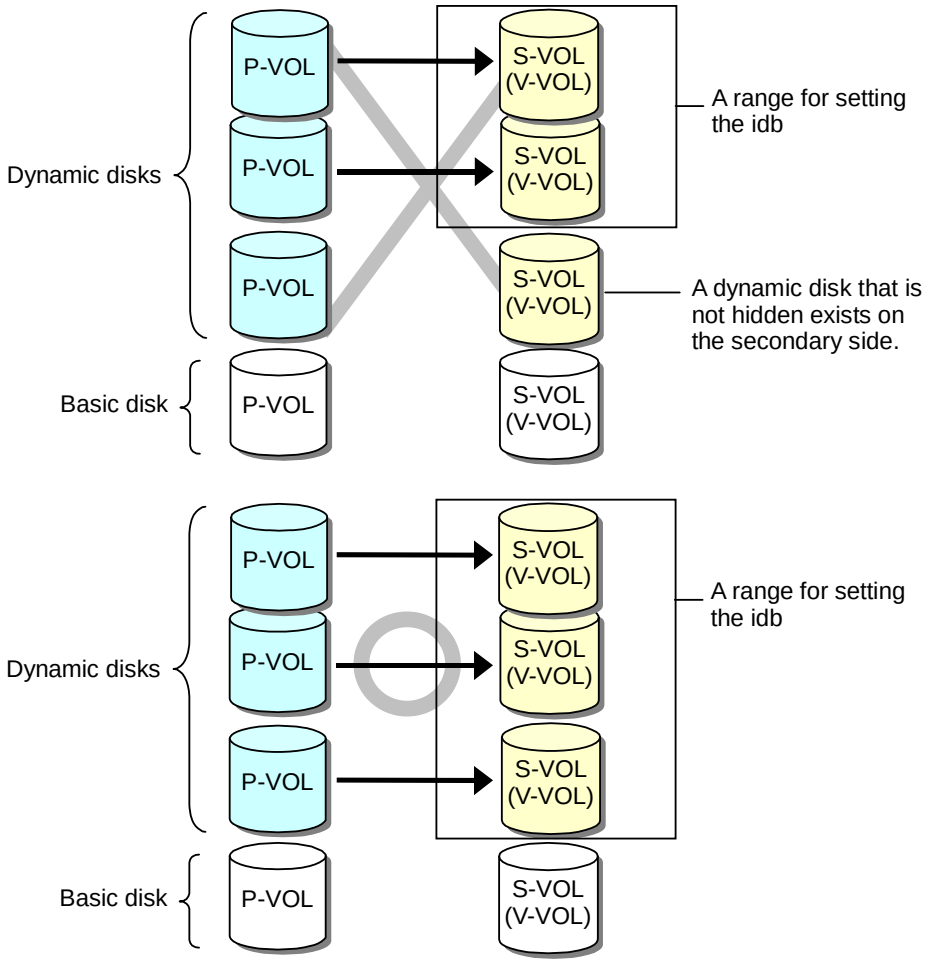
- An LU, in which two or more dynamic disk volumes coexist, cannot be copied.



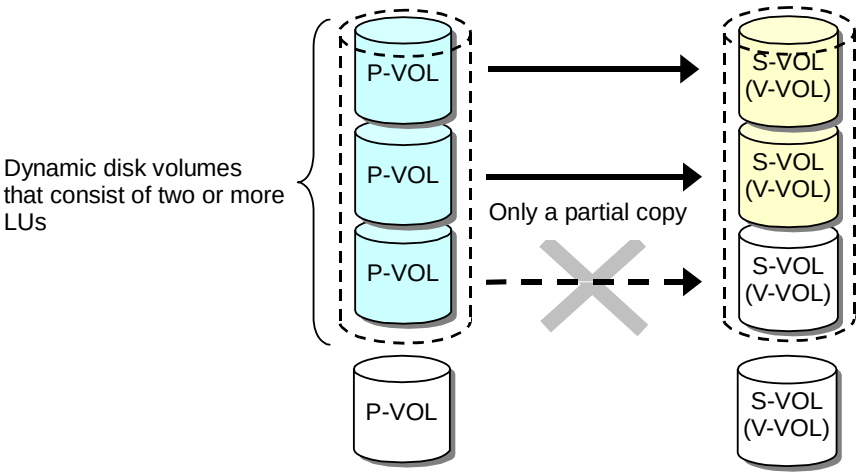
- Do not use a dynamic disk function for volumes other than an S-VOL (V-VOL) on the secondary host side.

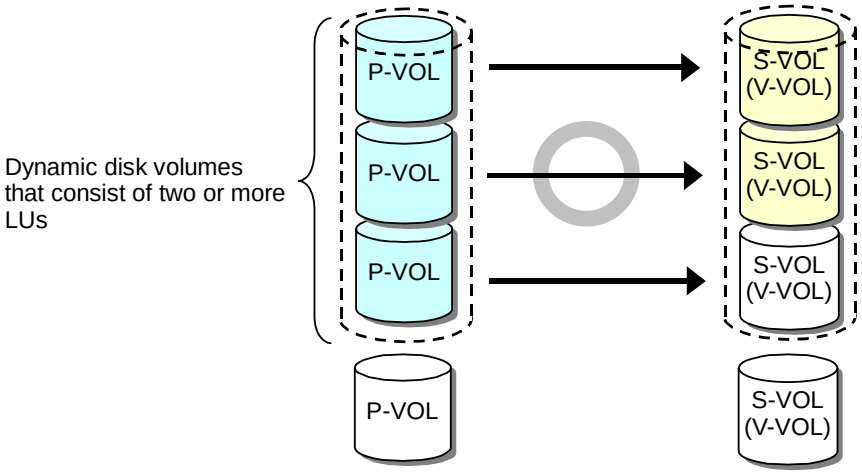
  When copying, hide all the dynamic disks existing on the primary side using the `raidvchkset -vg idb` command. No restriction is placed on the primary side. (Hide all the dynamic disk volumes to be restored on the primary side at the time of restoration.)

If any one of the dynamic disks is left unhidden, a **Missing** drive occurs. When this occurs, delete it manually using the diskpart delete command.



- When copying dynamic disk volumes that consist of two or more LUs, do this after hiding all LUs composing the dynamic disk at the same time. After the copy is completed, release LUs from being hidden and have them recognized by a host.





- A dynamic disk cannot be used with a cluster (MSCS, VCS, and etc).
- A dynamic disk cannot be used with VxVM and HDLM.

Command operation example

Table 4-3: Initial Operation on Windows Server™ 2003

Step	P-VOL Host Side	S-VOL Host Side
1	Copying of all the LUs (dynamic disks) paircreate pairsplit	—
2	—	The initial recognition of all the dynamic disk LUs (***Note 1***)
3	—	Import of a dynamic disk to be **Foreign** diskpart import (***Note 2***)
4	—	Changing a disk to be **Offline** to online diskpart online
5	—	Mount pairsplit -x mount
6	—	Acknowledge the data
7	—	Umount pairsplit -x umount
8	—	Hiding of all the dynamic disk LUs raidvchkset -vg idb diskpart rescan (***Note 3***)

Note 1: When you make LU recognize by a secondary host side, set the pair state to PSUS*.*

Note 2: The diskpart is a command of Windows® 2000/Windows Server™ 2003/Windows Server™ 2008. For each option of the diskpart command, refer to the Online Help, etc. of the diskpart command.

Note 3: When the diskpart rescan command is executed at the time of hiding, the LU that was recognized is hidden.

Table 4-4: Copy Operation on Windows Server™ 2003

Step	P-VOL Host Side	S-VOL Host Side
1	Copying of all the LUs (dynamic disks) paircreate/pairresync pairsplit	—
2	—	Release of all the dynamic disk LUs from the hiding raidvchkset -vg diskpart rescan (***Note 1, 2***)
3	—	Import of a dynamic disk to be **Foreign** diskpart import
4	—	Changing a disk to be **Offline** to online diskpart online
5	—	Mount pairsplit -x mount
6	—	Utilization of a dynamic disk by application software
7	—	Umount pairsplit -x umount
8	—	Hiding of all the dynamic disk LUs raidvchkset -vg idb diskpart rescan (***Note 3***)

Note 1: The diskpart is a command of Windows® 2000/Windows Server™ 2003/Windows Server™ 2008. For each option of the diskpart command, refer to the Online Help, etc. of the diskpart command.

Note 2: The diskpart rescan command executed at the time of removing the hiding displays that the LU that was a dynamic disk is **Foreign** or **Offline**. Return the LU to a normal disk using Steps 3 and 4 above.

Note 3: When the diskpart rescan command is executed at the time of hiding, the LU that was recognized is hidden.

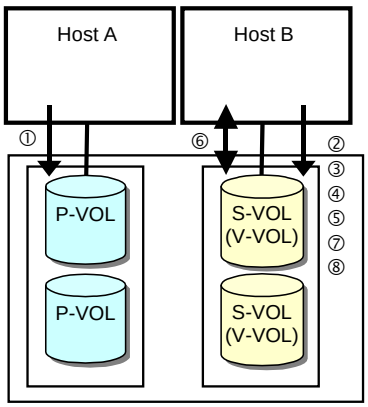


Table 4-5: Restore Operation on Windows Server™ 2003

Step	P-VOL Host Side	S-VOL Host Side
1	Umount of an LU to be restored pairsplit -x umount	—
2	Hiding of an LU to be restored raidvchkset -vg idb diskpart rescan (***Note 2***)	—
3	Restore pairresync -reverse pairsplit	—
4	Release the hiding to be restored raidvchkset -vg diskpart rescan (***Note 1, 3***)	—
5	Import of a dynamic disk to be **Foreign** diskpart import	—
6	Changing a disk to be **Offline** to online diskpart online	—
7	Mount pairsplit -x mount	—

Note 1: The diskpart rescan command executed at the time of removing the hiding displays that the LU that was a dynamic disk is **Foreign** or **Offline**. Return the LU to a normal disk using Steps 3 and 4 above.

Note 2: When the diskpart rescan command is executed at the time of hiding, the LU that was recognized is hidden.

Note 3: If any one of the dynamic disks is left unhidden in Step 2, a **Missing** drive occurs. In such a case delete it using the diskpart delete command. Incidentally, be careful not to delete a necessary drive by mistake.

Recovery procedure

- When an operation written in Restrictions, on page 4-9 is performed, the device search wizard of Windows® may work depending on when the disk is rescanned. If the device search wizard works, quit the wizard manually.
- When the state of the disk is offline and unreadable and the state of the volume in unsuccessful (online (error)), verify that the pair status is PSUS and execute the online command of the diskpart.

Concerning an LU that is hidden by the `raidvchkset –vg idb` command, deleting and formatting, etc. are restricted. For an LU that is no longer used as a dynamic disk, discontinue hiding using the `raidvchkset –vg` command.

5

RM Shadow Copy Provider for VSS

This chapter includes the following:

RM Shadow Copy Provider for VSS

Install Windows Enterprise Server™ 2003 (Build#3790)/Windows Server™ 2008, and use it under the following conditions.

Table 5-1: Relationship between RM Shadow Copy Provider and Windows Enterprise Server™ 2003/2008

RM Shadow Copy Provider Version	Windows Enterprise Server™ 2003 (Build#3790)	Windows Enterprise Server™ 2003 (Build#3790)+HotFix #833167+(831112)	Windows Enterprise Server™ 2003 SP1 +HotFix#891957+ (903081)	Windows Enterprise Server™ 2008
01-02-04/00 or later	Available	Available	Available	Available

NOTE: HotFix#891957 is required in environment of Windows Enterprise Server™ 2003 SP1.

Enable the services shown in Table 5-2 for the Volume Shadow Copy Service (VSS) installation on Windows Enterprise Server™ 2003. Refer to Installation procedure, on page 5-7 for details.

Table 5-2: Services for RM Shadow Copy Provider Installation

No.	Service Name	Display Name	Startup Type
1	RpcSs	Remote Procedure Call (RPC)	Automatic
2	EventLog	Event Log	Automatic
3	DcomLaunch	DCOM Server Process Launcher	Automatic
4	SamSs	Security Accounts Manager	Automatic
5	winmgmt	Windows Management Instrumentation	Automatic
6	EventSystem	COM+ Event System	Manual
7	MSIServer	Windows Installer	Manual
8	VSS	Volume Shadow Copy	Manual
9	COMSysApp	COM+ System Application	Manual
10	MSDTC	Distributed Transaction Coordinator	Manual

Table 5-3 shows relationship of the RM Shadow Copy Provider attached to CCI delivered with micro program of the array.

Table 5-3: Related Version of RM Shadow Copy Provider attached to CCI versus Micro Program

RM Shadow Copy Provider Version	CCI Version	AMS2100	AMS2300	AMS2500
01-04-03/00	01-21-03/06 or later	0832/B or later	0832/B or later	0840/A or later

Introduction

Windows Server™ 2003/Windows Server™ 2008 supports the VSS that provides an infrastructure for creating point-in-time images known as shadow copies. VSS is able to produce high fidelity shadow copies through its coordination with business applications, backup applications, and RAID.

VSS is a service that coordinates backup software (requestors), the writers (e.g., Database application), and hardware providers that provides vendor-unique shadow copy functions.

A shadow copy volume is a copy of a volume that is used by an application at a specific time. An RM shadow copy provider is a component that creates a shadow copy volume with controlling RAID via VSS.

VSS configurations

CCI provides the RM shadow copy provider as a Hardware Provider for VSS. The RM shadow copy provider supports any disks that are defined in CCI configuration files. If any disks for a backup application are not defined in CCI configuration files, VSS will select the provider using the following default hierarchy:

Hardware provider (RM shadow copy provider) → Software provider → System software provider, and will create a snapshot volume by using the default System software provider.

Single host configuration

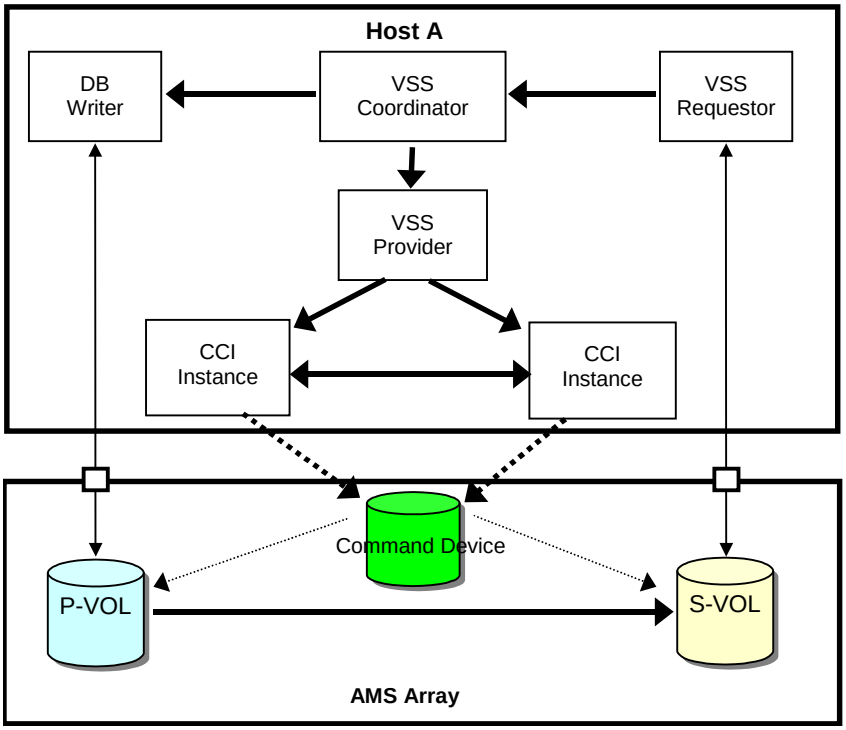


Figure 5-1: Single Host Configuration for VSS

Export and import host configuration VSS defined

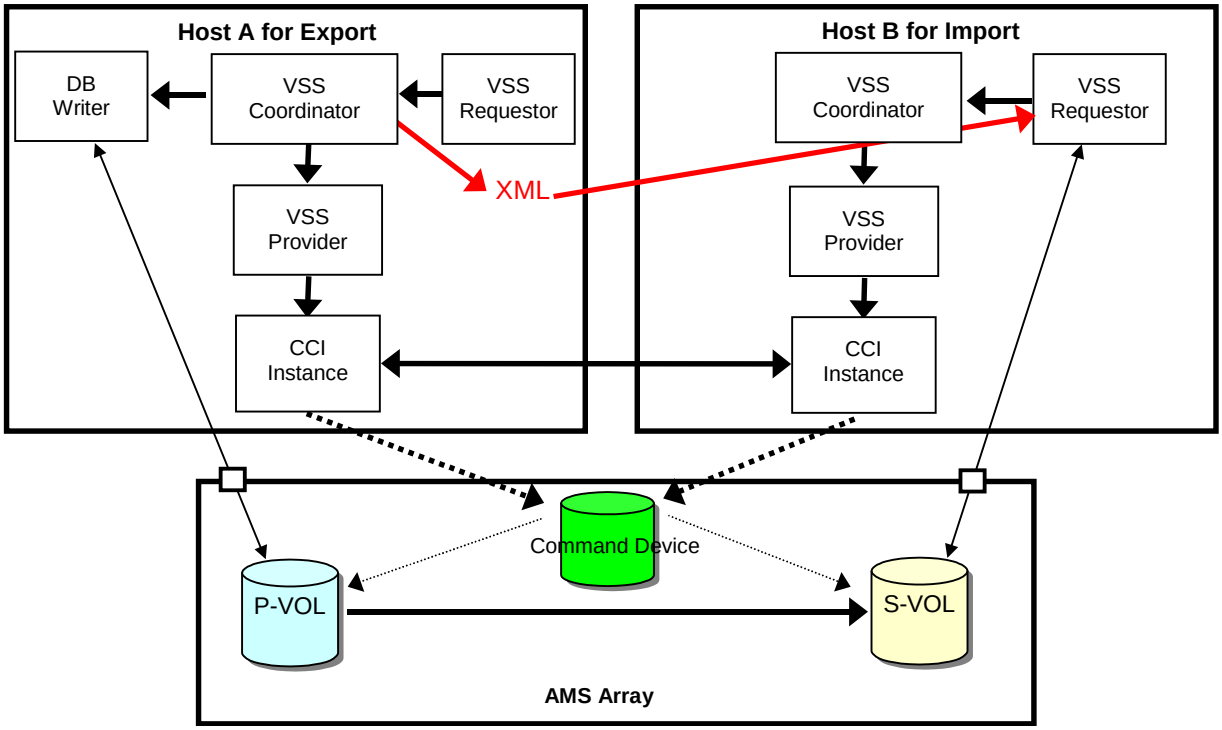


Figure 5-2: Export and Import Host Configuration for VSS

Coordination of Shadow Copy creation

1. The various roles of the requestor, writer, and provider are placed into context in this section, which lists the steps that need to be taken to create a shadow copy. Coordination of the requestor, writer, and provider is under VSS control.
2. A backup application notifies to prepare a volume that will be backed up to the VSS coordinator service.
3. The VSS coordinator notifies the application-specific writer to prepare its data for making a shadow copy.
4. The VSS coordinator relays the message to the requestor, and the requestor initiates the commit snapshot phase. The VSS coordinator temporarily halts (quiesces) application I/O write requests (I/O read requests are still possible) for the several seconds required to create the shadow copy of the volume or volumes.
5. The VSS coordinator chooses a provider that matches to the volume. If any disks for a backup application are not defined in CCI configuration files, then VSS will selects the provider using the default hierarchy (Software provider → System software provider).
6. The writer prepares the data appropriately for that application (ex: completing all open transactions, rolling transaction logs, and flushing caches). When the data is prepared for shadow copy creation, the writer notifies to the VSS coordinator.

7. RM Shadow Copy Provider splits a pair of a designated disk and a snapshot disk in order to create the shadow copy (a maximum of 10 seconds).
8. After the shadow copy is created, the VSS coordinator releases the writer from its temporary quiescent phase. VSS queries the writers to confirm that write I/Os were successfully held during shadow copy creation. If the writes were not successfully held (the shadow copy data is potentially inconsistent), the shadow copy is deleted and the requestor is notified. The requestor can retry the process (loop back to 1) or notify the administrator to retry at a later time.
9. RM Shadow Copy Provider notifies the snapshot disks that match a designated disk to the VSS coordinator.
10. The VSS coordinator creates the XML document file describing the snapshot set in order to export the transportable snapshot volume.
11. The RM Shadow Copy Provider performs to map (Unmask) the designated disk by the VSS coordinator to the LUN.
12. The VSS coordinator discovers the new LUN, and notifies the snapshot volume mapped to an LUN to a backup application.

NOTE: In Export and Import configuration, Step 10 through 11 above will be performed on Import host, but a backup requestor should support this configuration.

Transportable configuration

The configuration shown in Figure 5-3 is required when the setting functions of VDS (Diskraid command) are supported by VDS provider. This should be supported by a backup requestor.

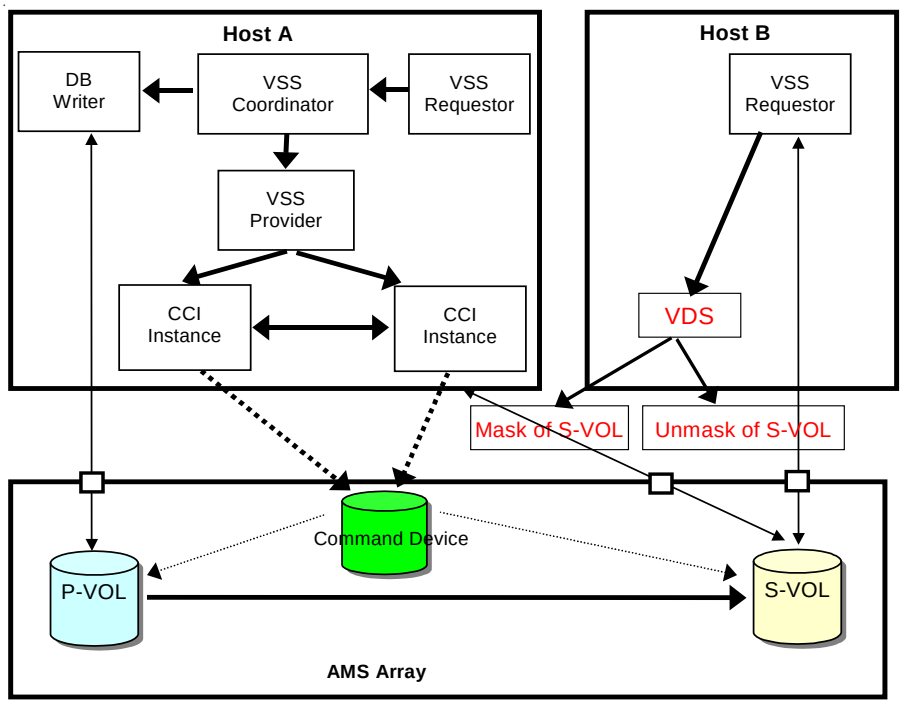


Figure 5-3: Transportable Configuration for VSS

Restrictions on VSS configurations

The VSS and RM shadow copy provider must be used under the following conditions:

- Property of the Shadow Copy Volume. The Shadow Copy volume (S-VOL) must be created as property of the hidden and read-only when detected by Windows Server™ 2003/Windows Server™ 2008. The drive letters and/or mount points are not automatically assigned.
- Snapshots Containing Dynamic Disks. The native support for dynamic disks cannot accommodate LUNs with duplicate signatures and configuration database contents. The snapshot LUNs must be transported to a different host; VSS enforces this.

  When transporting dynamic disk LUNs to a new host, at least one dynamic disk should exist on the receiving host. This ensures that the disk group identifiers will be unique to both machines.
- Hardware Snapshots not Supported on MSCS. MSCS cannot accommodate LUNs with duplicate signatures and partition layout. The snapshot LUNs must be transported to a host outside the cluster.
- Using VSS under the I/O Path Manager. The I/O Path Manager must support the Shadow Copy volume as the PnP device, and must support all of DeviceIocontrol functions used on the Shadow Copy volume.

NOTE: JP1/HiCommand Dynamic Link Manager (HDLM) supported the DeviceIocontrol functions that VSS uses. Therefore, you can use VSS with I/O Path Manager.

Relationship between backup software and configurations

Table 5-4 displays the related support between the backup software and applicable configurations.

The RM Shadow Copy Provider must be used within scope of the following supported backup software.

Table 5-4: Backup Software with RM Shadow Copy Provider

Software Vendor	Software Name	Applicable Configurations		
		Single Host	Export / Import Host	Transportable
Microsoft	NT Backup	Supported	Not supported	Not supported
Veritas	Backup Exec (BEWS)	Supported	BEWS10.0	

Installation procedure

Use the installation files and locations shown in Table 5-5, according to your product. DIR is the installation directory: default directory is \Program Files.

Table 5-5: Installation Files and Locations per Product

No	Product	Installation File Name	Installation Location
1	RM Shadow Copy Provider	\HORCM\Tool\RMVSSPRV.exe	DIR\HITACHI\VSS Provider\RMVSSPRV.dll
2	RM Shadow Copy Provider for IA64	\HORCM\Tool\RMVSSPRV64.exe	DIR\HITACHI\VSS Provider\RMVSSPRV.dll
3	RM Shadow Copy Provider for x64 (EM64T)	\HORCM\Tool\RMVSSPRV_64.exe	DIR\HITACHI\VSS Provider\RMVSSPRV.dll

Procedure for new installation

1. Verify that MSDTC and COMSysApp services are enabled in the RM Shadow Copy Provider host. Also confirm the services listed in Table 5-2 on page 5-2 are present by using Administrative Tools → Services.

```
C:\>sc qc MSDTC
[SC] GetServiceConfig SUCCESS

SERVICE_NAME: MSDTC
TYPE                : 10 WIN32_OWN_PROCESS
START_TYPE          : 3 DEMAND_START
ERROR_CONTROL       : 1 NORMAL
BINARY_PATH_NAME    : C:\WINDOWS\System32\msdtc.exe
LOAD_ORDER_GROUP    : MS Transactions
TAG                 : 0
DISPLAY_NAME        : Distributed Transaction Coordinator
DEPENDENCIES        : RPCSS
: SamSS
SERVICE_START_NAME  : LocalSystem

C:\>sc qc COMSysApp
[SC] GetServiceConfig SUCCESS

SERVICE_NAME: COMSysApp
TYPE                : 10 WIN32_OWN_PROCESS
START_TYPE          : 3 DEMAND_START
ERROR_CONTROL       : 1 NORMAL
BINARY_PATH_NAME    : C:\WINDOWS\System32\dllhost.exe /Processid:{02D4B3F
1-FD88-11D1-960D-00805FC79235}
LOAD_ORDER_GROUP    :
TAG                 : 0
DISPLAY_NAME        : COM+ System Application
DEPENDENCIES        : rpcss
SERVICE_START_NAME  : LocalSystem
```

2. If the MSDTC and COMSysApp services have not started, set them to the automatic start or manual start using the Computer Management option, and install RM Shadow Copy Provider using the following procedure, after the services are started.

```
C:\>sc config MSDTC start= demand
[SC] ChangeServiceConfig SUCCESS

C:\>sc config COMSysApp start= demand
[SC] ChangeServiceConfig SUCCESS
```

3. Stop Microsoft® Volume Shadow Copy Service by using the following command.

   For Windows Server™ 2003:

   ```
   C:\net STOP Volume Shadow Copy
   ```

   For Windows Server™ 2008:

   ```
   C:\net STOP VSS
   ```

   If starting:

   ```
   The Volume Shadow Copy service is stopping.
   The Volume Shadow Copy service was stopped successfully.
   ```

   If stopping:

   ```
   The Volume Shadow Copy service is not started.
   ```

4. Change the current directory to \HORCM\Tool\ where CCI has been installed.
5. Execute the appropriate RMVSSPRV.exe setup program:
   - For a 32-bit system, run the RMVSSPRV.exe.
   - For an IA64 system, run the RMVSSPRV64.exe.
6. Restart Microsoft® Volume Shadow Copy Service by using the following command if VSS will not start.

   For Windows Server™ 2003:

   ```
   C:\net START Volume Shadow Copy
   The Volume Shadow Copy service is starting.
   The Volume Shadow Copy service was started successfully.
   ```

   For Windows Server™ 2008:

   ```
   C:\net START VSS
   The Volume Shadow Copy service is starting.
   The Volume Shadow Copy service was started successfully.
   ```

Procedure for version up

1. Stop Microsoft® Volume Shadow Copy Service by using the following command.

   For Windows Server™ 2003:

   ```
   C:\net STOP Volume Shadow Copy
   ```

   For Windows Server™ 2008:

   ```
   C:\net STOP VSS
   ```

   If starting:

```
The Volume Shadow Copy service is stopping.
The Volume Shadow Copy service was stopped successfully.
```

If stopping:

```
The Volume Shadow Copy service is not started.
```

2. Delete the installed RM Shadow Copy Provider using **Addition and deletion of application** on the control panel.
3. Change the current directory to \HORCM\Tool\ where CCI has been installed.
4. Execute the appropriate RMVSSPRV.exe setup program:
   - For a 32-bit system, run the RMVSSPRV.exe.
   – For an IA64 system, run the RMVSSPRV64.exe.
5. Restarts Microsoft® Volume Shadow Copy Service by using the following command if VSS will not be started.

   For Windows Server™ 2003:

```
C:\net START Volume Shadow Copy
The Volume Shadow Copy service is starting.
The Volume Shadow Copy service was started successfully.
```

   For Windows Server™ 2008:

```
C:\net START VSS
The Volume Shadow Copy service is starting.
The Volume Shadow Copy service was started successfully.
```

Version confirmation after installation

After a new installation or update, verify the version information (Version) by using the following command:

Example

```
C:\vssadmin list providers
vssadmin 1.1 - Volume Shadow Copy Service administrative command-
line tool
(C) Copyright 2001 Microsoft Corp.

Provider name: 'RM Shadow Copy Provider'
Provider type: Hardware
Provider Id: {748babd3-8c62-4b3d-b6b7-430b5f858c74}
Version: 01-02-03/06

Provider name: 'Microsoft Software Shadow Copy provider 1.0'
Provider type: System
Provider Id: {b5946137-7b9f-4925-af80-51abd60b20d5}
Version: 1.0.0.7
```

Checking the service registration

Check that RM Shadow Copy Provider has been registered as a service using the following command.

```
C:\ >sc qc “RM Shadow Copy Provider”
SERVICE_NAME: RM Shadow Copy Provider
TYPE               : 10  WIN32_OWN_PROCESS
START_TYPE         : 3 DEMAND_START
ERROR_CONTROL      : 1 NORMAL
BINARY_PATH_NAME   : C:\WINDOWS\System32\dllhost.exe /
Processid:{08BD82A
3-CF60-4B6E-80A2-55A13611D951}
LOAD_ORDER_GROUP   :
TAG                : 0
DISPLAY_NAME       : RM Shadow Copy Provider
DEPENDENCIES       : rpcss
SERVICE_START_NAME : LocalSystem
```

Uninstallation procedure

1. Stop Microsoft® Volume Shadow Copy Service by using the following command.

   For Windows Server™ 2003:

   ```
   C:\net STOP Volume Shadow Copy
   ```

   For Windows Server™ 2008:

   ```
   C:\net STOP VSS
   ```

   If starting:

   ```
   The Volume Shadow Copy service is stopping.
   The Volume Shadow Copy service was stopped successfully.
   ```

   If stopping:

   ```
   The Volume Shadow Copy service is not started.
   ```

2. Delete the installed RM Shadow Copy Provider using **Addition and deletion of application** on the control panel.
3. Restart Microsoft® Volume Shadow Copy Service with the following command if VSS will not be started.

   For Windows Server™ 2003:

   ```
   C:\net START Volume Shadow Copy
   The Volume Shadow Copy service is starting.
   The Volume Shadow Copy service was started successfully.
   ```

   For Windows Server™ 2008:

   ```
   C:\net START VSS
   The Volume Shadow Copy service is starting.
   The Volume Shadow Copy service was started successfully.
   ```

VSS start-up procedures

Setting system environment variables

1. Define the system environment variables as shown in Table 5-6 on page 5-11:

Table 5-6: Environment Variables

Variables	Value
VSHTCHORCMINST_LOCAL	Specifies the CCI Instance number for P-VOL side.
VSHTCHORCMINST_REMOTE	Specifies the CCI Instance number for S-VOL side.
VSHTCHOMRCF_MUN	Specifies the MUN specified to P-VOL on CCI configuration file.

2. Reboot the Windows®. The VSS service will be start automatically.

Setting the CCI environment

The example in the following procedure assumes the instance number and the target volume for backup as follows:

VSHTCHORCMINST_LOCAL=50

VSHTCHORCMINST_REMOTE=51

VSHTCHOMRCF_MUN=2

The target volume for buck-up is mounted as E: drive on Harddisk1.

Use Ntbackup.exe as back-up program.

1. Discover and describe the command device for %windir%\horcm50.conf.

   CCI uses the command device; discover the command device (xxxx-CM).

```
C:\HORCM\etc>inqraid -CLI $Phy
DEVICE_FILE    PORT    SERIAL  LDEV CTG  H/M/12  SSID R:Group PRODUCT_ID
Harddisk0      CL2-A    85002496    16   -      -     -       - DF600F-CM
Harddisk1      CL2-A    85002496    18   -  s/s/ss  0000 5:01-04 DF600F
Harddisk2      CL2-A    85002496    19   -  s/s/ss  0000 5:01-04 DF600F
Harddisk3       -          -       -   -      -     -         - L040L2
```

```
C:\HORCM\etc>inqraid -CLI $LETALL
DEVICE_FILE    PORT    SERIAL  LDEV CTG  H/M/12  SSID R:Group PRODUCT_ID
E:\Vol2\Dsk1    CL2-A    85002496    18   -  s/s/ss  0000 5:01-04 DF600F
D:\Vol1\Dsk3     -          -       -   -      -     -         - L040L2
```

   %windir%horcm50.conf:

```
HORCM_MON
#ip_address       service        poll(10ms)       timeout(10ms)
127.0.0.1          52050           12000               3000

HORCM_CMD
#dev_name          dev_name        dev_name
\\.\CMD-85002496
```

2. Execute a horcmstart 50 as background.

```
C:\HORCM\etc>horcmstart 50
starting HORCM inst 50
HORCM inst 50 starts successfully.
```

3. Verify a physical mapping.

```
C:\HORCM\etc>set HORCMINST=50
C:\HORCM\etc>raidscan -pi $Phys -find
DEVICE_FILE       UID  S/F PORT   TARG  LUN    SERIAL  LDEV  PRODUCT_ID
Harddisk0           0   F  CL2-A    25   16    85002496    16  DF600F-CM
Harddisk1           0   F  CL2-A    25   18    85002496    18  DF600F
Harddisk2           0   F  CL2-A    25   19    85002496    19  DF600F
```

4. Shut down a horcmstart 50.

```
C:\HORCM\etc>horcmshutdown 50
inst 50:
HORCM Shutdown inst 50 !!!
```

5. Describe the Known HORCM_DEV on %windir%\horcm50.conf.

   %windir%\horcm50.conf for P-VOL

```
HORCM_MON
#ip_address       service        poll(10ms)       timeout(10ms)
127.0.0.1          52050           12000               3000

HORCM_CMD
#dev_name          dev_name        dev_name
\\.\CMD-85002496

HORCM_LDEV
#dev_group         dev_name        Serial#    LDEV#    MU#
snap               snapdev1        85002496   18        0

HORCM_INST
#dev_group        ip_address       service
snap              127.0.0.1        52051
```

   %windir%\horcm51.conf for S-VOL

```
HORCM_MON
#ip_address       service        poll(10ms)       timeout(10ms)
127.0.0.1          52051          12000               3000

HORCM_CMD
#dev_name          dev_name       dev_name
\\.\CMD-85002496

HORCM_LDEV
#dev_group         dev_name       Serial#    LDEV#    MU#
snap               snapdev1       85002496   19        0

HORCM_INST
#dev_group        ip_address      service
snap              127.0.0.1       52050
```

6. Start horcmstart 50 51.

```
C:\HORCM\etc>horcmstart 50 51
starting HORCM inst 50
HORCM inst 50 starts successfully.
starting HORCM inst 51
HORCM inst 51 starts successfully.

C:\HORCM\etc>set HORCMINST=51
C:\HORCM\etc>set HORCC_MRCF=1

C:\HORCM\etc>pairdisplay -g snap -fdc
Group   PairVol(L/R) Device_File   ,Seq#,LDEV#.P/S,Status,   %,P-LDEV# M
snap    snapdev(L/R) Harddisk2     85002496   19.SMPL  ----,----- ----  -
snap    snapdev(L/R) Harddisk1     85002496   18.SMPL  ----,----- ----  -
```

7. Hide and create invisible S-VOL.

   The `-vg idb` option is an option only for VSS. Be sure to specify.

```
C:\HORCM\etc>raidvchkset -g snap -vg idb
C:\HORCM\etc>paircreate -g snap -vr -m noread

C:\HORCM\etc>pairdisplay -g snap
Group   PairVol(L/R) (Port#,TID,LU-M),Seq#,LDEV.P/S,Status, Seq#,P-LDEV# M
snap    snapdev1(L) (CL2-A  ,25, 19-0)85002496  19.S-VOL PAIR,-----    18  -
snap   snapdev1(R) (CL2-A  ,25, 18-0)85002496  18.P-VOL PAIR,85002496   19  N
```

8. Perform Rescan disk.

   VSS needs to make the hidden volumes for S-VOL, so you must execute the Rescan disk by using the diskpart command.

```
C:\HORCM\etc>diskpart
:
DISKPART>rescan
Please wait while DiskPart scans your configuration...
DiskPart has finished scanning your configuration.
```

9. Start horcmstart 50 51.

```
C:\HORCM\etc>horcmstart 50 51
starting HORCM inst 50
HORCM inst 50 starts successfully.
starting HORCM inst 51
HORCM inst 51 starts successfully
```

Notes:

- These steps must be performed for each change of the horcm*.conf file. VSS coordinator will activate the RM Shadow Copy provider automatically, and then RM Shadow Copy provider will perform the commands of CCI when Back-up program is executed. Therefore CCI must be started prior to execute the Back-up program.
- In case of the export and import host configuration, VSHTCHORCMINST_LOCAL variable must be set on P-VOL side (export) host, and VSHTCHORCMINST_REMOTE variable must be set on S-VOL side (import) host. P-VOL side host must be started by horcmstart 50, and has to set HORCMINST=50 variable. Also S-VOL side host similarly must be started by horcmstart 51 and has to set HORCMINST=51 variable. P-VOL side host must be connected only P-VOLs, and S-VOL side host must be connected only S-VOLs.

Execute the back-up

You are able to execute the Back-up program by specifying the target volume for backup after setting the CCI Environment.

When using GUI:

1. Execute the back-up program. Execute the NT backup (%SystemRoot%\system32\ntbackup.exe) by specifying E: drive on the P-VOL.
2. Verify that RM Shadow Copy Provider is working (if needed) by checking the Status field of CCI command (`pairdisplay -g snap`).

   When NT backup has been started, the `pairdisplay` state is PVOL_PSUS and SVOL_COPY or PVOL_PSUS and SVOL_SSUS.

   When NT backup has been deleted, the snap (OnLunEmpty() in H/W provider is called by VSS), the `pairdisplay` state is PVOL_COPY and SVOL_COPY or PVOL_PAIR and SVOL_PAIR.

When using CLI:

1. Execute the diskshadow.exe by specifying “E: drive” on the P-VOL.

```
C:\Windows>diskshadow
Microsoft DiskShadow version 1.0
:
DISKSHADOW> begin backup
DISKSHADOW> set context persistent
DISKSHADOW> add volume E:
DISKSHADOW> create
Alias VSS_SHADOW_1 for shadow ID {bfeelee0-b0af-4eef-8a00-768083ebc418}
set as environment variable.
Alias VSS_SHADOW_SET for shadow set ID {a8c8e0f0-2f06-4c87-8d79-
29f7d6edfc12} set as environment variable.

Querying all shadow copies with the shadow copy set ID {a8c8e0f0-2f06-4c87-
8d79-29f7d6edfc12}
        * Shadow copy ID = {bfeelee0-b0af-4eef-8a00-768083ebc418}
%VSS_SHADOW_1%
                - Shadow copy set: {a8c8e0f0-2f06-4c87-8d79-29f7d6edfc12}
%VSS_SHADOW_SET%
                - Original count of shadow copies = 1
               - Original volume name:\\?\Volume{064c2128-5b7a-11dc-9438-
806e6f6e6963}\ [E:\]
                - Creation time: 9/20/2007 2:09:12 PM
                - Shadow copy device name: \\?\Volume{63535314-5d14-11dc-
abd1-00c0a87bb335}
                - Originating machine: WIN-AK0K6OCBJSW
                - Service machine: WIN-AK0K6OCBJSW
                - Not exposed
                - Provider ID: {748babd3-8c62-4b3d-b6b7-430b5f858c74}
                - Attributes: No_Auto_Release Persistent Hardware
Number of shadow copies listed: 1

DISKSHADOW> expose %VSS_SHADOW_1% S:
-> %VSS_SHADOW_1% = {bfeelee0-b0af-4eef-8a00-768083ebc418}
The shadow copy was successfully exposed as mount point S:\.
```

2. Execute back-up operation on S: drive.

```
DISKSHADOW> unexposed S:
Shadow copy ID {bfeelee0-b0af-4eef-8a00-768083ebc418} is no longer
exposed.

DISKSHADOW> delete shadows ID %VSS_SHADOW_1%
-> %VSS_SHADOW_1% = {bfeelee0-b0af-4eef-8a00-768083ebc418}
Deleing shadow copy {bfeelee0-b0af-4eef-8a00-768083ebc418}...

1 shadow copy deleted.

DISKSHADOW> end backup:
```

3. Verify that RM Shadow Copy Provider is working (if needed).

You can verify that RM Shadow Copy Provider is working by the Status field of CCI command (**pairdisplay -g snap**) or not.

When NT backup has been starting, the pairdisplay state will be PVOL_PSUS and SVOL_COPY or PVOL_PSUS and SVOL_SSUS.

When NT backup has been deleting the snap (OnLunEmpty() in H/W provider is called by VSS), the **pairdisplay** state will be PVOL_COPY and SVOL_COPY or PVOL_PAIR and SVOL_PAIR.

Notes on VSS operation

S-VOL (V-VOL) that is no longer used as a VSS. For an LU that is hidden by the `raidvchkset –vg idb`, deleting and formatting, etc. are restricted. For an LU that is no longer used as a dynamic disk, eliminate hiding by using the `raidvchkset –vg` command.

Starting CCI. The CCI must be started with the privilege for administrator, when the user will start the CCI as a service. If the CCI is started with the System privilege, CCI commands via command prompt will be unable to attach to the CCI.

Independent VDS. RM Shadow Copy Provider and CCI does not use VDS interface.

RM Shadow Copy Provider and CCI can support two host configurations for the OFF HOST Backup (one is export host, another is import host), but these configurations must be supported via the back-up requestor by transporting the XML file between export and import host.

Known problems and concerns

- NTBackup cannot cancel a snapshot
  - Problem: NTbackup does not cancel after the Cancel button is pushed.
  - Solution: This as a bug in VSS that occurs when you try to delete (cancel) a snapshot while importing it. This bug will be corrected with Windows Server™ 2003 SP1.
- VSS cannot work with LDM (Disk Manager Tool)
  - Problem: VSS cannot work with LDM tool correctly, because VSS depends on PnP.
  - Solution: This would be the problem between VSS and LDM tool, so do not use the LDM tool while VSS has been working.
- Event log increases at every backup
  - Problem: A warning message is recorded to the event log at time every backup, because VSS uses PnP for mounting the copied S-VOL that has the same signature to P-VOL.
  - Solution: The rewriting of the signature occurs when S-VOL is imported by the re-scan operation of VSS. The administrator should regularly remove this log.
- LUN#0 cannot use S-VOL
  - Problem: VSS cannot recognize LUNs over LUN#1; if LUN#0 is set S-VOL for VSS, VSS requires the hidden volume as S-VOL.
  - Solution: Some HBA driver did not scan all LUNs on a port, if LUN#0 is hidden as
    S-VOL. Therefore, do not use LUN#0 as S-VOL for HBA drivers.

- BreakSnapShot() after importing fails with ERROR 0x80042306
  - Problem: The behavior VSS is expecting is that a device object (Volume\\?\GlobalRoot\Device\HarddiskVolumeX) is not changed via any RESCAN until the imported device object is deleted. If the PhysicalDriveX is changed by HBA driver via next RESCAN, a device object will be changed. So VSS coordinator will use old device object, and then VSS encounters an **ERROR_FILE_NOT_FOUND** when they deletes SnapShot volume.
  - Solution: The Full Port driver for the Emulex® should not be used. You need to use **StorPort** drivers including **HotFix#838894** for importing the SnapShot.
- raidscan –find does not show any volumes
  - Problem: `inqraid $Phys -CLI` shows the details for the PhysicalDrive, but `raidscan -pi $Phys -find` does not show any device.
  - Solution: You need to use **StorPort** drivers including **HotFix#883646.**
- RM Shadow Copy Provider does not exist as a service
  - Problem: When RM Shadow Copy Provider is installed in the status where MSDTC and COMSysApp have not started as a service, VSS cannot register the HardWhere Provider as a service. Therefore, the VSS outputs the following event and the backup fails.

```
------------------------------------------------------------
Event Type:          Error
Event Source:        VSS
:
Computer:
Description:
Volume Shadow Copy Service error: A critical component required by the Volume
Shadow Copy service is not registered.
:
The error returned from CoCreateInstance on class with CLSID
{9e8bcbdb-ff46-48eb-8f09-23b00344a6ac} and Name HWPRV is [0x80040154].
------------------------------------------------------------
```

  - Solution: Reinstall RM Shadow Copy Provider in the following procedure:
    1. Set MSDTC and COMSysApp to either automatic start or manual start using the Computer Management. Confirm the services in Services for RM Shadow Copy Provider Installation, on page 5-2.
    2. Uninstall and then reinstall RM Shadow Copy Provider.

Error messages in the Event Log

Table 5-7 shows RM Shadow Copy Provider error messages that identify a failure to the Event log.

Table 5-7: RM Shadow Copy Provider Error Messages

Message ID	Error Message	Condition	Recommended Action
EV_ERPERM	Permission denied with the VSS hardware provider.	RM Shadow Copy Provider is activated except for the Local System account.	Confirm the start up account of RM Shadow Copy Provider.
EV_ENOMEM	The memory become insufficient.	Couldn't retain the memory for executing a RM Shadow Copy Provider.	Increase the capacity of virtual memory of the whole system, or terminate unnecessary programs or daemon processes running simultaneously.
EV_INVSTP	Invalid pair status.	The pair status of a target volume isn't appropriate.	Confirm volume status with the pairdisplay command.
EV_ATTHOR	Can't attach to a HORCM daemon.	The HORCM daemon is not working.	Confirm if the HORCM daemon is working.
EV_CMDIOE	Control command I/O error.	Control command I/O error, or rejected.	Remove a cause of an error after confirming with system error code.
EV_CMDERR	VSS has caught an error of RAID Manager command.	RAID Manager command returns an error.	Remove a cause of an error after confirming with system error code of CCI.
EV_EGETEV	An error occurred in GetEnvironmentVariable ().	The system environment variable could not be got on GetEnvironmentVariable () system call.	Confirm if the system environment variable is defined. Remove a cause of an error after confirming with system error code.
EV_ENOSUP	No supported device.	The specified device is a command device or unsupported disk.	Confirm if a target disk is the supported disk.
EV_ENOINQ	No such inquiry.	An error occurred in the inquiry to the specified device.	Remove a cause of an error after confirming it with system error code. Confirm the connection with the device.
EV_ENOOBJ	Not found object.	The SnapshotSetID which provider specified is invalid.	Remove a cause of an error after confirming with event log if an error about Shadow Copy Service is written in it.
EV_ENOSER	No such serial number.	A serial number could not be acquired from the specified device information.	Remove a cause of an error after confirming it with event log if an error about Shadow Copy Service is written in it.
EV_ENRMCN	A RAID Manager command binary file is not found	An operation misses, and so on removed the file of CCI command.	Install CCI again.

Table 5-7: RM Shadow Copy Provider Error Messages (Continued)

Message ID	Error Message	Condition	Recommended Action
EV_ENRMPH	RAID Managerwas not found in the "\HORCM\ETC" directory in C-Z drives.	An operation misses, and so on removes the directory "HORCM\ETC".	Install CCI again.
EV_ESETEV	The system environment variable could not be set.	The system environment variable could not be set on SetEnvironmentVariable( ) system call.	Remove a cause of an error after confirming it with event log if system is unstable with event log.
EV_EXCEPT	An exception occurred.	An Exception occurred during a process of RM Shadow Copy Provider.	Remove a cause of an error after confirming it with event log if system is unstable with event log.
EV_INVARG	Invalid argument.	The argument, which a coordinator specified, is invalid.	Remove a cause of an error after confirming it with event log if an error about Shadow Copy Service is written in it.
EV_INVSEQ	Invalid sequence.	The order specified from a coordinator is invalid.	Remove a cause of an error after confirming it with event log if an error about Shadow Copy Service is written in it.
EV_EOPDEV	Cannot open a device.	Opening the specified device special file failed.	Remove a cause of an error after confirming it with system error code.
EV_INCMUN	Inconsistent MUN in a SnapShot Set.	The Mun of a volume within a Snapshot Set isn't identical to the others in the Snapshot Set.	Confirm the Mun in Snapshot Set using the pairdisplay command.

6

Consistency groups, CCI groups

Multiple pairs are managed as a group. A configuration file of CCI defines a group as a set of pairs. AMS array also manages and operates a set of pairs as a consistency group. The differences between two types of groups are explained by using Figure 6-1.

A group described in a configuration file (a group in short) can have one or more pairs. A group specified by -g option of CCI commands indicates a group defined in a configuration file. By using a group, an operation to multiple pairs is done at a time.

A CTG is a group managed by AMS array and a CTG can have one or more pairs. If data consistency across multiple pairs is required, such pairs must be operated as a consistency group by AMS array.

Two or more groups cannot belong to one CTG. A pair that belongs to one CTG cannot belong to another CTG.

CTG number cannot be specified in CCI commands except for `paircreate` command. Only a group can be specified in the CCI commands. Operations like `pairsplit` require operating pairs in a CTG at a time so CCI and AMS array interpret an operation request for a group as a request for a CTG to which the specified group belongs.

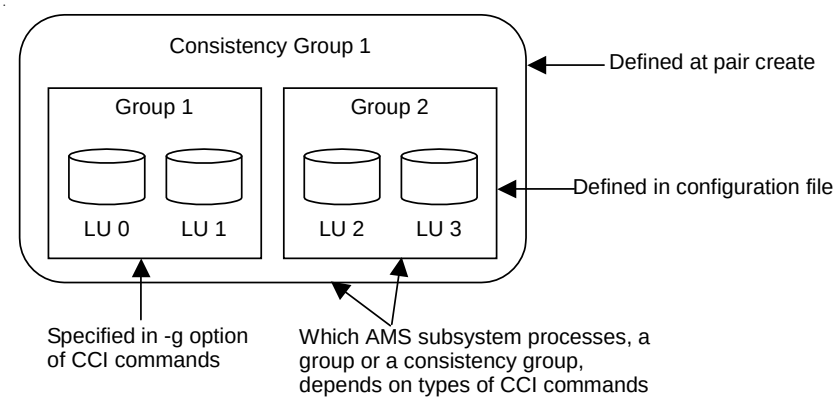


Figure 6-1: Groups and Consistency Groups

Figure 6-1 shows which AMS array processes, a group or a consistency group, when -g option is specified in each major CCI command.

For example, a `pairdisplay` command displays pair statuses of a specified group. In a case of Figure 6-1, specifying the group 1 in a `pairdisplay` command shows only information about the group 1.

On the other hand, a `pairsplit` command splits all pairs in all groups belonging to a CTG to which a specified group belongs. In a case of Figure 6-1, specifying the group 1 in a `pairsplit` command splits not only the group 1 but also the group 2.

If multiple groups belong to a CTG, operating only the specific group within the CTG is impossible. In the Figure 6-1 example, splitting only the group 1 but keeping the group 2 be PAIR is impossible. When splitting the specific group, it is required to split all pairs in the group one by one.

Notes:

- Only one pair per a CTG is processed at a time.
- Splitting each pair does not guarantee data consistency across the split pairs.

Table 6-1: The CCI -g Option and Its Target

Command Name or Status	ShadowImage	Snapshot	TrueCopy	TCE
pairvolchk	Group	Group	Group	Group
paircurchk	-	-	Group	Group
pairdisplay	Group	Group	Group	Group
pairevtwait	Group	Group	Group	Group
pairsyncwait	-	-	-	CTG
paircreate	Group	Group	Group	Group
pairsplit	CTG	CTG	Group	CTG
pairresync	Group	Group	Group	CTG
horctakeover	-	-	Group	CTG
PSUE (Failure Occurred)	Pair	Pair	Pair	CTG
PFUS (Pool Empty)	-	CTL	-	CTG&CTL

Notes:

CTG: All pairs in a CTG

Group: All pairs in a group

Pair: Only the specified pair

CTL: All pairs using a pool owned by a failed controller

CTG&CTL: All pairs using a pool owned by a failed controller and all pairs belonging to CTGs to which the former pairs belong

Glossary

This glossary provides definitions for replication terms as well as terms related to the technology that supports CCI and AMS. Click the letter of the glossary section to display the related page.

A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z

A

array

A set of hard disks mounted in a single enclosure and grouped logically together to function as one contiguous storage space.

asynchronous

Asynchronous data communications operate between a computer and various devices. Data transfers occur intermittently rather than in a steady stream. Asynchronous replication does not depend on acknowledging the remote write, but it does write to a local log file. Synchronous replication depends on receiving an acknowledgement code (ACK) from the remote system and the remote system also keeps a log file.

B

background copy

A physical copy of all tracks from the source volume to the target volume.

bps

Bits per second. The standard measure of data transmission speeds.

C

cache

A temporary, high-speed storage mechanism. It is a reserved section of main memory or an independent high-speed storage device. Two types of caching are found in computers: memory caching and disk caching. Memory caches are built into the architecture of microprocessors and often computers have external cache memory. Disk caching works like memory caching; however, it uses slower, conventional main memory that on some devices is called a memory buffer.

capacity

The amount of information (usually expressed in megabytes) that can be stored on a disk drive. It is the measure of the potential contents of a device; the volume it can contain or hold. In communications, capacity refers to the maximum possible data transfer rate of a communications channel under ideal conditions.

CCI

See command control interface.

CLI

See command line interface.

cluster

A group of disk sectors. The operating system assigns a unique number to each cluster and then keeps track of files according to which clusters they use.

cluster capacity

The total amount of disk space in a cluster, excluding the space required for system overhead and the operating system. Cluster capacity is the amount of space available for all archive data, including original file data, metadata, and redundant data.

command control interface (CCI)

Hitachi's Command Control Interface software provides command line control of Hitachi array and software operations through the use of commands issued from a system host. Hitachi's CCI also provides a scripting function for defining multiple operations.

command devices

Dedicated logical volumes that are used only by management software such as CCI, to interface with the storage systems. Command devices are not used by ordinary applications. Command devices can be shared between several hosts.

command line interface (CLI)

A method of interacting with an operating system or software using a command line interpreter. With Hitachi's Storage Navigator Modular Command Line Interface, CLI is used to interact with and manage Hitachi storage and replication systems.

concurrency of S-VOL

Occurs when an S-VOL is synchronized by simultaneously updating an S-VOL with P-VOL data AND data cached in the primary host memory. Discrepancies in S-VOL data may occur if data is cached in the primary host memory between two write operations. This data, which is not available on the P-VOL, is not reflected on to the S-VOL. To ensure concurrency of the S-VOL, cached data is written onto the P-VOL before subsequent remote copy operations take place.

concurrent copy

A management solution that creates data dumps, or copies, while other applications are updating that data. This allows end-user processing to continue. Concurrent copy allows you to update the data in the files being copied, however, the copy or dump of the data it secures does not contain any of the intervening updates.

configuration definition file

The configuration definition file describes the system configuration for making CCI operational in a TrueCopy Extended Distance Software environment. The configuration definition file is a text file created and/or edited using any standard text editor, and can be defined from the PC where the CCI software is installed. The configuration definition file describes configuration of new TrueCopy Extended Distance pairs on the primary or remote storage system.

consistency group (CTG)

A group of two or more logical units in a file system or a logical volume. When a file system or a logical volume which stores application data, is configured from two or more logical units, these multiple logical units are managed as a consistency group (CTG) and treated as a single entity. A set of volume pairs can also be managed and operated as a consistency group.

consistency of S-VOL

A state in which a reliable copy of S-VOL data from a previous update cycle is available at all times on the remote storage system A consistent copy of S-VOL data is internally pre-determined during each update cycle and maintained in the remote data pool. When remote takeover operations are performed, this reliable copy is restored to the S-VOL, eliminating any data discrepancies. Data consistency at the remote site enables quicker restart of operations upon disaster recovery.

CRC

Cyclical Redundancy Checking. A scheme for checking the correctness of data that has been transmitted or stored and retrieved. A CRC consists of a fixed number of bits computed as a function of the data to be protected, and appended to the data. When the data is read or received, the function is recomputed, and the result is compared to that appended to the data.

CTG

See Consistency Group.

cycle time

A user specified time interval used to execute recurring data updates for remote copying. Cycle time updates are set for each storage system and are calculated based on the number of consistency groups CTG.

cycle update

Involves periodically transferring differential data updates from the P-VOL to the S-VOL. TrueCopy Extended Distance Software remote replication processes are implemented as recurring cycle update operations executed in specific time periods (cycles).

D

data pool

One or more disk volumes designated to temporarily store un-transferred differential data (in the local storage system or snapshots of backup data in the remote storage system). The saved snapshots are useful for accurate data restoration (of the P-VOL) and faster remote takeover processing (using the S-VOL).

data volume

A volume that stores database information. Other files, such as index files and data dictionaries, store administrative information (metadata).

differential data control

The process of continuously monitoring the differences between the data on two volumes and determining when to synchronize them.

differential data copy

The process of copying the updated data from the primary volume to the secondary volume. The data is updated from the differential data control status (the pair volume is under the suspended status) to the primary volume.

Differential Management Logical Unit (DMLU)

The volumes used to manage differential data in a storage system. In a TrueCopy Extended Distance system, there may be up to two DM logical units configured per storage system. For Copy-on-Write and ShadowImage, the DMLU is an exclusive volume used for storing data when the array system is powered down.

differential-data

The original data blocks replaced by writes to the primary volume. In Copy-on-Write, differential data is stored in the data pool to preserve the copy made of the P-VOL to the time of the snapshot.

disaster recovery

A set of procedures to recover critical application data and processing after a disaster or other failure. Disaster recovery processes include failover and failback procedures.

disk array

An enterprise storage system containing multiple disk drives. Also referred to as “disk array device” or “disk storage system.”

DMLU

See Differential Management-Logical Unit.

dual copy

The process of simultaneously updating a P-VOL and S-VOL while using a single write operation.

duplex

The transmission of data in either one or two directions. Duplex modes are full-duplex and half-duplex. Full-duplex is the simultaneous transmission of data in two direction. For example, a telephone is a full-duplex device, because both parties can talk at once. In contrast, a walkie-talkie is a half-duplex device because only one party can transmit at a time.

E

entire copy

Copies all data in the primary volume to the secondary volume to make sure that both volumes are identical.

extent

A contiguous area of storage in a computer file system that is reserved for writing or storing a file.

F

failover

The automatic substitution of a functionally equivalent system component for a failed one. The term failover is most often applied to intelligent controllers connected to the same storage devices and host computers. If one of the controllers fails, failover occurs, and the survivor takes over its I/O load.

fallback

Refers to the process of restarting business operations at a local site using the P-VOL. It takes place after the storage systems have been recovered.

Fault tolerance

A system with the ability to continue operating, possibly at a reduced level, rather than failing completely, when some part of the system fails.

FC

See fibre channel.

fibre channel

A gigabit-speed network technology primarily used for storage networking.

firmware

Software embedded into a storage device. It may also be referred to as Microcode.

full duplex

The concurrent transmission and the reception of data on a single link.

G

Gbps

Gigabit per second.

granularity of differential data

Refers to the size or amount of data transferred to the S-VOL during an update cycle. Since only the differential data in the P-VOL is transferred to the S-VOL, the size of data sent to S-VOL is often the same as that of data written to the P-VOL. The amount of differential data that can be managed per write command is limited by the difference between the number of incoming host write operations (inflow) and outgoing data transfers (outflow).

GUI

Graphical user interface.

I

I/O

Input/output.

initial copy

An initial copy operation involves copying all data in the primary volume to the secondary volume prior to any update processing. Initial copy is performed when a volume pair is created.

initiator ports

A port-type used for main control unit port of Fibre Remote Copy function.

IOPS

I/O per second.

iSCSI

Internet-Small Computer Systems Interface. A TCP/IP protocol for carrying SCSI commands over IP networks.

iSNS

Internet-Small Computer Systems Interface. A TCP/IP protocol for carrying SCSI commands over IP networks.

L

LAN

Local Area Network. A computer network that spans a relatively small area, such as a single building or group of buildings.

load

In UNIX computing, the system load is a measure of the amount of work that a computer system is doing.

logical

Describes a user's view of the way data or systems are organized. The opposite of logical is physical, which refers to the real organization of a system. A logical description of a file is that it is a quantity of data collected together in one place. The file appears this way to users. Physically, the elements of the file could live in segments across a disk.

logical unit

See logical unit number.

logical unit number (LUN)

An address for an individual disk drive, and by extension, the disk device itself. Used in the SCSI protocol as a way to differentiate individual disk drives within a common SCSI target device, like a disk array. LUNs are normally not entire disk drives but virtual partitions (or volumes) of a RAID set.

LU

Logical unit.

LUN

See logical unit number.

LUN Manager

This storage feature is operated through Storage Navigator Modular 2 software and manages access paths among host and logical units for each port in your array.

M

metadata

In sophisticated data systems, the metadata -- the contextual information surrounding the data -- will also be very sophisticated, capable of answering many questions that help understand the data.

microcode

The lowest-level instructions directly controlling a microprocessor. Microcode is generally hardwired and cannot be modified. It is also referred to as firmware embedded in a storage subsystem.

Microsoft Cluster Server

Microsoft Cluster Server is a clustering technology that supports clustering of two NT servers to provide a single fault-tolerant server.

mount

To mount a device or a system means to make a storage device available to a host or platform.

mount point

The location in your system where you mount your file systems or devices. For a volume that is attached to an empty folder on an NTFS file system volume, the empty folder is a mount point. In some systems a mount point is simply a directory.

P

pair

Refers to two logical volumes that are associated with each other for data management purposes (e.g., replication, migration). A pair is usually composed of a primary or source volume and a secondary or target volume as defined by the user.

pair splitting

The operation that splits a pair. When a pair is "Paired", all data written to the primary volume is also copied to the secondary volume. When the pair is "Split", the primary volume continues being updated, but data in the secondary volume remains as it was at the time of the split, until the pair is re-synchronized.

pair status

Internal status assigned to a volume pair before or after pair operations. Pair status transitions occur when pair operations are performed or as a result of failures. Pair statuses are used to monitor copy operations and detect system failures.

paired volume

Two volumes that are paired in a disk array.

parity

The technique of checking whether data has been lost or corrupted when it's transferred from one place to another, such as between storage units or between computers. It is an error detection scheme that uses an extra checking bit, called the parity bit, to allow the receiver to verify that the data is error free. Parity data in a RAID array is data stored on member disks that can be used for regenerating any user data that becomes inaccessible.

parity groups

RAID groups can contain single or multiple parity groups where the parity group acts as a partition of that container.

peer-to-peer remote copy (PPRC)

A hardware-based solution for mirroring logical volumes from a primary site (the application site) onto the volumes of a secondary site (the recovery site).

point-in-time logical copy

A logical copy or snapshot of a volume at a point in time. This enables a backup or mirroring application to run concurrently with the system.

pool volume

Used to store backup versions of files, archive copies of files, and files migrated from other storage.

primary or local site

The host computer where the primary volume of a remote copy pair (primary and secondary volume) resides. The term "primary site" is also used for host failover operations. In that case, the primary site is the host computer where the production applications are running, and the secondary site is where the backup applications run when the applications on the primary site fail, or where the primary site itself fails.

primary volume (P-VOL)

The storage volume in a volume pair. It is used as the source of a copy operation. In copy operations a copy source volume is called the P-VOL while the copy destination volume is called "S-VOL" (secondary volume).

P-VOL

See primary volume.

R

RAID

Redundant Array of Independent Disks. A disk array in which part of the physical storage capacity is used to store redundant information about user data stored on the remainder of the storage capacity. The redundant information enables regeneration of user data in the event that one of the array's member disks or the access path to it fails.

Recovery Point Objective (RPO)

After a recovery operation, the RPO is the maximum desired time period, prior to a disaster, in which changes to data may be lost. This measure determines up to what point in time data should be recovered. Data changes preceding the disaster are preserved by recovery.

Recovery Time Objective (RTO)

The maximum desired time period allowed to bring one or more applications, and associated data back to a correct operational state. It defines the time frame within which specific business operations or data must be restored to avoid any business disruption.

remote or target site

Maintains mirrored data from the primary site.

remote path

A route connecting identical ports on the local storage system and the remote storage system. Two remote paths must be set up for each storage system (one path for each of the two controllers built in the storage system).

remote volume stem

In TrueCopy operations, the remote volume (R-VOL) is a volume located in a different subsystem from the primary host subsystem.

resynchronization

Refers to the data copy operations performed between two volumes in a pair to bring the volumes back into synchronization. The volumes in a pair are synchronized when the data on the primary and secondary volumes is identical.

RPO

See Recovery Point Objective.

RTO

See Recovery Time Objective.

S

SAS

Serial Attached SCSI. An evolution of parallel SCSI into a point-to-point serial peripheral interface in which controllers are linked directly to disk drives. SAS delivers improved performance over traditional SCSI because SAS enables up to 128 devices of different sizes and types to be connected simultaneously.

SATA

Serial ATA is a computer bus technology primarily designed for the transfer of data to and from hard disks and optical drives. SATA is the evolution of the legacy Advanced Technology Attachment (ATA) interface from a parallel bus to serial connection architecture.

secondary volume (S VOL)

A replica of the primary volume (P-VOL) at the time of a backup and is kept on a standby storage system. Recurring differential data updates are performed to keep the data in the S-VOL consistent with data in the P-VOL.

SMPL

Simplex.

snapshot

A term used to denote a copy of the data and data-file organization on a node in a disk file system. A snapshot is a replica of the data as it existed at a particular point in time.

SNM2

See Storage Navigator Modular 2.

Storage Navigator Modular 2

A multi-featured scalable storage management application that is used to configure and manage the storage functions of Hitachi arrays. Also referred to as “Navigator 2”.

suspended status

Occurs when the update operation is suspended while maintaining the pair status. During suspended status, the differential data control for the updated data is performed in the primary volume.

S-VOL

See secondary volume.

S-VOL determination

Independent of update operations, S-VOL determination replicates the S-VOL on the remote storage system. This process occurs at the end of each update cycle and a pre-determined copy of S-VOL data, consistent with P-VOL data, is maintained on the remote site at all times.

T

target copy

A file, device, or any type of location to which data is moved or copied.

V

virtual volume (V-VOL)

In Copy-on-Write, a secondary volume in which a view of the primary volume (P-VOL) is maintained as it existed at the time of the last snapshot. The V-VOL contains no data but is composed of pointers to data in the P-VOL and the data pool. The V-VOL appears as a full volume copy to any secondary host.

volume

A disk array object that most closely resembles a physical disk from the operating environment's viewpoint. The basic unit of storage as seen from the host.

volume copy

Copies all data from the P-VOL to the S-VOL.

volume pair

Formed by pairing two logical data volumes. It typically consists of one primary volume (P-VOL) on the local storage system and one secondary volume (S-VOL) on the remote storage systems.

V-VOL

See virtual volume.

V-VOLTL

Virtual Volume Tape Library.

W

WMS

Workgroup Modular Storage.

write order guarantee

Ensures that data is updated in an S-VOL, in the same order that it is updated in the P-VOL, particularly when there are multiple write operations in one update cycle. This feature is critical to maintain data consistency in the remote S-VOL and is implemented by inserting sequence numbers in each update record. Update records are then sorted in the cache within the remote system, to assure write sequencing.

write workload

The amount of data written to a volume over a specified period of time.

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Hitachi Data Systems

Corporate Headquarters
750 Central Expressway
Santa Clara, California 95050-2627
U.S.A.
Phone: 1 408 970 1000
www.hds.com
info@hds.com

Asia Pacific and Americas
750 Central Expressway
Santa Clara, California 95050-2627
U.S.A.
Phone: 1 408 970 1000
info@hds.com

Europe Headquarters
Sefton Park
Stoke Poges
Buckinghamshire SL2 4HD
United Kingdom
Phone: + 44 (0)1753 618000
info.eu@hds.com

Hitachi Data Systems

MK-97DF8123-08